Reference Manual

Catalog of Programs for IBM Data Processing Systems

KWIC Index

April 1962 No. 1

IBM

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CONTENTS

INTRODUCTION

This catalog has been published as a service to computer users. It contains a keyword-in-context index and the abstracts of the computer programs which may be ordered from the IBM Program Information Department, formerly known as IBM Library Services.

This department distributes four types of programs. The "A" section of the catalog contains Type I and II programs which are written, tested, published and maintained by IBM. The "B" section consists of Type III and IV programs. In the case of the Type III and IV programs, the Program Information Department acts only as a publishing and distributing agency. Checking and testing of these programs is done by the contributors, and questions concerning them should be directed to the author.

How to Order Programs

"A" Section
From local IBM branch office
"B" Section
Order programs directly from:
Program Information Department
IBM Corporation
~~2 William Street~~ 112 East Post Road 3/18/62
White Plains, New York - USA

World Trade Users order programs from the WTC Program Library in their Area if this Library services their computer. Otherwise programs may be ordered from the United States Program Information Department.

IBM World Trade Program Libraries:

Area	Librarian	Computers				
Europe	Central European Program Library 162 Rue de Charenton Paris 12, France		1401	1410		
	H. C. Koehler IBM Deutschland Postfach 66 Sindelfingen/Wuertt, Germany	650			1620	
	A. H. Lugtenburg IBM Deutschland Postfach 66 Sindelfingen/Wuertt, Germany					7070
Canada	K. C. Avann IBM Company, Limited 844 Don Mills Road Don Mills, Ontario, Canada	650	1401	1410	1620	7070

South America and Central America	A. Mogollon IBM de Venezuela, S.A. Edificio International Avenida Urdaneta Apartado 388 Caracas, Venezuela	650	1401		1620	
North Pacific	M. Hamaguchi IBM Japan, Ltd. 2 Niban-cho Chiyoda-ku Tokyo, Japan	650	1401	1410	1620	7070
Asia Pacific	P.A. Gygax IBM Australia Pty., Limited Box 3318 Sydney, Australia	650	1401		1620	

(All orders should include the IBM system and reference numbers shown on the abstract.)

The catalog contains three main parts:

Keyword-in-context (KWIC) Index for locating program abstracts
Program abstracts, Section "A" (by system type)
Program abstracts, Section "B" (by system type)

Keyword Index

The keyword-in-context index lists available programs arranged alphabetically by the keywords in the program titles. There are as many entries for each program as there are keywords in its title. Nonsignificant words such as "a," "the," "and," "for," "at," etc. (see complete list below) are not treated as keywords.

To prepare this KWIC index, each title was shifted to the right, one keyword at a time. After this was done, the multiple entries for each title were sorted in alphabetic order by keyword and listed on the IBM 1403 Printer to produce the master copy.

The first three entries for the program are shown below:

```
   #CARD SYSTEMS ERROR DETECTION AIDS                      A 1401--AT-017
IDS                          #CARD SYSTEMS ERROR DETECTION A A 1401--AT-017
          #CARD SYSTEMS ERROR DETECTION AIDS               A 1401--AT-017
```

Notice that the keyword for each entry is located near the center of the column and that some or all of the title may precede or follow — that is, wrap around — the keyword. The pound sign (#) indicates the first word in each title. Each line is concluded with a reference code which relates the entry to the corresponding program abstract in the abstract section of the catalog.

Using the KWIC Index

To locate a program, begin by thinking of the significant words describing the desired program. Then look in the index for the keyword entry. The reference code adjacent to the title will then direct you to the corresponding program abstract. The reference code is set up as follows:

Section	System Type	Reference Number
X	XXXX	XXXXXXXXX
A or B	The number of the IBM system for which the program is written	The IBM library code for filing and ordering a program.

To locate the required abstract, first turn to the "A" or "B" section. Then find the corresponding system type, then the reference number. The reference numbers are in numerical sequence within system. The "A" or "B" designation and the machine type are printed on the top right-hand corner of the page to facilitate finding the abstract. The abstracts describe the programs in enough detail to help you determine whether they meet your requirements.

Words Prevented from Indexing

These words will never appear as keywords

A
ADD
ADDS
AN
AND
ANY
AS
AT
ARITH.
BY
DECK
FOR
FROM
GENERAL
GENERATOR
IBM
IF
IN
INTO
KIND
MODIFIED
NO
NO.
NUMBER
OF
ON
ONLY
OR
OUT
PACKAGE
POINT
PROBLEM
PROG
PROGRAM
PROGRAMS
PT
PT.
ROUTINE
ROUTINES
SOLUTION
SUBPROGRAM
SUBR
SUBROU
SUBROUT
SYS
THE
TO
USING
WITH
I
II
III
V
VI

Keyword-in-Context (KWIC) Index

```
                        #704 ARCTAN A/B                                     B 0704-0598WH005
DED.                         #ARCTAN A/B, FORTRAN II VERSION,SAP CO B 0704-0603WH005
           #MATRIX TRANSLATION A/O TRANSPOSITION                            B 0650-01.6.031
                             #AD AND LOD                                    B 0650-01.2.008
NG POINT HARDWARE SIMULATOR.    #AB FLOAT SIM-ABREVIATED FLOATI B 7070-05.2.001
UTINE                        #ABBREVIATED PRINT 1 TRACING RO B 0705-A0-002-0
NAL PROGRAM NUCLEAR-CODE   # LIL ABNER A FEW-GROUP ONE DIMENSIO B 0650-08.2.007
ING                          #ABRAC-01 NUCLEAR-CODE ENGINEER B 0704-NUCLEAR
   #ON-LINE LOADER FOR COL. BIN. ABS. AND TSF. CARDS                B 0704-1012ORCBL
OADER                        #ABSOLUTE AND CORRECTION CARD L B 0704-0572PFCCB
ER CARD LOADER.              #ABSOLUTE AND CORRECTION TRANSF B 0704-0673WH005
 LOADER.                     #ABSOLUTE AND RELOCATABLE OCTAL B 0704-0623ELROL
ATE A FORTRAN II PROGRAM TAPE OR ABSOLUTE BINARY          #GENER B 0704-0754CEF2L
CTION CARD LOADER            #ABSOLUTE BINARY CARD AND CORRE B 0704-0525PKCSB
CTION CARD LOADER.           #ABSOLUTE BINARY CARD AND CORRE B 0704-0525PKCSB
                             #ABSOLUTE BINARY LOADER              B 0704-0405PFCCB
                    #  ONE CARD ABSOLUTE BINARY UPPER LOADER.  B 0704-0473CSBUL
NE CARD                      #ABSOLUTE BINARY UPPER LOADER O B 0709-1102SE9DU
                       #PUNCH ABSOLUTE COLUMN BINARY.            B 0704-1004GNPAC
              #LEAST MAXIMAL ABSOLUTE ERROR POLYNOMIAL FIT  B 0704-0500BSBFP
CARD PUNCH                   #ABSOLUTE ROW OR COLUMN BINARY  B 0704-0455BESCB
FER                 #LOADS BINARY ABSOLUTE, CORRECTION AND TRANS B 0704-0449MIOSI
                             #ABSORBER CALCULATION                  B 0650-09.6.004
        #INTERPRETATION MATRIX ABSTRACTION                          B 0704-0085CLMTX
#FLOATING POINT DOUBLE PRECISION ABSTRACTION                        B 0704-0110GLDPA
LOATING POINT COMPLEX ARITHMETIC ABSTRACTION                     #F B 0704-0715RWCA2
         #GENERAL MATRIX ABSTRACTION FROM TAPES                     B 0704-0367MBMTX
AM TO MAINTAIN THE SHARE LIBRARY ABSTRACTS         #A 1401 PROGR B 0704-1165PNSLI
RP SYS 650 MAG DRUM CALC W/IMMED ACCESS BELL 111   #FL DEC INTE B 0650-02.0.021
                     #DYNAMIC ACCESS TO MEMORY PROGRAM               B 0704-0395LL002
   #  CONVERTS BCD TAPE RECORDS ACCORDING TO A FORTRAN               B 0704-0495CVI02
ON WITH ITERATIVE IMPROVEMENT OF ACCURACY          #MATRIX INVERSI B 0650-05.2.022
                         #A MORE ACCURATE RUNGE-KUTTA                B 0704-0414GLMAR
UE                           #ACT-AUTOMATIC CHECKOUT TECHNIQ B 1401-13.1.004
IAL EQUATIONS               #ADMINT ADAMS INTEGRATION OF DIFFERENT B 7090-1131AS012
EGRATION         #FLOATING POINT ADAMS-MOULTON, RUNGE-KUTTA INT B 0704-0450RWDE2
AT I • COMPLETE ASSEMBLY ROUTINE ADAPTED TO TAPE •           #CAR B 1401-01.1.003
T II • COMPLETE ASSEMBLY ROUTINE ADAPTED TO TAPE •          #CARA B 1401-01.1.004
                         #BCD ADD-SUBTRACT                           B 0704-0359ELSMO
                      #MATRIX ADDITION                               B 0704-0085CLMAD
 FLOATING POINT DOUBLE PRECISION ADDITION                     #MURA B 0704-0280MUDPA
 DOUBLE PRECISION FLOATING POINT ADDITION                  #PARTIAL B 0704-0650RWADD
#DOUBLE PRECISION FLOATING POINT ADDITION                            B 0704-0650RWDPF
         #MURA DOUBLE PRECISION ADDITION /FIXED POINT/               B 0704-0256MUDPA
     #DOUBLE PRECISION MATRIX ADDITION AND SUBTRACTION.              B 0704-0744AMDPA
                             #ADDITION TO BASIC FORTRAN              B 7070-01.2.001
        #7072 UTILITIES FOR ADDITIONAL STORAGE                       A 7072--UT-085
               #CHAIN LOADING ADDITIONS & DELETIONS                  A 0650--UT-104
          #OPEN SUBROUTINE ADDITIONS TO FORTRAN EDIT DECK            B 0704-1081LROSR
                        #705 ADDRESS LISTING                         B 0705-A0-005-0
                        #705 ADDRESS LISTING                         B 0705-NW-001-0
                             #ADDRESS LOCATION SUBROUTINE.           B 0709-1120ATLOC
                             #ADDRESS MODIFICATION                   B 0705-BW-001-1
             #MURA EFFECTIVE ADDRESS SEARCH ROUTINE                  B 0704-0253MUEAS
#TRANSPORTATION PROBLEM-INDIRECT ADDRESSING                          A 1620--LM-017
IS OF VARIANCE OR COVARIANCE AND ADJUST MEANS PROGRAM    #ANALYS B 0650-06.0.034
#PROGRAM TO CALCULATE SEASONALLY ADJUSTED INDICES                    B 0650-06.0.042
                       #TRAVERSE ADJUSTMENT                          B 0650-09.2.083
 #TIME SERIES DECOMPOSITION AND ADJUSTMENT                           B 0704-0861ERTSD
 #TIME SERIES DECOMPOSITION AND ADJUSTMENT                           B 0704-0526TVTSD
 #TIME SERIES DECOMPOSITION AND ADJUSTMENT                           B 7090-1145ERTSD
 #REVISED TRAVERSE AND TRAVERSE ADJUSTMENT COMPUTATION               B 0650-09.2.015
RIES                        #SEASONAL ADJUSTMENT OF ECONOMIC TIME SE B 0650-06.0.041
       #CALCULATION OF SEASONAL ADJUSTMENTS                          B 0705-DP 0001
FFERENTIAL EQUATIONS         #ADMINT ADAMS INTEGRATION OF DI B 7090-1131AS012
 SYSTEM •              #ASC SYSTEM AERONUTRONIC SIMPLIFIED CODING B 1401-02.0.002
ONS                          #AETRA NUCLEAR-CODE CROSS-SECTI B 7090-NUCLEAR
                        #F/F AFP SUBROUTINE •CARD•                   A 1620--LM-022
                        #F/F AFP SUBROUTINE •TAPE•                   A 1620--LM-023
                        #IFS • AFTER SETTING • XX                    B 0705-PG-005-0
                             #AGAIN                                  B 0705-SR-004-0
   #CARD SYSTEMS ERROR DETECTION AIDS                                A 1401--AT-017
SION ONE-DIMENSIONAL         #AIM-6 NUCLEAR-CODE GROUP DIFFU B 7090-NUCLEAR
NG                           #AIMFIRE NUCLEAR-CODE ENGINEERI B 7090-NUCLEAR
                           • #AIREK-II NUCLEAR-CODE                  B 7090-NUCLEAR
UAL INTERVALS                #AITKENS INTERPOLATION FOR N EQ B 0704-0122PKANI
                    #BOOLEAN ALGEBRA MINIMIZER                       B 7090-1197LLBAM
          #GENERALIZED ALGEBRAIC TRANSLATOR • GAT •                  B 0650-02.1.007
 - 1 WCRD. OPEN.              #SORT, ALGEBRAIC. KEY AND ITEM LENGTH B 0704-0570ORSRT
 - 1 WORD. CLOSED.            #SORT, ALGEBRAIC. KEY AND ITEM LENGTH B 0704-0570ORSRT
OLE WORD KEYS ONLY/           #SORT, ALGEBRAIC. MULTIWORD KEYS. /WH B 0704-0570ORSRT
#REVISED TRAVERSE AND HORIZONTAL ALIGNMENT                           B 0650-09.2.084
PR REVISION OF OREGON HORIZONTAL ALIGNMENT PROGRAM           #B B 0650-09.2.053
 TERRAIN MODEL SYSTEM HORIZONTAL ALIGNMENT PROGRAMS      #DIGITAL B 0650-09.2.040
AL TERRAIN MODEL SYSTEM VERTICAL ALIGNMENT PROGRAMS       #DIGIT B 0650-09.2.041
J SUB K TIMES Z OR I         #ALL ORDERS OF BESSEL FUNCTION  B 0709-0984RWBF7
IONS Y SUB K TIMES Z         #ALL ORDERS OF THE BESSEL FUNCT B 0709-0985RWBF8
                     #UNLOAD ALL TAPES                               B 7090-1175WDSTO
ANGENT, FLOATING POINT--QUADRANT ALLOCATION                     #ARCT B 0704-0825JPATN
RCOSINE FLOATING POINT--QUADRANT ALLOCATION            #ARCSINE, A B 0704-0825JPASN
OUTINE IDENTIFICATION AND MEMORY ALLOCATION          # BINARY SUBR B 0704-0739ARPEK
AY                     # GENERAL ALPHANUMERIC CATHODE RAY DISPL B 0704-0314MUSCP
 CONVERSION.                 #ALPHANUMERICAL READING AND BCD B 0704-0405PFDCB
 CONVERSION                  #ALPHANUMERICAL READING AND BCD B 0704-0417PFDCB
           #TRACE INSTRUCTION ALTERATION                             B 0704-1079NOTIA
           #TRACE INSTRUCTION ALTERATION FOR 709                     B 0709-1090NOTIA
             #TRACE AND RECORD ALTERATIONS IN MEMORY PROGRAM         B 0704-0395LL003
                             #ALTERED MEMORY PRINT                   B 0705-EQ-005-0
                    #GENERAL AMORTIZATION SCHEDULE PROGRAM           B 0709-0955VGGAS
Y PROGS FOR INDERTERMINATE TRUSS ANAL   #CONNECTOR AND REDUNDANC B 0650-09.2.007
E FOR NON-ORTH/D & STAT. DESIGN #ANALY OF VARIANCE OR COVARIANC B 0650-06.0.059
                             #ANALYSER                               B 0705-SB-002-0
                   #MEM PRINT ANALYSER                               B 0705-SB-006-0
                      #TRUSS ANALYSIS                                B 0650-09.2.006
         #MULTIPLE REGRESSION ANALYSIS                               B 0650-06.0.046
         #MULTIPLE REGRESSION ANALYSIS                               B 0650-06.0.001
                     #FACTOR ANALYSIS                                B 0650-06.0.020
        #GENERAL LEAST SQUARES ANALYSIS                              B 0650-06.0.027
HE WHERRY-WINER METHOD OF FACTOR ANALYSIS                         #T B 0650-06.0.028
         #MULTIPLE REGRESSION ANALYSIS                               B 0650-06.0.031
           #CONTINUOUS BRIDGE ANALYSIS                               B 0650-09.2.066
                #SPEED CHECK ANALYSIS                                B 0650-09.2.023
 ELECTRICAL DISTRIBUTION SYSTEMS ANALYSIS                    #OVERHEAD B 0650-09.4.008
              #SLOPE STABILITY ANALYSIS                              B 0650-09.2.026
                 #PIPE STREES ANALYSIS                               B 0650-09.5.002
          #SUSPENSION BRIDGE ANALYSIS                                B 0650-09.2.034
           #CIRCULAR CULVERT ANALYSIS                                B 0650-09.2.059
          #HYDRAULIC NETWORK ANALYSIS                                B 0650-09.7.002
            #BACKWATER CURVE ANALYSIS                                B 0650-09.7.004
                    #GAS FLOW ANALYSIS                               B 0650-09.7.006

                    #RENT OR BUY ANALYSIS                            B 0650-10.1.007
O-CORRELATION AND POWER SPECTRUM ANALYSIS                       #AUT B 0704-0296NYCP2
PLE CORRELATIONS AND REGRESSIONS ANALYSIS                     #MULTI B 0704-0417PFCR1
             #AUTOREGRESSION ANALYSIS                                B 0704-0363NYAR1
             #AUTOREGRESSION ANALYSIS                                B 0704-0363NYAR2
LTIPLE REGRESSION, COMPREHENSIVE ANALYSIS                        #MU B 0704-0915TVMRC
                     #FACTOR ANALYSIS                                B 0704-0521PFAF1
              #CRITICAL PATH ANALYSIS                                B 1620-10.3.005
   #7070 - PRINCIPAL AXIS FACTOR ANALYSIS                            B 7070-11.3.005
DINARY DIFFERENTIAL W/AUTO ERROR ANALYSIS          #NUM SOLU OF OR B 0650-04.0.012
TEM              #• ZEUS PROGRAM ANALYSIS • •ZPA • COMPUTER SYS B 7070-01.9.004
             #SHORT CIRCUIT ANALYSIS • CARD •                        B 1620-09.4.006
               #GAS NETWORK ANALYSIS • CARD •                        B 1620-09.3.003
               #GAS NETWORK ANALYSIS • TAPE •                        B 1620-09.3.001
                     #TREND ANALYSIS AND PREDICTION                  B 0650-09.2.050
IPULATION              #FLOW CHART ANALYSIS BY BOOLEAN MATRIX MAN B 0709-0824LLFLC
#MULTIPLE CORRELATION&REGRESSION ANALYSIS BY STEPWISE METHOD         B 7070-11.3.007
D                          #FACTOR ANALYSIS BY THE CENTROID METHO B 0650-05.1.008
                 #REGRESSION ANALYSIS DATA PREPARATION               B 1620-01.6.001
HUB • CARD •          #S-109 STRESS ANALYSIS OF A FLANGED TAPERED B 1620-09.7.005
ND FRAMES              #COMPUTER ANALYSIS OF CONTINUOUS BEAMS A B 0650-09.2.067
. SUBCLASS NUMBERS            #ANALYSIS OF COVARIANCE DISPROP B 0650-06.0.057
RED HUB • CARD •      #S-100 STRESS ANALYSIS OF FLANGE WITH A TAPE B 1620-09.7.004
ILES                          #ANALYSIS OF LATERALLY LOADED P B 0650-09.2.013
S                             #STRESS ANALYSIS OF OPEN-WEB STRUCTURE B 0650-09.2.038
ECORDS                  #WAVE RECORD ANALYSIS OF TWO SIMULTANEOUS R B 0704-0574CSTUK
L DESIGNS   #IBM 650 PROGRAM FOR ANALYSIS OF TWO-LEVEL FACTORIA B 0650-07.0.019
OR THE IBM 650                #AN ANALYSIS OF VARIANCE PROGRAM F B 0650-06.0.044
                       #FOUR WAY ANALYSIS OF VARIANCE                B 0650-06.0.053
SUBCLASS NUMBERS              #ANALYSIS OF VARIANCE,DISPROP.  B 0650-06.0.058
 OR SING. REPLICATED KBY      #ANALYSIS OF VARIANCE FOR PART. B 0650-06.0.063
                              #ANALYSIS OF VARIANCE PROGRAM   B 0650-06.0.004
ANCE AND ADJUST MEANS PROGRAM #ANALYSIS OF VARIANCE OR COVARI B 0650-06.0.034
                        #GENERAL ANALYSIS OF VARIANCE                B 0650-06.0.036
                              #ANALYSIS OF VARIANCE                  B 0704-0421AAANV
                        #GENERAL ANALYSIS OF VARIANCE                B 0704-0776RWAV4
                  #LATIN SQUARES ANALYSIS OF VARIANCE                B 0704-0776RWAV5
                        #GENERAL ANALYSIS OF VARIANCE                B 0704-0491RWAV2
                  #LATIN SQUARES ANALYSIS OF VARIANCE                B 0704-0491RWAV3
                #GENERAL PURPOSE ANALYSIS OF VARIANCE PROGRAM        B 0709-0933NOANA
                              #ANALYSIS OF VARIANCE                  B 1620-06.0.010
ANCE                          #ANALYSIS OF VARIANCE OR COVARI B 7090-1212MFAOV
PWISE MULTIPLE LINEAR REGRESSION ANALYSIS ON THE IBM 7070  #STE B 7070-11.3.006
ING • IBM 650 •    #A GAS NETWORK ANALYSIS PROG WITH AUTO RECYCL B 0650-09.7.008
                   #GAS NETWORK ANALYSIS PROGRAM                     B 0650-09.7.001
            #RAP-A REGRESSION ANALYSIS PROGRAM                       B 0650-06.0.018
     #FORTRAN MULTIPLE CORRELATION ANALYSIS PROGRAM                  B 0709-1121NRNRM
• SIXTEEN-TWENTY CARD REGRESSION ANALYSIS PROGRAM •         #SCRAP B 1620-06.0.003
   #STRAP • STEPWISE REGRESSION ANALYSIS PROGRAM •                   B 1620-06.0.004
                     #REGRESSION ANALYSIS PROGRAM • CARD •           B 1620-06.0.002
                       #TRAVERSE ANALYSIS PROGRAM • CARD •           B 1620-09.2.006
                     #REGRESSION ANALYSIS PROGRAM • TAPE •           B 1620-06.0.001
                       #TRAVERSE ANALYSIS PROGRAM • TAPE •           B 1620-09.2.007
FILE COMPARISION AND STATISTICAL ANALYSIS PROGRAM DA-1       #PRO B 0650-09.2.074
ULTIPLE REGRESSION & CORRELATION ANALYSIS PROGRAM.              #M B 0704-0749SCRAP
P              #MULTIPLE REGRESSION ANALYSIS PROGRAMS RAP RAPA TRA B 0650-06.0.030
                       #HARMONIC ANALYSIS SUBROUTINE                 B 0704-0121GMHAS
                    #CORRELATION ANALYSIS WITH ANNOTATED OUTPUT B 0650-06.0.014
-PART II            #CORRELATION ANALYSIS WITH ANNOTATED OUTPUT B 0650-06.0.032
-PART 3             #CORRELATION ANALYSIS WITH ANNOTATED OUTPUT B 0650-06.0.037
     #CORRELATION AND REGRESSION ANALYSIS,                           B 0704-0782PFCR3
070 STEPWISE MULTIPLE REGRESSION ANALYSIS, MR1                    #7 B 7070-11.3.001
                        #THERMAL ANALYZER                            B 0704-0248CLTHA
                        #THERMAL ANALYZER                            B 0704-0677NA031
           #TRAP • TAPE RECORD ANALYZER PRINT •                      B 1401-01.4.019
SIMULATES A DIGITAL DIFFERENTIAL ANALYZER TO SOLVE               # B 0704-0319GLDAS
           #GMR DYANA DYNAMICS ANALYZER-PROGRAMMER                   B 0704-0930GMDYA
                              #ANALYZING SYSTEM FAILURE DATA  B 0704-1059WLFAI
MPUTATION OF A MINIMUM TWO-LEVEL AND-OR SWITCHING              #CO B 0704-0787PKMIN
     #FORTRAN CARD OR TAPE /ROW AND/OR COLUMN BINARY/ LOADER.  B 0709-1163MWRCT
                #TAPE DUPLICATION AND/OR COMPARE.                    B 0709-0717NA098
       #LAGRANGIAN INTERPOLATION AND/OR DIFFERENTIATION              B 0704-0762RFE00
NG TAPE 1              #FORTRAN II AND/OR FORTRAN I TO SELF-LOADI B 0704-0769TVF2T
 IBM 1401        #CARD REPRODUCING AND/OR LISTING PROGRAM FOR THE B 1401-01.4.003
         #SIMULTANEOUS CARD TO TAPE AND/OR TAPE TO PRINTER           B 1401-13.1.010
DOM NUMBER GENERATOR,  AZIMUTHAL ANGLE. FIXED POINT.           #RAN B 0704-0743ORAZI
#RANDOM NUMBER GENERATOR,  POLAR ANGLE. FLOATING POINT.              B 0704-0743ORPOL
     #CORRELATION ANALYSIS WITH ANNOTATED OUTPUT.                    B 0650-06.0.014
     #CORRELATION ANALYSIS WITH ANNOTATED OUTPUT-PART II             B 0650-06.0.032
     #CORRELATION ANALYSIS WITH ANNOTATED OUTPUT-PART 3              B 0650-06.0.037
                         #APCOI NUCLEAR-CODE                         B 0704-NUCLEAR
                      #GAUSS APPROXIMANT GENERATOR                   B 0704-1048JPGIN
WEIGHTED LEAST SQUARE POLYNOMIAL APPROXIMATION                     # B 0650-06.0.009
RANSFERS                      #APPROXIMATION OF FUTURE TRIP T B 0650-09.2.035
T SET          #MINIMAX POLYNOMIAL APPROXIMATION ON A FINITE POIN B 0650-06.0.043
       #LEAST SQUARES POLYNOMIAL APPROXIMATION.                      B 0704-0617CA021
                         #APWRC-SYNFAR NUCLEAR-CODE                  B 0709-NUCLEAR
  #A PROGRAM FOR PARTITIONING OF ARBITRARILY SHAPED AREA             B 0650-09.6.013
TINE                          #ARBITRARY CURVE PLOTTER SUBROU B 0704-0284WHWH2
                      #ZEROS,ARBITRARY FUNCTION/ZARF/                B 0704-0565CA005
           #SCHEDULING WITH ARBITRARY PROFIT FUNCTIONS               B 0709-1086IBAPF
                 #ARC SINE AND ARC COSINE                            B 0704-0116CLASC
                 #ARC SINE - ARC COSINE SUBROUTINE                   B 0704-0246NA135
RFACES AND CURVES     #MINIMUM ARC LGTH. INTERPOLATION FOR SU B 0704-0483NA029
NE                            #ARC SINE - ARC COSINE SUBROUTI B 0704-0246NA135
                              #ARC SINE AND ARC COSINE               B 0704-0116CLASC
         #DOUBLE PRECISION ARC TANGENT INSTRUCTION                   B 0704-0423BSATN
                 #ARCSIN X, ARCCOS X, SQUARE ROOT X                  B 0650-03.1.028
          #FLOATING POINT ARCCOSINE SUBROUTINE                       B 0709-0507IBACS
          #FLOATING-POINT ARCFUNCTION SUBROUTINE                     B 0709-0893RWAF3
ANT ALLOCATION        #ARCSINE, ARCOSINE FLOATING POINT--QUADR B 0704-0825JPASN
                    #ARCSINE ARCOSINE SUBROUTINE                     B 7070-08.1.019
T X                           #ARCSIN X, ARCCOS X, SQUARE ROO B 0650-03.1.028
        #DOUBLE PRECISION ARCSIN/ARCCOS SUBROUTINE.                  B 0704-0538NOASD
                              #ARCSINE ARCOSINE SUBROUTINE           B 7070-08.1.019
                              #ARCSINE N                             B 7070-08.1.003
    #A 6 DIGIT FLOATING POINT ARCSINE SUBROUTINE                     B 0704-0649IBASN
BM 7070                       #ARCSINE X SUBROUTINE FOR THE I B 7070-08.1.006
NT--QUADRANT ALLOCATION       #ARCSINE, ARCOSINE FLOATING POI B 0704-0825JPASN
                         #704 ARCTAN A/B                             B 0704-0598WH005
,SAP CODED.                   #ARCTAN A/B, FORTRAN II VERSION B 0704-0603WH005
                              #ARCTAN X                              B 7070-08.1.001
 BINARY ARITH.        #NORMALIZED ARCTAN-EXTENDED RANGE FLOATING B 0704-0370RS013
            #FLOATING POINT ARCTANGENT                               A 0650--LM-005
              #SINGLE-VALUED ARCTANGENT ROUTINE                      B 0704-0355GMATN
              #MURA FIXED POINT ARCTANGENT ROUTINE                   B 0704-0263MUATN
      #FLOATING-POINT 7090 ARCTANGENT SUBROUTINE COMPUTES B 0709-1016RWAT3
#DOUBLE PRECISION FLOATING POINT ARCTANGENT SUBROUTINE               B 0709-1148NODPA
                              #ARCTANGENT SUBROUTINE                 B 7070-08.1.010
                              #ARCTANGENT SUBROUTINE                 B 7070-08.1.012
```

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ADRANT ALLOCATION              #ARCTANGENT, FLOATING POINT--QU B 0704-0825JPATN
                               #ARDC ATMOSPHERE OF 1959         B 0709-0923RWMA4
                               #ARDC ATMOSPHERE SUBROUTINE      B 0704-0881HKATM
                               #ARDC MODEL ATMOSPHERE OF 1959   B 0709-0924RWMA5
ORMAL PROBABILITY - ORDINATE AND AREA                        #N B 0709-1001NA860
RTITIONING OF ARBITRARILY SHAPED AREA        #A PROGRAM FOR PA B 0650-09.6.013
                         #LAND AREA - SURVEY TRAVERSE           B 0650-09.2.054
                    #FN II AREA SET GENERATOR SUBROUTINE.      B 0704-0848ARGEN
ADER                           #ARGONNE CARD TO BINARY TAPE LO B 0704-0503ANI11
POLYNOMIAL FIT                 #ARGONNE LEAST SQUARE LEGENDRE  B 0704-0424ANE20
ER                             #ARGONNE TAPE LOWER BINARY LOAD B 0704-0503ANI11
   #  BESSEL FUNCTIONS FOR REAL ARGUMENT AND ORDER              B 0704-0469NUBES
    #  BESSEL FUNCTION OF COMPLEX ARGUMENT AND ORDER.           B 0704-0979NUBES
 #     PSI FUNCTION FOR COMPLEX ARGUMENTS                       B 0704-0493LAS85
    #NEUMANN FUNCTIONS OF LARGE ARGUMENTS                       B 0704-0416CSNMB
F THE GAMMA FUNCTION FOR COMPLEX ARGUMENTS          #LOGARITHM O B 0704-0493LAS86
T-EXTENDED RANGE FLOATING BINARY ARITH      #NORMALIZED SQ.ROO B 0704-0370RS013
INTERPRETIVE SYSTEM    #COMPLEX ARITH OPERATIONS IN BELL LAB.  B 0650-02.0.012
T-EXTENDED RANGE FLOATING BINARY ARITH.           #DECIMAL PRIN B 0704-0370RS013
G-EXTENDED RANGE FLOATING BINARY ARITH.          #NORMALIZED LO B 0704-0370RS013
 EXTENDED RANGE FLOATING BINARY ARITH.          #NORMALIZED ADD B 0704-0370RS013
A REAL POLYNOMIAL USING INTERVAL ARITH.          #REAL ROOTS OF B 0704-0880IBRRP
A REAL POLYNOMIAL USING INTERVAL ARITH.          #REAL ROOTS OF B 0704-0880IBRRP
RIX EQUATION AX-B USING INTERVAL ARITH.         #SOLUTION OF MAT B 0704-0880IBSME
RIX EQUATION AX-B USING INTERVAL ARITH.         #SOLUTION OF MAT B 0704-0880IBSME
 EXTENDED RANGE FLOATING BINARY ARITH.          #NORMALIZED MULT. B 0704-0370RS013
E-EXTENDED RANGE FLOATING BINARY ARITH.         #NORMALIZED DIVID B 0704-0370RS013
N-EXTENDED RANGE FLOATING BINARY ARITH.         #NORMALIZED ARCTA B 0704-0370RS013
X-EXTENDED RANGE FLOATING BINARY ARITH.         #NORMALIZED E TO  B 0704-0370RS013
 * INTERPRETIVE PKGE FOR COMPLEX ARITHMETIC           #COMPLEX 1 B 0650-07.0.014
                 #RATIONAL NUMBER ARITHMETIC                    B 0704-0908NURAT
               #TRIPLE PRECISION ARITHMETIC                     B 0704-0481CA004
 * INTERPRETIVE PKGE FOR COMPLEX ARITHMETIC          #COMPLEX 11 B 0650-07.0.015
 DOUBLE-PRECISION FLOATING-POINT ARITHMETIC        #INTERPRETIVE B 0704-0525PKINT
FOR IBM 650-653 * REAL & COMPLEX ARITHMETIC * #SYMB INTERP SYS  B 0650-07.0.016
       #FLOATING POINT COMPLEX ARITHMETIC ABSTRACTION           B 0704-0715RWCA2
                          #BCD ARITHMETIC CORRECTION            B 0704-0359ELSMO
E                      #COMPLEX ARITHMETIC INTERPRETIVE ROUTIN B 0650-02.0.003
                       #COMPLEX ARITHMETIC MATRIX INVERSION    B 0650-05.1.003
*               #BANG 4 * BASIC ARITHMETIC NOTATION GENERATOR  B 1401-10.2.002
               #TRIPLE PRECISION ARITHMETIC PACKAGE            B 0704-0378CA001
       #EXTENDED RANGE COMPLEX ARITHMETIC PACKAGE              B 0704-0609CA034
#DOUBLE-PRECISION FLOATING-POINT ARITHMETIC PACKAGE            B 0704-0525PKDOU
       #TRIPLE PRECISION COMPLEX ARITHMETIC PACKAGE            B 0704-0546CA005
        #FORTRAN DOUBLE PRECISION ARITHMETIC PACKAGE           B 7090-1122NRNPR
 # UNNORMALIZED DOUBLE-PRECISION ARITHMETIC PACKAGE 1.         B 0704-0614NUUDP
 # UNNORMALIZED DOUBLE-PRECISION ARITHMETIC PACKAGE 2.         B 0704-0614NUUDP
       #DOUBLE PRECISION COMPLEX ARITHMETIC PACKAGE.           B 0704-0647NPDFC
                        #LAMP-LESS ARITHMETIC PROGRAM          B 1620-01.1.001
                         #INTERVAL ARITHMETIC SUBROUTINE       B 0704-0880IBINT
#FLOATING POINT DOUBLE PRECISION ARITHMETICS.                  B 0704-0417PFSDP
        #FLOATING POINT COMPLEX ARITHMETICS.                   B 0704-0417PFSAC
¤ CODE NUCLEAR-CODE        # ARMOUR REACTOR KINETICS %ARK-1 B 0650-08.2.019
     #TO WRITE 2 DIMENSIONAL ARRAY BINARY INFO ON TAPE         B 0704-0910NUWTB
                          #ART I NUCLEAR-CODE ENGINEERING B 0704-NUCLEAR
G                         #ART 04 NUCLEAR-CODE ENGINEERIN B 0704-NUCLEAR
                          # ART-1   NUCLEAR-CODE             B 0650-08.2.020
FIED CODING SYSTEM *         #ASC SYSTEM AERONUTRONIC SIMPLI B 1401-02.0.002
OAP CONVERSION UTILITY PROGRAM * ASCUP *          #AUTOMATIC S B 0650-01.6.045
                 #CALL * CARAT ASSEMBLED LOGICAL LOADER *      B 1401-01.4.002
                         #SHARE ASSEMBLER                      B 0704-0347UASAP
                 #MUSH DATA ASSEMBLER AND PRINT ROUTINES       B 0704-0523SCMAP
                          #704 ASSEMBLER OF 709 PROGRAMS       B 0704-0279PK9AP
             #704 MACRO-SAP ASSEMBLER.                         B 0704-0958MIMS
ODING SYS      #UNIV OF HOUSTON ASSEMBLR FOR PROC.ENG. INTER C B 0650-02.0.017
                      #705-1401 ASSEMBLY                       A 0705--CV-045
 PROGRAM GENERATOR AND AUTOCODER ASSEMBLY          #CARD REPORT B 1401-01.3.001
 PROGRAM GENERATOR AND AUTOCODER ASSEMBLY          #TAPE REPORT B 1401-01.3.002
                    #SOS IBM-32K ASSEMBLY AND COMPILER         A 0709--PR-063
                  #SOS SHARE-32K ASSEMBLY AND COMPILER         A 0709--PR-064
      #PROCESS CONTROL COMPUTER ASSEMBLY FOR IBM  704          B 0704-1184ININI
               #MAST *MINNEAPOLI ASSEMBLY OF SPS TWO *         B 1401-01.1.005
   #FULL MAST *FULL MINNEAPOLIS ASSEMBLY OF SPS TWO *          B 1401-01.1.006
                        #704 ASSEMBLY OF 1401 SPS PROGRAMS     B 1401-01.1.007
                        #704 ASSEMBLY OF 1401 SPS PROGRAMS     B 1401-13.2.001
                        #705 ASSEMBLY OF 704/709 PROGRAMS      B 0705-AL 0001
                        #650 ASSEMBLY OF 705 PROGRAMS          B 0705-SR 0001
     #SYMBOLIC PROGRAMMING AND ASSEMBLY ON THE IBM RAMAC 305   A 0305--SP-003
M                           #1401 ASSEMBLY ON THE 650 TAPE SYSTE B 0650-01.1.013
PE 40K  #FLOW CHART LISTING FROM ASSEMBLY PROG  PRINT RECORD TA B 0705-IB 0003
                         #FAP ASSEMBLY PROGRAM                 B 0709-0949WDFAP
                         #FAP ASSEMBLY PROGRAM                 B 0709-1033BEFAP
                       #IBSFAP ASSEMBLY PROGRAM                A 7090--SP-920
04                       #FAP ASSEMBLY PROGRAM FOR THE IBM 7 B 0704-1193AFFAP
09                         #ASSEMBLY PROGRAM FOR THE IBM 7 B 0709-0536SE09A
        #SOAP-TYPE OPTIMAL ASSEMBLY PROGRAM STRAP              B 0650-01.1.007
         #SOAP TYPE OPTIMAL ASSEMBLY PROGRAM STRAP 4000        B 0650-01.1.012
PE *        #CARAT I * COMPLETE ASSEMBLY ROUTINE ADAPTED TO TA B 1401-01.1.003
PE *       #CARAT II * COMPLETE ASSEMBLY ROUTINE ADAPTED TO TA B 1401-01.1.004
APE * MASCOT *           #MODIFIED ASSEMBLY SYSTEM CONVERTED TO T B 1401-01.1.001
HAN THAT WHICH IS              #TO ASSIGN TAPE UNIT USAGE OTHER T B 7090-1199PEIBL
                #GENERAL FREEWAY ASSIGNMENT                    B 0650-09.2.036
           #SAN DIEGO FREEWAY ASSIGNMENT                       B 0650-09.2.043
                     #FREEWAY ASSIGNMENT                       B 0650-09.2.081
                       #TAPE ASSIGNMENT AND CONTROL PROGRAM B 0709-0534CSENK
                     #FREEWAY ASSIGNMENT PROGRAM               B 0650-09.2.017
          #GENERAL FREEWAY ASSIGNMENT, STOCKTON REVISION       B 0650-09.2.079
                          # ASSOCIATED LEGENDRE FUNCTIONS      B 0704-1040JPASL
         #MAD TRANSLATOR AND ASSOCIATED SUBROUTINES            B 0704-1101UMMAD
                          #ATBAC NUCLEAR-CODE ENGINEERING B 0704-NUCLEAR
   #AUTO TEST GENERATOR * ATG *                                A 7070--AT-083
                         #ARDC ATMOSPHERE OF 1959              B 0709-0923RWMA4
                   #ARDC MODEL ATMOSPHERE OF 1959              B 0709-0924RWMA5
                         #ARDC ATMOSPHERE SUBROUTINE           B 0704-0881HKATM
                         #ATMOSPHERIC DATA SUBROUTINE          B 0704-0436AAATM
                         #ATMOSPHERIC DATA SUBROUTINE          B 0704-0341AAATM
/.                     #COMMENT ATTACHED PROGRAM. /709 PROGRAM B 0709-0519CSCAP
LEAR-CODE   # CALCULATE NEUTRON ATTENUATION-REACTOR SHIELD NUC B 0650-08.2.025
                        #LOAD DECK AUDITOR                     B 0650-01.2.010
ORRELATION ROUTINE * FOR BASIC & AUGM. 650          #SIMPLE C B 0650-06.0.062
INVERSION VECTOR PART. CODE FOR AUGMENT 650#LINEAR PRG. FORCED B 0650-10.1.010
#LINEAR PROGRAMMING CODE FOR THE AUGMENTED IBM 650             B 0650-10.1.006
AMMING FORCED INVERSION CODE FOR AUGMENTED 650    #LINEAR PROGR B 0650-10.1.009
                #READS THE SORTED AUTHOR CROSS INDEX TAPE      B 0704-1144NCO14
 *       #FACTOR * FOURTEEN O ONE AUTO CONT TEST OPTIMIZING ROUT B 1401-01.4.007
A GAS NETWORK ANALYSIS PROG WITH AUTO RECYCLING * IBM 650 *  # B 0650-09.7.008
                        #AUTO TEST GENERATOR * ATG *           A 7070--AT-083
NCTION GENERATOR,FLOATING      #AUTO- AND CROSS-CORRELATION FU B 0704-0577RWAC2
CTRUM ANALYSIS                 #AUTO-CORRELATION AND POWER SPE B 0704-0296NYCP2
ECTRAL DENSITY   #CALCULATION OF AUTO-CORRELATION FUNCTION & SP B 0650-06.0.049

                         #AUTO-CORRELATION PROGRAM             B 0650-06.0.005
C PERSONAL IDENTIFICATION CODE * AUTO-PIC *        #AUTOMATI B 0650-01.6.041
                         #BASIC AUTOCODER                      A 1410--AU-102
                         #AUTOCODER * SEE 1410-PR-108 *        A 1410--AU-906
ARD REPORT PROGRAM GENERATOR AND AUTOCODER ASSEMBLY          #C B 1401-01.3.001
APE REPORT PROGRAM GENERATOR AND AUTOCODER ASSEMBLY          #T B 1401-01.3.002
                  #SYMBOLIC TO AUTOCODER CONVERSION            B 0705-EQ-002-0
         #PRE-ASSEMBLY EDIT FOR AUTOCODER III                  B 0705-SR-003-0
                         #AUTOCODER PROGRAM                    A 1401--AU-037
     #NEW MACRO LOOK-UP FOR 705 AUTOCODER SYSTEM               B 0705-PG-012-0
                         #AUTOCODER 72                         A 7070--AU-072
                         #AUTOCODER 74                         A 7070--AU-074
                         #AUTOCODER 76*SEE 7070-PR-075*        A 7070--AU-900
TRUM                     #AUTOCORRELATION AND POWER SPEC B 0650-06.0.013
                         #AUTOFLIN                             B 0650-02.0.013
                #COMPUTER AUTOMATED MUSIC                      B 0650-11.0.007
      #FAST * FOURTEEN O ONE AUTOMATED SYSTEM OF TESTING *     B 1401-01.4.004
VERY                     #AUTOMATIC CHECK POINT AND RECO B 0704-0801NOGWC
TH SAP                   #AUTOMATIC CODER, COMPATIBLE WI B 0704-1220NSABC
L PROGRAM                #AUTOMATIC INFORMATION RETRIEVA B 0650-12.0.007
OGRAMMING             #AN AUTOMATIC METHOD OF OPTIMUM PR B 0650-01.1.003
N OF STEEL FRAMES        #AUTOMATIC MINIMUM WEIGHT DESIG B 0650-09.2.052
                # CORBIE, AUTOMATIC OPERATOR SYSTEM            B 0704-0372BSCRB
ION CODE * AUTO-PIC *    #AUTOMATIC PERSONAL IDENTIFICAT B 0650-01.6.041
ITY PROGRAM * ASCUP *    #AUTOMATIC SOAP CONVERSION UTIL B 0650-01.6.045
              #PROCEDURE FOR AUTOMATIC TEST*PAT*               A 7070--AT-082
AL IDENTIFICATION CODE *     #AUTOPIC 1401 *AUTOMATIC PERSON B 1401-01.4.014
                   #1620 AUTOPLOTTER * CARD *                  B 1620-01.6.004
                   #1620 AUTOPLOTTER * TAPE *                  B 1620-01.6.003
                         #AUTOPROMT                            B 0704-1143IB4PR
                         #AUTOREGRESSION ANALYSIS              B 0704-0363NYAR1
                         #AUTOREGRESSION ANALYSIS              B 0704-0363NYAR2
                         #AUTOSET                              B 0650-01.5.003
      #SIMULATED PLANT RECORD AUXILIARY.                       B 0704-0604TVSPR
                         #AVAILABILITY                         B 0650-01.3.009
                #MOVING AVERAGES OF TIME-SERIES DATA           B 0704-0335NYMA1
      # LOST A CROSS SECTION AVERAGING PROGRAM NUCLEAR-CODE B 0650-08.2.004
UTION OF GENERAL MATRIX EQUATION AX - B.                 #SOL B 0704-0141LAS88
    #SOLUTION OF MATRIX EQUATION AX-B USING INTERVAL ARITH.    B 0704-0880IBSME
   #SOLUTION OF MATRIX EQUATION AX-B USING INTERVAL ARITH.     B 0704-0880IBSME
            #7070 - PRINCIPAL AXIS FACTOR ANALYSIS             B 7070-11.3.005
      #RANDOM NUMBER GENERATOR,  AZIMUTHAL ANGLE. FIXED POINT. B 0704-0743ORAZI
 OF GENERAL MATRIX EQUATION AX - B.                 #SOLUTION B 0704-0141LAS88
          #MULTIPLE REGRESSION BACK SOLUTION PROGRAM.          B 0704-0749SCBOP
SCRIBES FLOW OF CONTROL        #BACK TRACE SUBROUTINE WHICH DE B 0704-0907NUBAC
DULING-SCHED. PHASE ONLY LESS F. BACKER #LEAST COST EST. & SCHE B 0650-10.3.005
ILE.                     #BACKSPACE FILE,FORWARD SPACE F B 0704-1003GNBSP
                         #BACKWATER CURVE ANALYSIS             B 0650-09.7.004
      #PAIRED COMPARISONS FROM BALANCED INCOMPLETE BLOCKS      B 0650-06.0.038
             #PRODUCTION LINE BALANCING                        B 0650-10.3.002
             #PRODUCTION LINE BALANCING                        A 1620--LM-018
CAL GEOMETRY NUCLEAR-CODE    # BALL A REACTOR CODE FOR SPHERI B 0650-08.2.016
      #LINEAR EQUATION SOLVER OF BAND MATRICES                 B 0709-0990RWLE4
     #SIMULATION OF ONE-ARMED BANDIT * CARD *                  B 1620-11.0.011
 #1620 SIMULATION OF A ONE-ARMED BANDIT * TAPE *               B 1620-11.0.002
TION GENERATOR *             #BANG 4 * BASIC ARITHMETIC NOTA B 1401-10.2.002
                  #CHINESE BAR AND RING PUZZLE * TAPE *        B 1620-11.0.003
              #THE CHINESE BARRING PUZZLE * CARD *             B 1620-11.0.001
         #MURA EXPONENTIAL, BASE E                             B 0704-0256MUEXP
   #MURA FIXED POINT LOGARITHM, BASE E                         B 0704-0283MULOG
                         #LOG BASE 10 OR BASEE                 B 7070-08.2.002
         #MURA EXPONENTIAL, BASE 2                             B 0704-0256MUEXP
   #MURA FIXED POINT LOGARITHM, BASE 2                         B 0704-0280MULOG
   #MURA FIXED POINT LOGARITHM, BASE 2.                        B 0704-0357MULOG
                  #BBC-VIK BASEBALL DEMONSTRATOR * CARD * B 1620-11.0.007
                  #BBC-VIK BASEBALL DEMONSTRATOR * TAPE * B 1620-11.0.008
             #LOG BASE 10 OR BASEE                             B 7070-08.2.002
SIMPLE CORRELATION ROUTINE * FOR BASIC & AUGM. 650           # B 0650-06.0.062
RATOR *             #BANG 4 * BASIC ARITHMETIC NOTATION GENE B 1401-10.2.002
                         #BASIC AUTOCODER                      A 1410--AU-102
               #ADDITION TO BASIC FORTRAN                      B 7070-01.2.001
                         #BASIC FORTRAN                        A 7070--FO-073
#RSTR * FUNCTION SUBROUTINE FOR BASIC FORTRAN *                B 7070-01.9.001
     #XRANF * SUBROUTINE FOR A BASIC FORTRAN * FUNCTION        B 7070-01.9.002
RIAGE CONTROL *              #BASIC FORTRAN * PUNCH WITH CAR B 7070-01.2.002
                         #BASIC SOAP 2A                        A 0650--SP-201
     #LQC SURFACE FITTING FOR BASIC 650                        B 0650-08.3.001
                #SIMULATE BASIC 650 COMPUTER WITH 704.         B 0704-0480CE650
             #SIMULATION OF BASIC 650 ON THE 7070              B 7070-05.1.002
   #SIMULATES INPUT PLUGBOARD OF BASIC 650.  READS BCD         B 0704-0480CE650
UTINES.                  #BASIC 709 I/O CONVERSION SUBRO B 0709-0388GS7IO
* CARD *                 #BBC-VIK BASEBALL DEMONSTRATOR B 1620-11.0.007
* TAPE *                 #BBC-VIK BASEBALL DEMONSTRATOR B 1620-11.0.008
T PLUGBOARD OF BASIC 650.  READS BCD         #SIMULATES INPU B 0704-0480CE650
            #KEYS SEARCH BCD  LISTING TAPE ROUTINE             B 0709-0921VGKEY
                         #BCD ADD-SUBTRACT                     B 0704-0359ELSMO
                         #BCD ARITHMETIC CORRECTION            B 0704-0359ELSMO
                  #ON-LINE BCD CARD READ ROUTINE               B 0709-0948MLRBC
    #ALPHANUMERICAL READING AND BCD CONVERSION                 B 0704-0417PFDCB
             #HOLLERITH TO BCD CONVERSION                      B 0704-0235NYDBD
 INTEGERS.          #BINARY TO BCD CONVERSION OF UNRESTRICTED B 0704-0423BSFRE
           #BCD TO MODIFIED BCD CONVERSION ROUTINE             B 0704-0512DMCVT
                #BINARY TO BCD CONVERSION SUBROUTINE           B 0704-0525PKBCD
    #ALPHANUMERICAL READING AND BCD CONVERSION.                B 0704-0405PFDCB
          #BINARY TO PACKED BCD CONVERTER                      C 0704-0359ELSMO
ONVERTS A FOURIER SERIES TERM TO BCD FORM.                  #C B 0704-0788IBCFT
      #TRANSLATE CARD IMAGE TO BCD IN COMMON.                  B 0709-0778AEIEC
             #HOLLERITH TO BCD INPUT FROM CARDS                B 0704-0387CEI41
          #DECIMAL, OCTAL, BCD LOADER                          B 0704-0073UADEC
          #DECIMAL, OCTAL, BCD LOADER                          B 0704-0756RWINP
          #DECIMAL, OCTAL, BCD LOADER                          B 0704-0756RWINP
          #DECIMAL, OCTAL, BCD LOADER                          B 7090-1138RWINP
                         #BCD OUTPUT PROGRAM                   B 0704-0528RSWOT
                         #BCD OUTPUT PROGRAM                   B 0704-0654AMWOT
                         #BCD OUTPUT SUBROUTINE                B 0704-0500BSEWO
R                   #READ BCD TAPE OR ON-LINE CARD READE B 0704-0073UACSH
6.0,4I2             #FN II BCD TAPE OUTPUT FOR FORMAT 12F B 0704-1057TVMFP
A FORTRAN        #  CONVERTS BCD TAPE RECORDS ACCORDING TO  B 0704-0495CVIO2
                    #COPY BCD TAPE ROUTINE                     B 0709-0889GDBCD
IPLE SCAN.               #BCD TAPE-CARD READING FOR MULT B 0704-0904SISCA
OUTPUT          #PRINTER PLOT BCD TEXT GENERATOR FOR FORTRAN B 0709-1118URPLO
RESTRICTED INTEGERS.         #BCD TO BINARY CONVERSION OF UN B 0704-0423BSDCH
                         #BCD TO BINARY FIELD CONVERSION B 0704-0387CEI32
ON                       #BCD TO BINARY INTEGER CONVERSI B 0704-1056TVME2
                         #BCD TO HOLLERITH                     B 0704-0235NYDHL
ROUTINE                  #BCD TO MODIFIED BCD CONVERSION B 0704-0512DMCVT
         #MANIPULATE BCD-CODED DATA, INCLUDING I/O             B 0704-0879MI4BC
                #BINARY TO BCS INTERGER CONVERSION             B 0709-0997MLCVR
     #GENERATE MATRICES TO BE SOLVED BY NU TPLI                B 0704-1110NUGEN
                #COMPOSITE BEAM                                B 0650-09.2.019
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#CONTINUOUS BEAM DESIGN PROGRAM B 0650-09.2.064
#COMPUTER ANALYSIS OF CONTINUOUS BEAMS AND FRAMES B 0650-09.2.067
SPHERICAL GEO NUCLEAR-CODE # BEEHIVE & HORNET REACTOR CODE B 0650-08.2.009
M#THERMODYNAMIC PROPS AND PHASE BEHAVIOR OF LIGHT HYDROCARBON B 0650-09.3.002
SED BELL LAB TAPE SYS #REVISED BELL LAB INTERPRETIVE SYS REVI B 0650-02.0.015
ELL LAB INTERPRETIVE SYS REVISED BELL LAB TAPE SYS #REVISED B B 0650-02.0.015
#COMPLEX ARITH OPERATIONS IN BELL LAB. INTERPRETIVE SYSTEM B 0650-02.0.012
YSTEM #704 COMPILER FOR BELL LABORATORY INTERPRETIVE S B 0704-0470ELBEL
OGRAM #BELL LABS PERMUTATION INDEX PR B 7090-1239BEPIP
G DRUM CONE STGE COMPU #MOD BELL TRANS PROG FOR 650-653 MA B 0650-02.1.011
650 MAG DRUM CALC W/IMMED ACCESS BELL 111 #FL DEC INTERP SYS B 0650-02.0.021
ETERMINATION OF COEFFICIENTS FOR BENEDICT EQUATION OF STATE #D B 0650-09.3.001
OF STATE. #BENEDICT-WEBB-RUBIN EQUATIONS B 0704-1187IBTEQ
Z OR I #ALL ORDERS OF BESSEL FUNCTION J SUB K TIMES B 0709-0984RWBF7
/ #BESSEL FUNCTION J1/X/ AND Y1/X B 0704-0833RWBJY
UMENT AND ORDER. # BESSEL FUNCTION OF COMPLEX ARG B 0704-0979NUBES
#BESSEL FUNCTION Y SUB N /X/. B 0704-0704RWBF4
AND HYPERBOLIC FUNCTIONS REGULAR BESSEL FUNCTIONS #CIRCULAR B 0650-03.2.001
#IRREGULAR BESSEL FUNCTIONS B 0650-03.2.002
OF INTERPRETIVE SUBROUTINES FOR BESSEL FUNCTIONS #A SET B 0650-03.2.007
#BESSEL FUNCTIONS B 0704-0415ATBES
MENT AND ORDER # BESSEL FUNCTIONS FOR REAL ARGU B 0704-0469NUBES
/ #BESSEL FUNCTIONS J0/X/AND Y0/X B 0704-0833RWBJY
KIND FOR NLLS. #BESSEL FUNCTIONS OF THE FIRST B 0704-0837ORBFN
. #BESSEL FUNCTIONS OF ORDER ZERO B 0704-0636RWBF2
#BESSEL FUNCTIONS OF ORDER ONE. B 0704-0636RWBF3
#BESSEL FUNCTIONS SUBROUTINE B 0650-03.2.005
Z #ALL ORDERS OF THE BESSEL FUNCTIONS Y SUB K TIMES B 0709-0985RWBF8
OD #POLYNOMIAL OF BEST FIT BY LEAST SQUARES METH B 0650-06.0.006
OF A #CALC. OF THE LEAST SQRS. BEST 1/2WAVE POTENT. AND SLOPE B 0650-09.3.003
D NETWORK #TRACING A MIN. PATH BET. ZONE CENTROIDS OVER A ROA B 0650-09.2.080
#DAYS BETWEEN DATES B 0650-01.6.021
#BIG FILE GENERATOR * BFG *@ B 7070-04.3.001
09/90 COMPATIBILITY #BI EDITOR FOR PROGRAMMED 704/7 B 0709-1031RL040
#READS THE FINAL SORTED BIBLIOGRAPHY TAPE B 0704-1144NC014
#SORTS THE BIBLIOGRAPHY TAPE FROM NC 138 B 0704-1144NC014
#READS THE SORTED BIBLIOGRAPHY TAPE FROM NC 142 B 0704-1144NC014
#CONTRACT BID COMPUTATIONS B 0650-09.2.047
#BID SUMMARIES B 0650-09.2.048
#BIG FILE GENERATOR * BFG *@ B 7070-04.3.001
#ON-LINE LOADER FOR COL. BIN. ABS. AND TSF. CARDS B 0704-1012ORCBL
#CARD TO TAPE, BINARY B 0704-0425WBCTB
#BINARY TO CHINESE BINARY B 0704-0395LL000
TRAN II PROGRAM TAPE OR ABSOLUTE BINARY #GENERATE A FOR B 0704-0754CEF2L
D TRANSFER #LOADS BINARY ABSOLUTE, CORRECTION AN B 0704-0449MI9SI
#TWO CARD BINARY AND OCTAL LOADER B 0704-0381ASAS5
#BINARY AND OCTAL LOADER B 0709-0951NA092
SQ.ROOT-EXTENDED RANGE FLOATING BINARY ARITH #NORMALIZED B 0704-0370RS013
ZED ADD EXTENDED RANGE FLOATING BINARY ARITH. #NORMALI B 0704-0370RS013
D MULT. EXTENDED RANGE FLOATING BINARY ARITH. #NORMALIZE B 0704-0370RS013
D DIVIDE-EXTENDED RANGE FLOATING BINARY ARITH. #NORMALIZE B 0704-0370RS013
D ARCTAN-EXTENDED RANGE FLOATING BINARY ARITH. #NORMALIZE B 0704-0370RS013
IZED LOG-EXTENDED RANGE FLOATING BINARY ARITH. #NORMAL B 0704-0370RS013
D E TO X-EXTENDED RANGE FLOATING BINARY ARITH. #NORMALIZE B 0704-0370RS013
AL PRINT-EXTENDED RANGE FLOATING BINARY ARITH. #DECIM B 0704-0370RS013
D LOADER #ABSOLUTE BINARY CARD AND CORRECTION CAR B 0704-0525PKCSB
D LOADER. #ABSOLUTE BINARY CARD AND CORRECTION CAR B 0704-0525PKCSB
E #STANDARD-TO-COLUMN BINARY CARD CONVERSION, ON-LIN B 0704-0374NA277
O CORE AND DRUMS #LOAD BINARY CARD IMAGES FROM TAPE T B 0704-0395LL010
#ROW BINARY CARD LOADER B 0709-1034SCCSB
S/. #OCTAL COLUMN BINARY CARD LOADER /THREE CARD B 0704-0668MUCBL
#ABSOLUTE ROW OR COLUMN BINARY CARD PUNCH B 0704-0455BESCB
TED INTEGERS. #BCD TO BINARY CONVERSION OF UNRESTRIC B 0704-0423BSDCH
#704 ROW BINARY TO COLUMN BINARY CONVERSION. B 0709-0951NA901
#704 ROW BINARY TO 709 COLUMN BINARY CONVERSION. B 0709-0951NA901
ELF LOADING ROW BINARY TO COLUMN BINARY CONVERTER #709 S B 0709-0808GDRCC
#BINARY DECK MINIMIZER B 0704-0333CWBDO
#COLUMN BINARY DISASSEMBLY PROGRAM B 0704-0784GECDS
#ROW BINARY DISASSEMBLY PROGRAM B 0704-0784GERDS
#RESTART PROGRAM FOR THE BINARY EDITOR /RL 0400/ B 0709-1032RL041
#BCD TO BINARY FIELD CONVERSION B 0704-0387CEI32
ER #INCREMENT COLUMN BINARY IMAGE OF HOLLERITH NUMB B 0704-0843ORICB
#TO WRITE 2 DIMENSIONAL ARRAY BINARY INFO ON TAPE B 0704-0910NUWTB
#BCD TO BINARY INTEGER CONVERSION B 0704-1056TVME2
L CONVERSION. #BINARY INTEGER TO ROMAN NUMERA B 0704-0870ORROM
#RELOCATABLE BINARY LOADER B 0704-0467BECSB
#ARGONNE TAPE LOWER BINARY LOADER B 0704-0503ANI11
#ABSOLUTE BINARY LOADER B 0704-0405PFCCB
#24 WORD PER CARD BINARY LOADER B 0704-0263MULBL
#RELOCATABLE BINARY LOADER B 0709-0563SE9RB
#MURA UPPER RELOCATABLE BINARY LOADER /ONE CARD/ B 0704-0432MURBL
#MURA LOWER BINARY LOADER /ONE CARD/ B 0704-0251MULBL
RECTOR #BINARY LOADER AND CHECKSUM COR B 0709-0563SE9BL
#RELOCATING BINARY LOADER, UPPER B 0704-0525PKCSB
#RELOCATING BINARY LOADER,LOWER B 0704-0525PKCSB
#RELOCATING BINARY LOADER,LOWER B 0709-0563SE9LR
#RELOCATING BINARY LOADER,UPPER B 0709-0563SE9UR
#DOUBLE-PRECISION FLOATING BINARY MATRIX CONVERSION PROG B 0704-0329NYDFM
ER #BINARY OCTAL CARD OR TAPE LOAD B 0704-0690GDBOT
#BINARY OCTAL LOADER B 0704-0215NYBOL
#RELOCATABLE OCTAL-COLUMN BINARY ON LINE FORTRAN LOADER B 0704-0912ASAS8
#BINARY PUNCH PROGRAM B 0704-0212NYBPU
#BINARY PUNCH PROGRAM B 0704-0405PFPFO
#MURA BINARY PUNCH ROUTINE 4 B 0704-0283MUBPU
#MURA BINARY PUNCH ROUTINE B 0704-0256MUBPU
#MURA BINARY PUNCH ROUTINE B 0704-0256MUBPU
#MURA BINARY PUNCH ROUTINE B 0704-0263MUBPU
#BINARY PUNCHING SUBROUTINE B 0709-0942MLPUN
#WRITES A FOURIER SERIES AS ONE BINARY RECORD ON TAPE. B 0704-0788IBWFS
#PUNCHES A FOURIER SERIES ONTO BINARY RELOCATABLE CARDS. B 0704-0788IBPUF
#BINARY SEARCH ROUTINE NA 839 B 0709-0951NA083
#BINARY SEARCH, FORTRAN B 0709-0935NGBSF
ON AND MEMORY ALLOCATION # BINARY SUBROUTINE IDENTIFICATI B 0704-0739ARPEK
DER WITH FL.PT.OFL. #FN II BINARY SYMBOLIC SUBROUTINE LOA B 0704-0848ARBSS
#BINARY TABLE SEARCH B 0705-PG-007-0
CHECKING, A FOURIER SERIES FROM BINARY TAPE #READS, WITH B 0704-0788IBRFS
TEM VERSION #BINARY TAPE CORRECTOR. NON-SYS B 0709-1055DIBTC
#BINARY TAPE DUMP B 1401-01.4.008
#BINARY TAPE LOADER B 0704-0425WBTSB
#ARGONNE CARD TO BINARY TAPE LOADER B 0704-0503ANI11
#BINARY TAPE OR DRUM DUMP B 0704-0213NYBTD
#BINARY TAPE-TO-CARD SIMULATOR C 0704-0455BETCB
RESTRICTED INTEGERS. #BINARY TO BCD CONVERSION OF UN B 0704-0423BSFRE
UTINE #BINARY TO BCD CONVERSION SUBRO B 0704-0525PKBCD
ION #BINARY TO BCS INTERGER CONVERS B 0709-0997MLCVR
#BINARY TO CHINESE BINARY B 0704-0395LL000
SION. #704 ROW BINARY TO COLUMN BINARY CONVER B 0709-0951NA901
TER #709 SELF LOADING ROW BINARY TO COLUMN BINARY CONVER B 0709-0808GDRCC
#BINARY TO PACKED BCD CONVERTER B 0704-0359ELSMO
NVERSION. #704 ROW BINARY TO 709 COLUMN BINARY CO B 0709-0951NA901

#ABSOLUTE BINARY UPPER LOADER ONE CARD B 0709-1102SE9DU
ONE CARD ABSOLUTE BINARY UPPER LOADER. B 0704-0473CSBUL
#PUNCH ABSOLUTE COLUMN BINARY. B 0704-1004GNPAC
#SELF-LOADING BINARY-OCTAL LOWER LOADER. B 0709-0999RL039
#709 FOUR CARD ROW BINARY-OCTAL UPPER CARD LOADER B 0709-0819GDBOC
CARD OR TAPE /ROW AND/OR COLUMN BINARY/ LOADER. #FORTRAN B 0709-1163MWRCT
BINOMIAL COEFFICIENTS B 0704-1042JPBIC
E #FORTRAN II BINOMIAL COEFFICIENT SUBROUTIN B 0704-0918MEPYR
SUBPROGRAM #FORTRAN II BINOMIAL COEFFICIENT FUNCTION B 0704-0919MEPYR
POINT #BINOMIAL COEFFICIENT-FLOATING B 0704-0417PFCBN
#BINTO NUCLEAR-CODE ENGINEERING B 0704-NUCLEAR
ION #BIVARIATE PARABOLIC INTERPOLAT B 0704-0248CLPIN
#FLOATING POINT BIVARIATE SEARCH B 0704-0692JPWEI
#BLACK JACK GAME * CARD * B 1620-11.0.006
#BLACK JACK GAME * TAPE * B 1620-11.0.005
#VIPP INSERT LEADING BLANKS. B 0704-0895TAVIL
#BLOCK CORRELATION AND * COR2 B 0650-01.6.046
#CLEAR BLOCK TO ZERO B 0650-01.6.006
#SORT 57 BLOCKED VARIABLE B 0705-CU-001-1
ARISONS FROM BALANCED INCOMPLETE BLOCKS #PAIRED COMP B 0650-06.0.038
#GENERAL PURPOSE BOARD TEST DECK A 0305--MI-004
#NY BOL1 TRANSITION B 0704-0216NYPLB
#BOOLEAN ALGEBRA MINIMIZER B 7090-1197LLBAM
#FLOW CHART ANALYSIS BY BOOLEAN MATRIX MANIPULATION B 0709-0824LLFLC
AM #BUMP, BOSTON UNIVERSITY MATRIX PROGR B 0650-02.1.006
EQU. SOLVER #TWO POINT BOUNDRY CONDITION DIFFERENTIAL B 0704-0238ATTPI
#LINEAR PROGRAMMING WITH UPPER BOUNDS ON VARIABLES B 0704-0973RSBP1
#BPR PARALLAX REDUCTION PROGRAM B 0650-09.8.002
TAL ALIGNMENT PROGRAM #BPR REVISION OF OREGON HORIZON B 0650-09.2.053
BIC-SKELLY TR. ROUT. WITH OPTION BR&TRANS&IND. ADD. CONV #STRO B 1620-01.4.004
NE ORDINATE FROM CONTINUOS GIRD. BRIDGE #MOMENT REACT INFLU LI B 0650-09.2.057
#SUSPENSION BRIDGE ANALYSIS B 0650-09.2.034
#CONTINUOUS BRIDGE ANALYSIS B 0650-09.2.066
#SKEWED BRIDGE ELEVATIONS B 1620-09.2.005
#STRAIGHT LINE BRIDGE GRID SYSTEM B 0650-09.2.058
#CURVED BRIDGE PROGRAM B 0650-09.2.018
#3-SPAN CURVED CONCRETE SLAB BRIDGE PROGRAM B 0650-09.2.060
#GEORGIA SKEWED BRIDGE PROGRAM B 0650-09.2.008
#COMPUTATION OF BRIDGE SCREED ELEVATIONS B 0650-09.2.075
#EXTENDED FORTRAN 2 BSS LOADER B 0704-0902NULUC
#RELOCATABLE FORTRAN BSS LOADER B 0704-0909MPBSS
#PRINT BSS LOADER DIAGNOSTICS B 0704-0830MINOL
#WRITE BSS LOADER STORAGE MAP B 0704-0830MISTP
#WRITE BSS LOADER STORAGE MAP B 0704-0830MISTP
TIONS #THE BUCKLEY-LAVERETT WELGE CALCULA B 0650-09.6.010
#BUFFERED CARD-INPUT SUBROUTINE B 0709-0633WDCRD
ORTRAN. # WDPC BUFFERED I/O PACKAGE FOR 709 F B 0709-0978WDIOF
#709 VIPP BUG TRAP. B 0709-1137BW9BU
UTILITY PROGRAMS OUTLINED IN 305 BULLETIN NO. 1 #TWELVE A 0305--UT-008
PROGRAM #BUMP, BOSTON UNIVERSITY MATRIX B 0650-02.1.006
#CANDLE NUCLEAR-CODE BURNUP B 0704-NUCLEAR
#TURBO NUCLEAR-CODE BURNUP B 0704-NUCLEAR
#DRACO NUCLEAR-CODE BURNUP B 0704-NUCLEAR
#SIZZLE NUCLEAR-CODE BURNUP B 7090-NUCLEAR
#50 BUS LOAD FLOW PROGRAM B 0650-09.4.003
#30 SERIES BUS LOAD FLOW PROGRAM B 0650-09.4.012
#FORTRAN BUTLER B 1620-01.5.002
#RENT OR BUY ANALYSIS B 0650-10.1.007
T.&SCHED. PHASE ONLY * LESS * M. C. FRISHBERG #LEAST COST ES B 0650-10.3.009
#FL DEC INTERP SYS 650 MAG DRUM CALC W/IMMED ACCESS BELL 111 B 0650-02.0.021
1/2WAVE POTENT. AND SLOPE OF A #CALC. OF THE LEAST SQRS. BEST B 0650-09.3.003
OCATING COMP. WITH ELEC. COMP. #CALC. PERF. CHARACT. OF RECIPR B 0650-09.6.015
CAM LEADER CO-ORDINATE ROUTINE * CALCOR * # B 0650-09.5.006
* #ESCAPE * EFFORTLESS SYS CALCUL AND PRINTING EVERYTHING B 1401-01.4.010
REACTOR SHIELD NUCLEAR-CODE # CALCULATE NEUTRON ATTENUATION- B 0650-08.2.025
INDICES #PROGRAM TO CALCULATE SEASONALLY ADJUSTED B 0650-06.0.042
#GIVEN X, THIS PROGRAM CALCULATES LN X TO 20D OR 20S. B 0704-0498CA004
#EQUILIBRIUM FLASH CALCULATION B 0650-09.6.003
#ABSORBER CALCULATION B 0650-09.6.004
DISTRIBUTION AND INFLUENCE LINE CALCULATION #MOMENT B 0650-09.2.033
ITICAL PATH AND RESOURCE SUMMARY CALCULATION #CR B 7090-1158ORCPS
LOG INTERPRETATION #POROSITY CALCULATION FROM RADIOACTIVITY B 0650-09.6.006
N FUNCTION & SPECTRAL DENSITY #CALCULATION OF AUTO-CORRELATIO B 0650-06.0.049
ON FUNCTION & CROSS-SPECT DENS #CALCULATION OF CROSS-CORRELATI B 0650-06.0.050
SYSTEM SHORT-CIRCUIT CURRENTS #CALCULATION OF ELECTRIC POWER B 0650-09.4.007
XPANSION STRESSES #CALCULATION OF PIPING SYSTEM E B 0650-09.5.001
MENTS #CALCULATION OF SEASONAL ADJUST B 0705-DP 0001
#PLATE-TO-PLATE CALCULATIONS B 0650-09.3.004
#P-V-I DATA CALCULATIONS B 0650-09.6.002
#THE BUCKLEY-LAVERETT WELGE CALCULATIONS B 0650-09.6.010
PONENT DISTILLATION TOWER DESIGN CALCULATIONS #MULTICOM B 1620-09.3.002
POWER SYSTEM TRANSIENT STABILITY CALCULATIONS #ELECTRICAL B 0650-09.4.001
100 MOMENT OF INERTIA & CENTROID CALCULATIONS * CARD * #M- B 1620-09.3.004
#SHORT CIRCUIT CALCULATIONS * CARD * B 1620-09.4.007
100 MOMENT OF INERTIA & CENTROID CALCULATIONS * TAPE * #M- B 1620-09.3.005
USING THE IBM 650 COMPUTER #CALCULATIONS OF RATE OF RETURN B 0650-09.6.011
#CUT & FILL-EARTHWORD VOLUME CALCULATIONS ON THE 305 RAMAC B 0305-09.2.001
-DIMENSIONAL MESH FOR RELAXATION CALCULATIONS. #TWO B 0704-0725PKMFR
#MODULUS 11 SELF-CHECKING DIGIT CALCULATOR B 7070-02.9.001
NTERPRETIVE SYS FOR IBM MAG DRUM CALCULATOR #STATISTICAL I B 0650-06.0.017
#PRODUCTION DAY CALENDAR B 0650-10.3.004
#CALENDAR DEMONSTRATION B 0705-IB 0009
#GENERAL PURPOSE CALENDAR PROGRAM B 0650-11.0.006
LOADER * #CALL * CARAT ASSEMBLED LOGICAL B 1401-01.4.002
M #SOS PROGRAM LOADER. CALLS IN A SELECTED SOS PROGRA B 7090-1229IQCSO
* CALCOR * #CAM LEADER CO-ORDINATE ROUTINE B 0650-09.5.006
#CANDLE NUCLEAR-CODE BURNUP B 0704-NUCLEAR
#GIVEN A FOURIER HALF-SERIES IN CANONICAL REPRESENTATION B 0704-0788IBGFL
#INTEGRATES A FOURIER SERIES IN CANONICAL REPRESENTATION B 0704-0788IBIFS
#SEARCH A FOURIER SERIES IN CANONICAL REPRESENTATION. B 0704-0788IBSFS
#CONVERTS A FOURIER SERIES IN CANONICAL REPRESENTATION. B 0704-0788IBWFS
AM #CAPACITATED NETWORK FLOW PROGR B 0704-0511MICNF
#LOCATION OF SHUNT CAPACITORS ON RADIAL LINES B 1620-09.4.002
* #CALL * CARAT ASSEMBLED LOGICAL LOADER B 1401-01.4.002
UTINE ADAPTED TO TAPE * #CARAT I * COMPLETE ASSEMBLY RO B 1401-01.1.003
OUTINE ADAPTED TO TAPE * #CARAT II * COMPLETE ASSEMBLY R B 1401-01.1.004
ABSOLUTE BINARY UPPER LOADER ONE CARD # B 0709-1102SE9DU
#1620 FORCOM CARD B 1620-01.6.006
#FORTRAN PRE-COMPILER FOR CARD A 1620--FO-006
OAP II 8-WORD LIST, AND 650 LOAD CARD #402 CONTROL PANEL FOR S B 0650-12.0.005
#1620 AUTOPLOTTER * CARD * B 1620-01.6.004
#IDA EDIT SUBROUTINE * CARD * B 1620-01.6.005
#EDIT SUBROUTINE * CARD * B 1620-01.6.011
IVE PROGRAMMING SYSTEM * IPS * * CARD * #INTERPRET B 1620-02.0.002
#650 SIMULATOR PROGRAM * CARD * B 1620-02.0.004
SIMULTANEOUS EQUATION SOLUTION * CARD * # B 1620-05.0.002
#REGRESSION ANALYSIS PROGRAM * CARD * B 1620-06.0.002
ISE MULTIPLE LINEAR REGRESSION * CARD * #STEPW B 1620-06.0.007
#POLYNOMIAL CURVE FITTING * CARD * B 1620-07.0.002
#CUT AND FILL * CARD * B 1620-09.2.003

#TRAVERSE ANALYSIS PROGRAM * CARD * B 1620-09.2.006
#GAS NETWORK ANALYSIS * CARD * B 1620-09.3.003
#ELECTRIC LOAD FLOW PROGRAM * CARD * B 1620-09.4.003
#BLACK JACK GAME * CARD * B 1620-11.0.006
#BBC-VIK BASEBALL DEMONSTRATOR * CARD * B 1620-11.0.007
SIMULATION OF ONE-ARMED BANDIT * CARD * # B 1620-11.0.011
#SHORT CIRCUIT ANALYSIS * CARD * B 1620-09.4.006
#SHORT CIRCUIT CALCULATIONS * CARD * B 1620-09.4.007
#STRAIN GAGE DATA REDUCTION * CARD * B 1620-09.6.001
INVENTORY MANAGEMENT SIMULATOR * CARD * #AN B 1620-10.2.001
INVENTORY MANAGEMENT SIMULATOR * CARD * # B 1620-10.2.003
#THE CHINESE BARERING PUZZLE * CARD * B 1620-11.0.001
LIC PROGRAMMING SYSTEM * SPS * * CARD * #1620/1710 SYMBO A 1620--SP-020
LYSIS OF A FLANGED TAPERED HUB * CARD * #S-109 STRESS ANA B 1620-09.7.005
NERTIA & CENTROID CALCULATIONS * CARD * #M-100 MOMENT OF I B 1620-09.3.004
S OF FLANGE WITH A TAPERED HUB * CARD * #S-100 STRESS ANALYSI B 1620-09.7.004
CHEDULING * SCHED PORTION#LESS * CARD * LEAST COST ESTIMATING S B 1620-10.3.003
DER. # ONE CARD ABSOLUTE BINARY UPPER LOA B 0704-0473CSBUL
R #ABSOLUTE BINARY CARD AND CORRECTION CARD LOADE B 0704-0525PKCSB
R. #ABSOLUTE BINARY CARD AND CORRECTION CARD LOADE B 0704-0525PKCSB
#TWO CARD BINARY AND OCTAL LOADER B 0704-0381ASAS5
#24 WORD PER CARD BINARY LOADER B 0704-0263MULBL
#709 CARD CONVERSION A 0709--CV-070
#650 TO 704-709 DATA CARD CONVERSION. B 0709-0792AE650
#STANDARD-TO-COLUMN BINARY CARD CONVERSION, ON-LINE B 0704-0374NA277
#DUMMY FRONT END CARD FOR 709-7090, CHANNEL A B 7090-1123WPS02
#FORMAT CONTROL SUBROUTINE FOR CARD FORTRAN B 1620-01.6.017
#CARD IMAGE PROGRAM B 0705-IB 0002
FOR FINP5 704 #FORTRAN CARD IMAGE READ ROUTINE /CSH/S B 0704-0820RWCSH
FOR FINP5 709 #FORTRAN CARD IMAGE READ ROUTINE /CSH/S B 0709-0820RWCSH
#TRANSLATE CARD IMAGE TO BCD IN COMMON. B 0709-0778AEIBC
AND DRUMS #LOAD BINARY CARD IMAGES FROM TAPE TO CORE B 0704-0395LL010
#FIXED AND FLOATING DECIMAL CARD INPUT B 0704-0325RS014
#DOUBLE PRECISION FLOATING POINT CARD INPUT B 0704-0650RWREA
RCORRELATION MATRIX, CORR2 - FOR CARD INPUT #7070 INTE B 7070-11.3.004
R PROGRAMMING CODE FOR 1620 WITH CARD INPUT&OUTPUT #LINEA B 1620-10.1.002
#TRACE PROGRAM FOR CARD INPUT/OUTPUT B 1620-01.4.002
#CHANGE CARD LOAD B 0705-AF-001-1
#CHANGE CARD LOAD B 0705-AF-001-1
#ABSOLUTE AND CORRECTION CARD LOADER B 0704-0572PFCCB
OLUTE BINARY CARD AND CORRECTION CARD LOADER #ABS B 0704-0525PKCSB
FOUR CARD ROW BINARY-OCTAL UPPER CARD LOADER #709 B 0709-0819GDBOC
#ROW BINARY CARD LOADER B 0709-1034SCCSB
#CORRECTION CARD LOADER B 1401-01.4.001
#OCTAL COLUMN BINARY CARD LOADER /THREE CARDS/. B 0704-0668MUCBL
#GENERAL CARD LOADER SUBROUTINE GROUP B 0704-0446PECSM
OLUTE BINARY CARD AND CORRECTION CARD LOADER. #ABS B 0704-0525PKCSB
ABSOLUTE AND CORRECTION TRANSFER CARD LOADER. # B 0704-0673WH005
#ONE CARD LOWER LOAD B 0705-EK 0001
N BINARY/ LOADER. #FORTRAN CARD OR TAPE /ROW AND/OR COLUM B 0709-1163MWRCT
#BINARY OCTAL CARD OR TAPE LOADER B 0704-0690GDBOT
#SIMULATION OF CARD OR TAPE 650 ON THE 7070 B 7070-05.1.005
#1401 TAPE TO CARD PROGRAM B 1401-13.1.003
#ABSOLUTE ROW OR COLUMN BINARY CARD PUNCH B 0704-0455DESCB
#VARIABLE FIXED FORMAT CARD READ B 0704-0381ASAS5
#ON-LINE BCD CARD READ ROUTINE B 0709-0948MLRBC
#OCTAL CORRECTION CARD READER B 0704-0830MIOCT
#OCTAL CORRECTION CARD READER B 0704-0830MIOCT
#READ BCD TAPE OR ON-LINE CARD READER B 0704-0073UACSH
AM * #SCRAP * SIXTEEN-TWENTY CARD REGRESSION ANALYSIS PROGR B 1620-06.0.003
AND AUTOCODER ASSEMBLY #CARD REPORT PROGRAM GENERATOR B 1401-01.3.001
G PROGRAM FOR THE IBM 1401 #CARD REPRODUCING AND/OR LISTIN B 1401-01.4.003
RD LOADER #709 FOUR CARD ROW BINARY-OCTAL UPPER CA B 0709-0819GDBOC
#FORTRAN END CARD SEARCH. B 0704-0899MEFEN
IDS #CARD SYSTEMS ERROR DETECTION A A 1401--AT-017
#CARD SYSTEMS SUBROUTINES A 1401--LM-007
#CARD SYSTEMS UTILITY PROGRAMS A 1401--UT-001
#ONE CARD TAPE COPY ROUTINE B 0704-0540SC
#ARGONNE CARD TO BINARY TAPE LOADER B 0704-0503ANI11
#HOLLERITH CARD TO TAPE B 0704-0525PKCTH
INTER #SIMULTANEOUS CARD TO TAPE AND/OR TAPE TO PR B 1401-13.1.010
G ROUTINE #CARD TO TAPE CONVERSION-EDITIN B 0704-0387CEI4E
#CARD TO TAPE LOAD B 0705-AF-012-0
#1401 CARD TO TAPE PROGRAM B 1401-13.1.002
#CARD TO TAPE ROUTINE A 0650--UT-002
TO COLUMN CONVERTER. #CARD TO TAPE SIMULATOR AND ROW B 0704-1013ORCTT
#CARD TO TAPE SIMULATOR. B 0709-0605WDCTS
#CARD TO TAPE UTILITY PROGRAM A 1401--UT-027
AND 80/84 SIMULATION OF THE 714 CARD TO TAPE. #72/84 B 0704-0676OR714
#CARD TO TAPE, BINARY B 0704-0425WBCTB
#ONE CARD UPPER LOAD B 0705-EK 0002
#SIX CARD UPPER LOADER B 0704-1183GDCOR
#TAPE TO CARD UTILITY PROGRAM A 1401--UT-028
#PERIPHERAL CARD VERIFIER B 0704-0262NYPCV
#LINEAR PROGRAMMING CODE FOR CARD 1620 B 1620-10.1.006
70 #SIMULATING THE CARD 650 ON A TAPE ORIENTED 70 B 7070-05.1.004
#BUFFERED CARD-INPUT SUBROUTINE B 0709-0633WDCRD
R RELOCATABLE BINARY LOADER /ONE CARD/ #MURA UPPE B 0704-0432MURBL
#MURA LOWER BINARY LOADER /ONE CARD/ B 0704-0251MULBL
#IOCS CARD/TAPE * SEE 1410-PR-108 * A 1410--IO-909
#SIMPLIFIED PRIORITY CARD/TAPE ROUTINE B 7070-02.4.004
#INDIVIDUAL CARD/TAPE UTILITIES A 1410--UT-106
-PR-108 * #REPORT PRO. GENERAT. CARD/TAPE/1405 DISK * SEE 1410 A 1410--RG-910
#HOLLERITH TO BCD INPUT FROM CARDS B 0704-0387CEI41
#FORTRAN WITH FORMAT FOR CARDS A 1620--FO-004
#SPS TWO PASS FOR CARDS A 1620--SP-009
#FORTRAN FOR CARDS A 1620--FO-002
#GOTRAN FOR CARDS A 1620--PR-011
ADER FOR COL. BIN. ABS. AND TSF. CARDS #ON-LINE LO B 0704-1012ORCBL
R SERIES ONTO BINARY RELOCATABLE CARDS. #PUNCHES A FOURIE B 0704-0788IBPUF
COLUMN BINARY CARD LOADER /THREE CARDS/. #OCTAL B 0704-0668MUCBL
#EURIPUS-3 NUCLEAR-CODE MONTE CARLO B 0704-NUCLEAR
#DAEDALUS NUCLEAR-CODE MONTE CARLO B 0704-NUCLEAR
#POLYPHEMUS NUCLEAR-CODE MONTE CARLO B 0704-NUCLEAR
#SPAN-2 NUCLEAR-CODE MONTE CARLO B 0704-NUCLEAR
#SPIC-1 NUCLEAR-CODE MONTE CARLO B 0704-NUCLEAR
#TUT-T5 NUCLEAR-CODE MONTE CARLO B 0704-NUCLEAR
#CONSTANTS FOR OR MONTE CARLO PKG. /NOT A SUBROUTINE/ B 0704-0743ORMOC
PROGRAM #CARP-A CONELATION & REGRESSION B 0650-06.0.064
#BASIC FORTRAN * PUNCH WITH CARRIAGE CONTROL * B 7070-01.2.002
#POLAR TO CARTESIAN COORDINATES B 0650-03.1.015
#SELEC ECON. COND. SIZE-SPEC CASE NEW ENG ELEC SYS PROG 18 B 1620-09.4.004
PROGRAM. #SHARE CATALOG UPDATER, LISTER. 1401 B 0704-1224UCSCU
GENERAL ALPHANUMERIC CATHODE RAY DISPLAY B 0704-0314MUSCP
TINE. #GENERAL CATHODE RAY TUBE COUPLE SUBROU B 0704-0439NA029
#MURA SIX COLUMN FRACTION CATHODE RAY TUBE DISPLAY B 0704-0310MUSCP
#MURA CATHODE RAY TUBE POINT PLOTTER B 0704-0321MUSCP
#RANDOM NUMBER GENERATOR, CAUCHY DISTRIBUTION. FT. PT. B 0704-0743ORCAU
#CDCSB B 0650-01.6.029
#S4 CYLINDRICAL GEOMETRY CELL CODE NUCLEAR-CODE B 7090-NUCLEAR
UP OF RW REQX.SPACE REQUIRED-122 CELLS #FORTRAN WRITE- B 0709-0946RWFEQ
TURNS #THREE CENTER CURVES FOR SHORT RADIUS B 0650-09.2.020
#M-100 MOMENT OF INERTIA & CENTROID CALCULATIONS * CARD * B 1620-09.3.004
#M-100 MOMENT OF INERTIA & CENTROID CALCULATIONS * TAPE * B 1620-09.3.005
#FACTOR ANALYSIS BY THE CENTROID METHOD B 0650-05.1.008
#TRACING A MIN. PATH BET. ZONE CENTROIDS OVER A ROAD NETWORK B 0650-09.2.080
#CEPTR NUCLEAR-CODE TRANSPORT B 0704-NUCLEAR
TIONS #CHAIN LOADING ADDITIONS & DELE A 0650--UT-104
D RATE OF RETURN * PVIA * * INF. CHAIN MACH * #PRESENT VALUE AN B 0650-07.0.017
PRES VAL-RATE OF RET-PV2A-FINITE CHAIN OF ONE INVESTMENT # B 0650-07.0.018
#CHANGE CARD LOAD B 0705-AF-001-1
#CHANGE CARD LOAD B 0705-AF-001-1
#ISENTROPIC PRESSURE CHANGE SUBROUTINE B 7090-1095WHISD
#TAPE TO TAPE COPY WITH CHANGES B 0704-0425WBTTC
MMY FRONT END CARD FOR 709-7090, CHANNEL A #DU B 7090-1123WPS02
IT * COMPILER FOR USE OF SPECIAL CHAR #MODS OF INTER TRANS * B 0650-02.1.002
. WITH ELEC. COMP. #CALC. PERF. CHARACT. OF RECIPROCATING COMP B 0650-09.6.015
RS #CHARACTERISTIC ROOTS AND VECTO B 0704-0148NYCRV
#TAPE CHARACTERISTICS B 0705-SP-001-0
IX MANIPULATION #FLOW CHART ANALYSIS BY BOOLEAN MATR B 0709-0824LLFLC
OG PRINT RECORD TAPE 40K #FLOW CHART LISTING FROM ASSEMBLY PR B 0705-IB 0003
#CONTOUR CHART OF TRIP DESIRES B 0650-09.2.016
CHEBYSHEV TRUNCATION SYSTEM B 0704-1008IBCTR
#EARTHWORK DATA CHECK B 0650-09.2.044
#SEQUENCE CHECK B 0705-EQ-007-0
#SPEED CHECK ANALYSIS B 0650-09.2.023
#TO READ AND CHECK NU WTB-WRITTEN RECORDS B 0704-0911NURTB
#AUTOMATIC CHECK POINT AND RECOVERY B 0704-0801NOGWC
#TAPE LABEL,TRA,CHECK POINT ROUTINE B 0705-SR-001-0
#TAPE CHECK SUBROUTINE B 7070-03.4.004
#CHECK TAPE SETTINGS B 0705-PG-004-0
#OVERFLOW, UNDERFLOW, AND DIVIDE CHECK TEST B 0704-0248CLOUD
#CHECKER DEMONSTRATION PROGRAM B 0704-0282PKCKR
#SORT 55 CHECKING LOADING ROUTINE B 0705-EQ-001-0
ANSLATING #709 PROGRAM FOR CHECKING OPERATIONS NEEDING TR B 0709-0482GASPO
M BINARY TAPE #READS, WITH CHECKING, A FOURIER SERIES FRO B 0704-0788IBRFS
#ACT-AUTOMATIC CHECKOUT TECHNIQUE B 1401-13.1.004
#CHECKSUM CORRECTOR B 0704-0405PFSML
#BINARY LOADER AND CHECKSUM CORRECTOR B 0709-0563SE9BL
TINGENCY TABLE #CHI SQUARE AND PHI FOR 2X2 CON B 0650-06.0.016
TIGENCY TABLE #CHI SQUARE FOR UP TO 10X10 CON B 0650-06.0.015
TAPE * #CHINESE BAR AND RING PUZZLE * B 1620-11.0.003
* #THE CHINESE BARERING PUZZLE * CARD B 1620-11.0.001
#BINARY TO CHINESE BINARY B 0704-0395LL000
ENTRY #ROUTINES TO READ A CHRONO-LOG CLOCK VIA 716 ECHO B 0704-0843ORCLK
IMULATOR #CHRYSLER INTERPRETER AND 650 S B 0704-0486CMCIS
#OFFSET CIRCLE PROBABILITY FUNCTION. B 0704-0869RCOCI
OF A MIN 2 LEVEL &/OR SWITCHING CIRCUIT #COMPUTATION B 0704-1104PKMIN
#SHORT CIRCUIT ANALYSIS * CARD * B 1620-09.4.006
#SHORT CIRCUIT CALCULATIONS * CARD * B 1620-09.4.007
#SEQUENTIAL CIRCUIT PROBLEM SOLVING B 0704-1103PKSEQ
#RADIAL SHORT CIRCUIT PROGRAM B 0650-09.4.013
NETWORK #IMPROVED DIGITAL SHORT CIRCUIT SOLUTION OF POWER SYS B 0650-09.4.004
GE FUNCTION #CIRCULAR AND ELLIPTICAL COVERA B 7090-1182DVCIR
ONS REGULAR BESSEL FUNCTIONS #CIRCULAR AND HYPERBOLIC FUNCTI B 0650-03.2.001
#CIRCULAR CULVERT ANALYSIS B 0650-09.2.059
E PROG TAPE OPR TAPE LBL&TRAILER CKN #GEN. TRA ROUTIN B 0705-SR-002-0
ION CLEAR AND ADD #PK CLAD & PK STOD - DOUBLE PRECIS B 0704-0525PKCLA
LAD & PK STOD - DOUBLE PRECISION CLEAR AND ADD #PK C B 0704-0525PKCLA
#CLEAR BLOCK TO ZERO B 0650-01.6.006
RESET AND CLEAR CORE AND N LOGICAL DRUMS B 0704-0443LL024
ROUTINE #CLEBSCH-GORDAN COEFFICIENT SUB B 0650-07.0.012
#ROUTINES TO READ A CHRONO-LOG CLOCK VIA 716 ECHO ENTRY B 0704-0843ORCLK
#FIXED POINT SQUARE ROOT * CLOSED * SUBROUTINE B 1620-03.0.002
C. KEY AND ITEM LENGTH - 1 WORD. CLOSED. #SORT, ALGEBRAI B 0704-0570ORSRT
#CLOUD NUCLEAR-CODE PHYSICS B 7090-NUCLEAR
LOATING POINT E AT 10 AT SINH AT CO #A F B 0650-03.1.020
#CAM LEADER CO-ORDINATE ROUTINE * CALCOR * B 0650-09.5.006
#CORRECTION OF COAL MOISTURE MEASUREMENTS B 0650-09.4.011
#COBOL * SEE 7070-PR-075 A 7070--CB-923
#COBOL *SEE 1410-PR-108* A 1410--CB-912
R #0705/7080 COBOL AND COMMERCIAL TRANSLATO A 0705--PR-131
#QUADRATIC PROGRAMMING CODE B 0704-1050RSQP1
#WHIRLAWAY NUCLEAR CODE B 7090-NUCLEAR
ENSIGN CODE NUCLEAR-CODE B 0650-08.2.022
UTOMATIC PERSONAL IDENTIFICATION CODE * #AUTOPIC 1401 *A B 1401-01.4.014
UTOMATIC PERSONAL IDENTIFICATION CODE * AUTO-PIC * #A B 0650-01.6.041
G. FORCED INVERSION VECTOR PART. CODE FOR AUGMENT 650#LINEAR PR B 0650-10.1.010
EAR PROGRAMMING FORCED INVERSION CODE FOR AUGMENTED 650 #LIN B 0650-10.1.009
#LINEAR PROGRAMMING CODE FOR CARD 1620 B 1620-10.1.006
CLEAR-CODE # BALL A REACTOR CODE FOR SPHERICAL GEOMETRY NU B 0650-08.2.016
#LINEAR PROGRAMMING CODE FOR THE AUGMENTED IBM 650 B 0650-10.1.006
#CONTOUR CODE FOR THE IBM 650 B 0650-06.0.061
OUTPUT #LINEAR PROGRAMMING CODE FOR 1620 WITH CARD INPUT& B 1620-10.1.002
ARMOUR REACTOR KINETICS %ARK-1¤ CODE NUCLEAR-CODE # B 0650-08.2.019
#S4 CYLINDRICAL GEOMETRY CELL CODE NUCLEAR-CODE B 7090-NUCLEAR
ERROR CORRECTION CODE READER B 0709-0938VGREC
T EDITOR FOR MULTIPLE REGRESSION CODE SCRAP. #INPU B 0704-0749SCIEM
E # BEEHIVE & HORNET REACTOR CODE SPHERICAL GEO NUCLEAR-COD B 0650-08.2.009
#ERROR CORRECTION CODE WRITER B 0709-0938VGWEC
#704 TRANSPORTATION CODE. B 0704-0726SCXPC
#FORTRAN LINEAR PROGRAMMING CODE. B 0704-0480CEFLP
#LINEAR EQUATIONS SOLUTION FAP CODED 7090 B 7090-1206NULEQ
CTAN A/B, FORTRAN II VERSION,SAP CODED. #AR B 0704-0603WH005
NT TRAP ROUTINE 704 FORTRAN SAP CODED. #FLOATING POI B 0704-1071NUEFM
#AUTOMATIC CODER, COMPATIBLE WITH SAP B 0704-1220NSABC
#RAYTHEON RAETOR SURVEY CODES * 2G,2RI * B 0650-08.2.024
#SET CODES NUCLEAR-CODE ENGINEERING B 0704-NUCLEAR
TON ASSEMBLR FOR PROC.ENG. INTER CODING SYS #UNIV OF HOUS B 0650-02.0.017
#SPEED CODING SYSTEM B 0650-02.0.005
C SYSTEM AERONUTRONIC SIMPLIFIED CODING SYSTEM * #AS B 1401-02.0.002
#FN II NTH DEGREE LEAST SQU COEF COMPUTATION SUBROUTINE B 0704-0848ARPLN
M #FORTRAN II BINOMIAL COEFFICIENT FUNCTION SUBPROGRA B 0704-0919MEPYR
#POLYNOMIAL COEFFICIENT REDUCTION B 0704-0224ASAS1
#CORRELATION COEFFICIENT ROUTINE B 0650-06.0.003
#CLEBSCH-GORDAN COEFFICIENT SUBROUTINE B 0650-07.0.012
#FORTRAN II BINOMIAL COEFFICIENT SUBROUTINE B 0704-0918MEPYR
#BINOMIAL COEFFICIENT-FLOATING POINT B 0704-0417PFCBN
#54X54 CORRELATION COEFFICIENTS B 0650-06.0.052
#MISSING DATA CORRELATION COEFFICIENTS B 0650-06.0.055
#SIMPLE CORRELATION COEFFICIENTS B 0650-06.0.002
#10X 90 CORRELATION COEFFICIENTS B 0650-06.0.033
#FIXED POINT FOURIER COEFFICIENTS B 0704-0250NYFSC
BINOMIAL COEFFICIENTS B 0704-1042JPBIC
#ROOTS OF POLYNOMIAL WITH REAL COEFFICIENTS B 0709-0927MAPOL
TION OF STATE #DETERMINATION OF COEFFICIENTS FOR BENEDICT EQUA B 0650-09.3.001
US #COFIT NUCLEAR-CODE MISCELLANEO B 0704-NUCLEAR
USION ONE-DIMENSIONAL #COGENT NUCLEAR-CODE GROUP DIFF B 0704-NUCLEAR
#ON-LINE LOADER FOR COL. BIN. ABS. AND TSF. CARDS B 0704-1012ORCBL
EE CARDS/. #OCTAL COLUMN BINARY CARD LOADER /THR B 0704-0668MUCBL

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          #ABSOLUTE ROW OR COLUMN BINARY CARD PUNCH       B 0704-0455BESCB
 #709 SELF LOADING ROW BINARY TO COLUMN BINARY CONVERTER  B 0709-0808GDRCC
        #704 ROW BINARY TO COLUMN BINARY CONVERSION.      B 0709-0951NA901
    #704 ROW BINARY TO 709 COLUMN BINARY CONVERSION.      B 0709-0951NA901
RAM                     #COLUMN BINARY DISASSEMBLY PROG B 0704-0784GECDS
TH NUMBER            #INCREMENT COLUMN BINARY IMAGE OF HOLLERI B 0704-0843ORICB
             #PUNCH ABSOLUTE COLUMN BINARY.               B 0704-1004GNPAC
FORTRAN CARD OR TAPE /ROW AND/OR COLUMN BINARY/ LOADER.  # B 0709-1163MWRCT
ARD TO TAPE SIMULATOR AND ROW TO COLUMN CONVERTER.     #C B 0704-1013ORCTT
BE DISPLAY          #MURA SIX COLUMN FRACTION CATHODE RAY TU B 0704-0310MUSCP
                    #MURA SIX COLUMN FRACTION PRINT       B 0704-0314MUPRF
               #MURA VARIABLE COLUMN FRACTION PRINT       B 0704-0357MUPRF
               #MURA VARIABLE COLUMN FRACTION PRINT       B 0704-0357MUPRF
 #MATRIX INTERCHANGE OF ROWS AND COLUMNS                  B 0704-0085CLMIN
         #NORMALIZE MATRIX BY COLUMNS.                    B 0704-0236CLMNR
                #SELECTOR OF COMBINATIONS OF INPUT DATA.  B 0704-0648AVSEL
SERIES.                     #COMBINES INDICES IN A FOURIER B 0704-0788IBCIF
TERM.                       #COMBINES INDICES IN A FOURIER B 0704-0788IBCIF
GE FOR SYMBOL MANIPULATION  #COMIT - GENERAL PURPOSE LANGUA B 0709-1198MICOM
 PROGRAM/.                  #COMMENT ATTACHED PROGRAM. /709 B 0709-0519CSCAP
        #0705/7080 COBOL AND COMMERCIAL TRANSLATOR        A 0705--PR-131
ARY *SEE 7070-PR-075*       #COMMERCIAL TRANSLATOR-PRELIMIN A 7070--CT-903
                    #709/7090 COMMERCIAL TRANSLATOR COMPILER A 7090--CT-921
 #TRANSLATE CARD IMAGE TO BCD IN COMMON.                  B 0709-0778AEIBC
F RECIPROCATING COMP. WITH ELEC. COMP.  #CALC. PERF. CHARACT. O B 0650-09.6.015
ITY WITH DEPTH   #NORMAL MOVEOUT COMP. FOR LINEAR INC. OF VELOC B 0650-09.6.019
 PERF. CHARACT. OF RECIPROCATING COMP. WITH ELEC. COMP.  #CALC. B 0650-09.6.015
         #CROWN LIFE INSURANCE COMPANY SORTING PROGRAM    B 0650-01.5.006
#TAPE EDITOR AND DUPLICATOR WITH COMPARE                  B 0704-0318GMTED
               #TAPE COPY AND COMPARE                     B 0709-0998RL039
          #TAPE DUPLICATE AND COMPARE                     B 0709-0887PPTUA
     #1401 TAPE DUPLICATION OR COMPARE                    B 1401-13.1.001
                         #TAPE COMPARE * TPCMP *          B 0705-NW-003-1
                         #TAPE COMPARE FOR THE 709        B 0709-0502RLTC9
      #TAPE DUPLICATION AND/OR COMPARE.                   B 0709-0717NA098
ALYSIS PROGRAM DA-1     #PROFILE COMPARISION AND STATISTICAL AN B 0650-09.2.074
                        #MEMORY COMPARISON DUMP           B 0704-0931PKCOM
MPLETE BLOCKS           #PAIRED COMPARISONS FROM BALANCED INCO B 0650-06.0.038
ET-2-21 *       #COMPLETE PAIRED COMPARISONS SCHEDULE * PARCOPL B 0650-06.0.045
       #DOUBLE PRECISION SIGN COMPATIBILITY               B 0704-0417PFCSF
                       #704/9 COMPATIBILITY               A 0709--CV-065
EDITOR FOR PROGRAMMED 704/709/90 COMPATIBILITY        #BI B 0709-1031RL040
      #FLICOR FLOATING INTERP. COMPATIBLE OPERATION ROUTINE B 0650-02.0.020
           #AUTOMATIC CODER, COMPATIBLE WITH SAP          B 0704-1220NSABC
     #SOS IBM-32K ASSEMBLY AND COMPILER                   A 0709--PR-063
   #SOS SHARE-32K ASSEMBLY AND COMPILER                   A 0709--PR-064
                         #PAT COMPILER                    B 7070-04.4.001
 #709/7090 COMMERCIAL TRANSLATOR COMPILER                 A 7090--CT-921
NTERPRETIVE SYSTEM       #704 COMPILER FOR BELL LABORATORY I B 0704-0470ELBEL
  #INTERNAL TRANSLATOR * IT * A COMPILER FOR THE 650      B 0650-02.1.001
AR  #MODS OF INTER TRANS * IT * COMPILER FOR USE OF SPECIAL CH B 0650-02.1.002
                    #1401 PAT COMPILER FOR 7070           B 7070-04.4.004
                    #7070 PAT COMPILER SYSTEM             B 7070-04.4.002
                    #7070/2/4 COMPILER SYSTEMS TAPE       A 7070--PR-075
         #ELLIPTIC INTEGRAL, COMPLETE AND INCOMPLETE.     B 0704-0977ALELP
TED TO TAPE *        #CARAT I * COMPLETE ASSEMBLY ROUTINE ADAP B 1401-01.1.003
TED TO TAPE *       #CARAT II * COMPLETE ASSEMBLY ROUTINE ADAP B 1401-01.1.004
 THE FIRST KIND             #COMPLETE ELLIPTIC INTEGRALS OF B 0704-1070RMELF
                       #MURA COMPLETE ELLIPTIC INTEGRALS  B 0704-0668MUCEI
HEDULE * PARCOPLET-2-21 *   #COMPLETE PAIRED COMPARISONS SC B 0650-06.0.045
        #EIGENVALUE SOLUTION, COMPLEX                     B 0704-0248CLPMC
      #SIMULTANEOUS EQUATIONS COMPLEX                     B 0704-0116CLSME
                            #COMPLEX AND REAL EIGENVALUES B 0650-05.2.005
       #  BESSEL FUNCTION OF COMPLEX ARGUMENT AND ORDER.  B 0704-0979NUBES
     #      PSI FUNCTION FOR COMPLEX ARGUMENTS            B 0704-0493LAS85
ARITHM OF THE GAMMA FUNCTION FOR COMPLEX ARGUMENTS   #LOG B 0704-0493LAS86
LL LAB. INTERPRETIVE SYSTEM   #COMPLEX ARITH OPERATIONS IN BE B 0650-02.0.012
OMPLEX 1 * INTERPRETIVE PKGE FOR COMPLEX ARITHMETIC    #C B 0650-07.0.014
MPLEX 11 * INTERPRETIVE PKGE FOR COMPLEX ARITHMETIC   #CO B 0650-07.0.015
ERP SYS FOR IBM 650-653 * REAL & COMPLEX ARITHMETIC * #SYMB INT B 0650-07.0.016
           #FLOATING POINT COMPLEX ARITHMETIC ABSTRACTION B 0704-0715RWCA2
E ROUTINE                   #COMPLEX ARITHMETIC INTERPRETIV B 0650-02.0.003
RSION                       #COMPLEX ARITHMETIC MATRIX INVE B 0650-05.1.003
         #DOUBLE PRECISION COMPLEX ARITHMETIC PACKAGE.    B 0704-0647NPDFC
           #EXTENDED RANGE COMPLEX ARITHMETIC PACKAGE     B 0704-0609CA034
         #TRIPLE PRECISION COMPLEX ARITHMETIC PACKAGE     B 0704-0546CA005
           #FLOATING POINT COMPLEX ARITHMETICS.           B 0704-0417PFSAC
         #DOUBLE PRECISION COMPLEX FAD AND FMP            B 0704-0223CLDPC
         #DOUBLE PRECISION COMPLEX FAD, FMP, AND FDP      B 0704-0223CLDPC
                            #COMPLEX FORTRAN FOR THE 1620 B 1620-06.0.008
  #PRELIM. EIGENVALUE PROB. OF A COMPLEX HERMITIAN MATRIX. B 0704-0460MIMAU
 PROGRAM                    #COMPLEX LINEAR SYSTEM SOLUTION B 0704-0522PFEL3
      #A GENERAL PROGRAM FOR COMPLEX MATRIX INVERSION     B 0704-1075ANF10
#DETERMINANT AND EIGENVECTOR FOR COMPLEX MATRIX.          B 0704-0116CLDET
                            #COMPLEX NATURAL LOGARITHM    B 0704-0354NA66.
                            #COMPLEX NTH ROOT             B 0704-0354NA63.
STEM /FLOATING POINT/       #COMPLEX NUMBER INTERPRETIVE SY B 0704-0832BECPK
. FOR PERFORMING OPERATIONS WITH COMPLEX NUMBERS  #INTERP. SYS B 1620-02.0.003
                  #ZEROS OF A COMPLEX POLYNOMIAL          B 0704-0405PFZPC
                  #ZEROS OF A COMPLEX POLYNOMIAL          B 0704-0225GMZER
                    #ZEROS OF COMPLEX POLYNOMIALS         B 0650-07.0.006
                   # ZEROS OF COMPLEX POLYNOMIALS         B 0704-0692JPZPO
         #TRIPLE PRECISION COMPLEX SQUARE ROOT            B 0704-0565CA005
FOR COMPLEX ARITHMETIC      #COMPLEX 1 * INTERPRETIVE PKGE B 0650-07.0.014
 FOR COMPLEX ARITHMETIC     #COMPLEX 11 * INTERPRETIVE PKGE B 0650-07.0.015
         #INVERSE, REAL OR COMPLEX.                       B 0704-0223CLMIV
                  #PRINCIPAL COMPONENTS PREDICTION EQUATION B 0704-1168TVPCP
                            #COMPOSITE BEAM               B 0650-09.2.019
       #MULTIPLE REGRESSION, COMPREHENSIVE ANALYSIS       B 0704-0915TVMRC
NG ON THE IBM 704.          #COMPREHENSIVE LINEAR PROGRAMMI B 0704-0818CESCR
     #ENTHALPY AND ENTROPY OF COMPRESSED LIQUID           B 7090-1095WHHCL
         #SPECIFIC VOLUME OF COMPRESSED LIQUID            B 7090-1095WHVCL
              #EVALUATING COMPRESSOR PERFORMANCE          B 0650-09.5.005
G FOR 650-653 MAG DRUM CONE STGE COMPU    #MOD BELL TRANS PRO B 0650-02.1.011
TRAVERSE AND TRAVERSE ADJUSTMENT COMPUTATION     #REVISED B 0650-09.2.015
/OR SWITCHING CIRCUIT       #COMPUTATION OF A MIN 2 LEVEL & B 0704-1104PKMIN
EVEL AND-OR SWITCHING       #COMPUTATION OF A MINIMUM TWO-L B 0704-0787PKMIN
LEVATIONS                   #COMPUTATION OF BRIDGE SCREED E B 0650-09.2.075
#FN II NTH DEGREE LEAST SQU COEF COMPUTATION SUBROUTINE   B 0704-0848ARPLN
           #FN II FACTORIAL COMPUTATION SUBROUTINE        B 0704-0848ARTOR
              #EIGENVALUE COMPUTATION.                    B 0704-0405PFMVP
      #CORRELATIONAL RESIDUE COMPUTATION.                 B 0704-0405PFCR2
              #GEODIMETER COMPUTATIONS                    B 0650-09.2.065
            #CONTRACT BID COMPUTATIONS                    B 0650-09.2.047
                #WATERWAY COMPUTATIONS                    B 1620-09.2.004
RATE OF RETURN USING THE IBM 650 COMPUTER   #CALCULATIONS OF B 0650-09.6.011
S BEAMS AND FRAMES          #COMPUTER ANALYSIS OF CONTINUOU B 0650-09.2.067
           #PROCESS CONTROL COMPUTER ASSEMBLY FOR IBM  704 B 0704-1184ININI
                            #COMPUTER AUTOMATED MUSIC     B 0650-11.0.007
 305                        #COMPUTER PACKAGE FOR THE RAMAC A 0305--PR-001

* ZEUS PROGRAM ANALYSIS * *ZPA * COMPUTER SYSTEM        # B 7070-01.9.004
          #SIMULATE BASIC 650 COMPUTER WITH 704.          B 0704-0480CE650
             #  TYDAC /PSEUDO COMPUTER/ SIMULATOR         B 0704-0441CSTYD
POINT 7090 ARCTANGENT SUBROUTINE COMPUTES       #FLOATING- B 0709-1016RWAT3
OF THE INDICES.             #COMPUTES A SPECIAL FUNCTION F B 0704-0788IBSPF
E OF A FOURIER SERIES.      #COMPUTES THE PARTIAL DERIVATIV B 0704-0788IBPDF
               #EASTMAN KODAK CON. EDISON TRANSFER TRACING B 0705-EK 0003
               #3-SPAN CURVED CONCRETE SLAB BRIDGE PROGRAM B 0650-09.2.060
LEC SYS PROG 18    #SELEC ECON. COND. SIZE-SPEC CASE NEW ENG E B 1620-09.4.004
 INFORMATION.               #A CONDENSER ROUTINE FOR SYMBOLIC B 0704-0959MICND
               #FIVE-PER-CARD CONDENSING ROUTINE          B 0650-01.6.007
               #FIVE-PER-CARD CONDENSING ROUTINE          B 0650-01.6.022
     #UNIVERSAL MEMORY DUMP AND CONDENSING ROUTINE        B 0650-01.6.028
LVER          #TWO POINT BOUNDRY CONDITION DIFFERENTIAL EQU. SO B 0704-0238ATTPI
LVINS LAW              #ECONOMIC CONDUCTOR SIZE SELECTION BY KE B 1620-09.4.005
                       #ECONOMIC CONDUCTOR STUDY          B 0650-09.4.009
 TRANS PROG FOR 650-653 MAG DRUM CONE STGE COMPU   #MOD BELL B 0650-02.1.011
M                        #CARP-A CONELATION & REGRESSION PROGRA B 0650-06.0.064
 FOR INDERTERMINATE TRUSS ANAL  #CONNECTOR AND REDUNDANCY PROGS B 0650-09.2.007
     #THIS SUBROUTINE SAVES THE CONSOLE /AC,MQ,IRA,IRB,IRC,  B 0704-0345ELSAV
     #THIS SUBROUTINE SAVES THE CONSOLE /AC,MQ,IRA,IRB,IRC,  B 0704-0345ELSAV
RANDOMNESS OF DECIMALS #PRINTING CONSTANT DECIMALS AND TESTING B 1401-11.0.004
                       #FRAME CONSTANTS                   B 0650-09.2.068
KG. /NOT A SUBROUTINE/      #CONSTANTS FOR OR MONTE CARLO P B 0704-0743ORMOC
R PRINTING--ERTBL           #CONSTRUCT A TABLE OF ERRORS FO B 0704-0391NOERT
                       #STAGE CONSTRUCTION PROGRAM        B 0650-09.2.070
   #FACTOR * FOURTEEN O ONE AUTO CONT TEST OPTIMIZING ROUT * B 1401-01.4.007
*          #SEISMOGRAM SYN FORM CONT. INTERVAL VELOCITY * CVL B 0650-09.6.018
                 #KEY WORD IN CONTEXT                     B 0704-0884PKKWI
    #CHI SQUARE FOR UP TO 10X10 CONTIGENCY TABLE          B 0650-06.0.015
    #CHI SQUARE AND PHI FOR 2X2 CONTINGENCY TABLE         B 0650-06.0.016
                            #CONTINUED FRACTION SUBROUTINE B 0704-0225GMCFR
ING AND INTERPOLATION       #CONTINUED FRACTIONS CURVE FITT B 0704-0858GS541
T REACT INFLU LINE ORDINATE FROM CONTINUOS GIRD. BRIDGE  #MOMEN B 0650-09.2.057
                            #CONTINUOUS BEAM DESIGN PROGRAM B 0650-09.2.064
        #COMPUTER ANALYSIS OF CONTINUOUS BEAMS AND FRAMES B 0650-09.2.067
                            #CONTINUOUS BRIDGE ANALYSIS   B 0650-09.2.0
ATION SUBROUTINE            #CONTINUOUS DERIVATIVE INTERPOL B 0704-0760GECUI
                            #CONTOUR CHART OF TRIP DESIRES B 0650-09.2.016
                            #CONTOUR CODE FOR THE IBM 650 B 0650-06.0.061
                            #CONTOUR INTERPOLATION        B 0650-09.2.025
                            #CONTOUR PLOT PROGRAM         B 0704-0506MICR1
                            #CONTOUR PLOT PROGRAM         B 0704-0506MICR2
                            #CONTRACT BID COMPUTATIONS    B 0650-09.2.047
IX TO TRIANGULAR FORM.      #CONTRACT SQUARE SYMMETRIC MATR B 0704-0460MICNT
INPUT PROGRAM UNDER SENSE SWITCH CONTROL                # B 0704-0206NYINP
OUTPUT PROGRAM UNDER SENSE LIGHT CONTROL         #DECIMAL B 0704-0206NYOUT
#INPUT PROGRAM UNDER SENSE LIGHT CONTROL                  B 0704-0206NYINP
#INPUT PROGRAM UNDER SENSE LIGHT CONTROL                  B 0709-1025WPK06
OUTPUT PROGRAM UNDER SENSE LIGHT CONTROL         #DECIMAL B 0709-1026WPK07
             #SCS 80 SUPERVISOR CONTROL                   A 7080--SV-115
      #7090 IOCS INPUT/OUTPUT CONTROL                     A 7090--10-919
BROUTINE WHICH DESCRIBES FLOW OF CONTROL    #BACK TRACE SU B 0704-0907NUBAC
NPUT/OUTPUT ROUTINE USING FORMAT CONTROL   #1620 FORTRAN I B 1620-01.6.008
IC FORTRAN * PUNCH WITH CARRIAGE CONTROL *           #BAS B 7070-01.2.002
IBM  704               #PROCESS CONTROL COMPUTER ASSEMBLY FOR B 0704-1184ININI
                         #PRINT CONTROL FOR REPORT GENERATION B 0709-1038RWPCR
       #GENERAL PURPOSE 407 CONTROL PANEL                 B 0650-01.6.056
RD LIST, AND 650 LOAD CARD  #402 CONTROL PANEL FOR SOAP II 8-WO B 0650-12.0.005
N                       #650 SOAP CONTROL PANEL WIRING SUGGESTIO B 0650-12.0.006
           #READ-WRITE TAPE CONTROL PROGRAM               B 0704-0403MITCR
              #SUPERVISORY CONTROL PROGRAM                B 0704-0487DAZ00
       #TAPE ASSIGNMENT AND CONTROL PROGRAM.              B 0709-0534CSENK
RTRAN                    #FORMAT CONTROL SUBROUTINE FOR CARD FO B 1620-01.6.017
             #TAPE LIBRARY CONTROL SYSTEM                 B 1401-02.0.001
          #1401 TCS * TAPE CONTROL SYSTEM *               B 1401-01.4.006
FOURTEEN O ONE INPUT-OUTPUT TAPE CONTROL SYSTEM *  #FITS * B 1401-01.4.011
           #INTEGRATION WITH CONTROLLED ERROR             B 0704-1232AAICE
. WITH OPTION BR&TRANS&IND. ADD. CONV  #STROBIC-SKELLY TR. ROUT B 1620-01.4.004
O FLT PT REPRE         #INT OP 4 CONV OF NO FROM FIX PT REPRE T B 0650-01.6.017
          #BCD TO BINARY FIELD CONVERSION                 B 0704-0387CEI32
 #ALPHANUMERICAL READING AND BCD CONVERSION               B 0704-0417PFDCB
        #RECTANGULAR TO POLAR CONVERSION                  B 0704-0354NA87.
           #HOLLERITH TO BCD CONVERSION                   B 0704-0235NYDBD
        #BCD TO BINARY INTEGER CONVERSION                 B 0704-1056TVME2
             #EKACT-10 DIGIT CONVERSION                   B 0705-EK-002-0
       #SYMBOLIC TO AUTOCODER CONVERSION                  B 0705-EQ-002-0
                   #709 CARD CONVERSION                   A 0709--CV-070
      #BINARY TO BCS INTERGER CONVERSION                  B 0709-0997MLCVR
          #DEGREES TO RADIUS CONVERSION                   B 7070-08.1.008
         #RADIANS TO DEGREES CONVERSION                   B 7070-08.1.009
    #650 TO 7070 TAPE RECORD CONVERSION * XXA15 *         B 7070-02.4.001
EGERS.          #BCD TO BINARY CONVERSION OF UNRESTRICTED INT B 0704-0423BSDCH
EGERS.          #BINARY TO BCD CONVERSION OF UNRESTRICTED INT B 0704-0423BSFRE
         #QD SURGE /709-90 CONVERSION OF 704 SURGE/       B 0709-1063GEQUD
PRECISION FLOATING BINARY MATRIX CONVERSION PROG   #DOUBLE- B 0704-0329NYDFM
               #ROD READING CONVERSION PROGRAM            B 0650-09.2.028
         #DECIMAL-TO-BINARY CONVERSION PROGRAM            B 0704-0768UADBC
       #BCD TO MODIFIED BCD CONVERSION ROUTINE            B 0704-0512DMCVT
             #BINARY TO BCD CONVERSION SUBROUTINE         B 0704-0525PKBCD
             #BASIC 709 I/O CONVERSION SUBROUTINES.       B 0709-0388GS7I0
                #MODULO 2PI CONVERSION SUBROUTINE         B 7070-08.1.014
SCUP *            #AUTOMATIC SOAP CONVERSION UTILITY PROGRAM * A B 0650-01.6.045
 #ALPHANUMERICAL READING AND BCD CONVERSION.              B 0704-0405PFDCB
      #DOUBLE PRECISION INPUT CONVERSION.                 B 0704-0585CA006
#BINARY INTEGER TO ROMAN NUMERAL CONVERSION.              B 0704-0870ORROM
#704 ROW BINARY TO COLUMN BINARY CONVERSION.              B 0709-0951NA901
 ROW BINARY TO 709 COLUMN BINARY CONVERSION.         #704 B 0709-0951NA901
      #650 TO 704-709 DATA CARD CONVERSION.               B 0709-0792AE650
               #CARD TO TAPE CONVERSION-EDITING ROUTINE   B 0704-0387CEI4E
 #STANDARD-TO-COLUMN BINARY CARD CONVERSION, ON-LINE      B 0704-0374NA277
TING DECIMAL  #FLOATER-A SUB. TO CONVERT NO. FROM FIXED TO FLOA B 7070-08.9.001
IXED DECIMAL   #FIXER, A SUB. TO CONVERT NO. FROM FLOATING TO F B 7070-08.9.002
      #MODIFIED ASSEMBLY SYSTEM CONVERTED TO TAPE * MASCOT * B 1401-01.1.001
               #ONE-TO-SEVEN CONVERTER                    B 0650-01.6.009
               #SEVEN-TO-ONE CONVERTER                    B 0650-01.6.011
        #BINARY TO PACKED BCD CONVERTER                   B 0704-0359ELSMO
      #LP/90 TO SCROL 704 INPUT CONVERTER                 B 0704-0937ERCON
            #FORTRAN TO SQUOZE CONVERTER                  B 0709-0875RCFNS
DING ROW BINARY TO COLUMN BINARY CONVERTER    #709 SELF LOA B 0709-0808GDRCC
TAPE SIMULATOR AND ROW TO COLUMN CONVERTER.       #CARD TO B 0704-1013ORCTT
ANONICAL REPRESENTATION.    #CONVERTS A FOURIER SERIES IN C B 0704-0788IBWFS
 TO BCD FORM.               #CONVERTS A FOURIER SERIES TERM B 0704-0788IBCFT
RDING TO A FORTRAN          #  CONVERTS BCD TAPE RECORDS ACCO B 0704-0495CVI02
            #TRAVERSE AND COORDINATE PROGRAM              B 0650-09.2.021
ROG LAPLACES EQUA IN CYLINDRICAL COORDINATE SYS   #RELAXATION P B 0650-04.0.008
         #POLAR TO CARTESIAN COORDINATES                  B 0650-03.1.015
OG LAPLACES EQUAT IN RECTANGULAR COORDINATES   #RELAXATION PR B 0650-04.0.007
OG POISSONS EQUAT IN RECTANGULAR COORDINATES   #RELAXATION PR B 0650-04.0.009
                         #TAPE COPY AND COMPARE           B 0709-0998RL039
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#COPY BCD TAPE ROUTINE B 0709-0889GDBCD
#INTERRUPT FORTRAN-LOADING TO COPY MEMORY ON TO TAPE. B 0709-1164MWFOT
#TAPE COPY PROGRAM. B 0704-0733PFDUP
#ONE CARD TAPE COPY ROUTINE B 0704-0540SC
#TAPE COPY ROUTINE B 7070-03.4.001
#TAPE TO TAPE COPY WITH CHANGES B 0704-0425WBTTC
#COR IV B 0650-06.0.025
TEM # CORBIE, AUTOMATIC OPERATOR SYS B 0704-0372BSCRB
#READ TAPE TO CORE B 0704-0387CEI4H
SPOSED ON ITSELF OR DISPLACED IN CORE #SQUARE MATRIX TRAN B 0704-0661GDF02
BINARY CARD IMAGES FROM TAPE TO CORE AND DRUMS #LOAD B 0704-0395LL010
RESET AND CLEAR CORE AND N LOGICAL DRUMS B 0704-0443LL024
#OCTAL MNEMONIC FLOATING POINT CORE DUMP B 0709-0633WDOMF
#WRITE CORE IMAGE ON TAPE B 0704-0830MIWTP
#CORE PRINTOUT ROUTINE-VARIABLE B 1401-01.4.017
4 #GENERAL LOGICAL CORE SORT SUBROUTINE FOR 32K70 B 0704-1054BSSEA
#DUMP STORAGE, CORE, DRUM, AND TAPES B 0704-0496CSDS2
#DUMP STORAGE, CORE, DRUM, AND TAPES B 0704-0420CSDS1
#THE CORNELL RESEARCH SIMULATOR B 0650-10.2.008
#BCD ARITHMETIC CORRECTION B 0704-0359ELSMO
AP FLOATING-POINT TRAP UNDERFLOW CORRECTION #704-S B 0704-0705MIFLT
N II FLOATING-PT. TRAP UNDERFLOW CORRECTION #704-FORTRA B 0704-0705MIFLT
#LOADS BINARY ABSOLUTE, CORRECTION AND TRANSFER B 0704-0449MI9SI
#ABSOLUTE BINARY CARD AND CORRECTION CARD LOADER B 0704-0525PKCSB
#ABSOLUTE BINARY CARD AND CORRECTION CARD LOADER. B 0704-0525PKCSB
#ABSOLUTE AND CORRECTION CARD LOADER B 0704-0572PFCCB
#CORRECTION CARD LOADER B 1401-01.4.001
#OCTAL CORRECTION CARD READER B 0704-0830MIOCT
#OCTAL CORRECTION CARD READER B 0704-0830MIOCT
ERROR CORRECTION CODE READER B 0709-0938VGREC
#ERROR CORRECTION CODE WRITER B 0709-0938VGWEC
ASUREMENTS #CORRECTION OF COAL MOISTURE ME B 0650-09.4.011
R. #ABSOLUTE AND CORRECTION TRANSFER CARD LOADE B 0704-0673WH005
#TAPE CORRECTOR B 0704-0508DITPC
#CHECKSUM CORRECTOR B 0704-0405PFSML
#BINARY LOADER AND CHECKSUM CORRECTOR B 0709-0563SE9BL
#FORTRAN SOURCE TAPE CORRECTOR B 1620-01.5.001
#NUMERIC TAPE DUPLICATOR AND CORRECTOR A 1620--MI-016
#BINARY TAPE CORRECTOR. NON-SYSTEM VERSION B 0709-1055DIBTC
ARIABLES #CORRELATING PROGRAM-UP TO 30 V B 1620-06.0.009
#MULTI-VARIABLE CORRELATION B 0650-06.0.022
TATED OUTPUT #CORRELATION ANALYSIS WITH ANNO B 0650-06.0.014
TATED OUTPUT-PART II #CORRELATION ANALYSIS WITH ANNO B 0650-06.0.032
TATED OUTPUT-PART 3 #CORRELATION ANALYSIS WITH ANNO B 0650-06.0.037
#MULTIPLE REGRESSION & CORRELATION ANALYSIS PROGRAM. B 0704-0749SCRAP
#FORTRAN MULTIPLE CORRELATION ANALYSIS PROGRAM B 0709-1121NRNRM
#BLOCK CORRELATION AND * COR2 B 0650-01.6.046
LYSIS, #CORRELATION AND REGRESSION ANA B 0704-0782PFCR3
#SIMPLE CORRELATION COEFFICIENTS B 0650-06.0.002
E #CORRELATION COEFFICIENT ROUTIN B 0650-06.0.003
#10X 90 CORRELATION COEFFICIENTS B 0650-06.0.033
#54X54 CORRELATION COEFFICIENTS B 0650-06.0.052
#MISSING DATA CORRELATION COEFFICIENTS B 0650-06.0.055
#MULTIPLE CORRELATION FOR 50 VARIABLES B 0650-06.0.007
C & AUGM. 650 #SIMPLE CORRELATION ROUTINE * FOR BASI B 0650-06.0.062
S BY STEPWISE METHOD #MULTIPLE CORRELATION&REGRESSION ANALYSI B 7070-11.3.007
#SIMPLE CORRELATION-COR1 B 0650-06.0.047
ION. #CORRELATIONAL RESIDUE COMPUTAT B 0704-0405PFCR2
NALYSIS #MULTIPLE CORRELATIONS AND REGRESSIONS A B 0704-0417PFCR1
#7070 INTERCORRELATION MATRIX, CORR1 B 7070-11.3.003
#7070 INTERCORRELATION MATRIX, CORR2 - FOR CARD INPUT B 7070-11.3.004
#BLOCK CORRELATION AND * COR2 B 0650-01.6.046
LOATING POINT E A, 10 A, SINH A, COSH A #F B 0650-03.1.020
#SINH X AND COSH X B 0650-03.1.009
ETABLE DOUBLE PRECISION SINE AND COSINE #INTERPR B 0704-0385BSSCC
#ARC SINE AND ARC COSINE B 0704-0116CLASC
#FLOATING POINT SINE A AND COSINE A A 0650--LM-004
E #HYPERBOLIC SINE, COSINE AND COTANGENT SUBROUTIN B 7070-08.1.020
#SINE AND COSINE FUNCTIONS FOR NLLS. B 0704-0837ORSCN
INTER SUBROU FOR SINE INTEGRAL & COSINE INTEGRAL FUNCTIONS # B 0650-03.2.004
#ARC SINE - ARC COSINE SUBROUTINE B 0704-0246NA135
#SINE AND COSINE SUBROUTINE B 7070-08.1.002
#SINE AND COSINE SUBROUTINE B 7070-08.1.011
#SINE AND COSINE SUBROUTINE B 7070-08.1.015
#SINE AND COSINE SUBROUTINE B 7070-08.1.021
#SINE AND COSINE, FLOATING B 0704-0577RWSC5
#HYPERBOLIC SINE AND COSINE,FLOATING POINT. B 0704-0417PFCSH
PHASE ONLY LESS F. BACKER #LEAST COST EST. & SCHEDULING-SCHED. B 0650-10.3.005
LESS * M. C. FRISHBERG #LEAST COST EST.&SCHED. PHASE ONLY * B 0650-10.3.009
* #1401 LESS 4K * LEAST COST ESTIMATING AND SCHEDULING B 1401-10.3.001
#1401 LESS 8K,12K,16K * LEAST COST ESTIMATING AND SCHED * B 1401-10.3.002
CHEDULING PORTION *#LESS * LEAST COST ESTIMATING SCHEDULING * S B 1620-10.3.002
CHED PORTION#LESS * CARD * LEAST COST ESTIMATING SCHEDULING * S B 1620-10.3.003
APE * #1620 LESS * LEAST COST ESTIMATING&SCHEDULING * T B 1620-10.3.001
#DTM-ZONE COST EVALUATION PROGRAM EA-2 B 0650-09.2.086
#TANGENT COTANGENT SUBROUTINE B 7070-08.1.016
#HYPERBOLIC SINE, COSINE AND COTANGENT SUBROUTINE B 7070-08.1.020
#GENERAL CATHODE RAY TUBE COUPLE SUBROUTINE. B 0704-0439NA029
#ANALYSIS OF VARIANCE OR COVARIANCE B 7090-1212MFAOV
OGRAM #ANALYSIS OF VARIANCE OR COVARIANCE AND ADJUST MEANS PR B 0650-06.0.034
UMBERS #ANALYSIS OF COVARIANCE DISPROP. SUBCLASS N B 0650-06.0.057
AT. DESIGN #ANALY OF VARIANCE OR COVARIANCE FOR NON-ORTH/D & ST B 0650-06.0.059
#CIRCULAR AND ELLIPTICAL COVERAGE FUNCTION B 7090-1182DVCIR
INTEGRATION #FLOATING PT. COWELL /2ND SUM/, RUNGE-KUTTA B 0704-0775RWDE6
#CREATE MASTER PROGRAM TAPE B 0705-A0-010-0
BROUTINE. #TAPE CREATING PROGRAM AND LOADER SU B 0704-0734PFPRO
#CRITICAL PATH ANALYSIS B 1620-10.3.005
MARY CALCULATION #CRITICAL PATH AND RESOURCE SUM B 7090-1158ORCPS
OD #CRITICAL PATH PROGRAMMING METH B 0704-1188GMCP
#READS THE SORTED AUTHOR CROSS INDEX TAPE B 0704-1144NC014
#FLUID FLOW DISTRIBUTION. HARDY CROSS METHOD B 0650-09.7.007
#VECTOR TRIPLE CROSS PRODUCT B 0709-0885VGVPR
M NUCLEAR-CODE # LOST A CROSS SECTION AVERAGING PROGRA B 0650-08.2.004
ROSS-SPECT DENS #CALCULATION OF CROSS-CORRELATION FUNCTION & C B 0650-06.0.050
ERATOR,FLOATING #AUTO- AND CROSS-CORRELATION FUNCTION GEN B 0704-0577RWAC2
#TEMPEST-II NUCLEAR-CODE CROSS-SECTIONS B 7090-NUCLEAR
#FORM NUCLEAR-CODE CROSS-SECTIONS B 7090-NUCLEAR
#TEMPEST NUCLEAR-CODE CROSS-SECTIONS B 7090-NUCLEAR
#AETRA NUCLEAR-CODE CROSS-SECTIONS B 7090-NUCLEAR
#GAM-I NUCLEAR-CODE CROSS-SECTIONS B 7090-NUCLEAR
OF CROSS-CORRELATION FUNCTION & CROSS-SPECT DENS #CALCULATION B 0650-06.0.050
ORTING PROGRAM #CROWN LIFE INSURANCE COMPANY S B 0650-01.5.006
IGIT DECIMAL INTEGER AND SIGN ON CRT #WRITE 6-D B 0704-0362NA117
#CRT NUMBER PLOT B 0704-0458GDNUM
#CRYSTALLOGRAPHIC PROGRAM B 7090-1240ERBR1
RAL STRUCTURE FACTOR PROGRAM FOR CRYSTALLOGRAPHY #A GENE B 7070-07.5.001
#CUBE ROOT B 0650-03.1.003
#MURA FIXED POINT CUBE ROOT B 0704-0314MUCRT
#FLOATING-POINT DOUBLE-PRECISION CUBE ROOT B 0704-0525PKCBR
#CUBE ROOT SUBROUTINE B 0704-0931PKCBR
#CUBE ROOT X B 0650-03.1.029
#MURA FLOATING POINT CUBE ROOT. B 0704-0280MUCRT
#CUBEROOT SUBROUTINE B 7070-08.3.005
EXPLICIT SOLUTION OF THE GENERAL CUBIC EQUATION # B 0704-1028GC000
#CIRCULAR CULVERT ANALYSIS B 0650-09.2.059
ION TWO-DIMENSIONAL #CURE NUCLEAR-CODE GROUP DIFFUS B 0704-NUCLEAR
CTRIC POWER SYSTEM SHORT-CIRCUIT CURRENTS #CALCULATION OF ELE B 0650-09.4.007
#BACKWATER CURVE ANALYSIS B 0650-09.7.004
QUALLY FOR UNEQUALLY SPACED PT #CURVE AND SURFACE FITTING ON E B 0650-06.0.021
#SPLINE CURVE FIT B 0704-0483NA029
#POLYNOMIAL CURVE FIT B 1620-07.0.004
#ORTHOGONAL POLYNOMIAL CURVE FITTER B 0650-06.0.039
#LEAST SQUARES RATIONAL FUNCTION CURVE FITTING B 0704-0859GSL16
#TAYLOR SERIES RATIONAL FUNCTION CURVE FITTING B 7090-1150RLRAT
#POLYNOMIAL CURVE FITTING * CARD * B 1620-07.0.002
#POLYNOMIAL CURVE FITTING * TAPE * B 1620-07.0.001
N #CONTINUED FRACTIONS CURVE FITTING AND INTERPOLATIO B 0704-0858GS541
#GENERAL LEAST SQUARE CURVE FITTING ROUTINE B 0704-0775RWGLS
#GENERAL LEAST SQUARE CURVE FITTING ROUTINE. B 0704-0742RWLS3
#LEAST SQUARES POLYNOMIAL CURVE FITTING ROUTINE B 0705-A0-003-0
POLYNOMIALS #LEAST SQUARES CURVE FITTING WITH ORTHOGONAL B 0650-06.0.023
RECORD METHOD #CURVE FITTING- SIMULATED PLANT B 1620-09.4.009
#ARBITRARY CURVE PLOTTER SUBROUTINE B 0704-0284WHWH2
#CURVE PLOTTING SUBROUTINE B 0705-A0-004-0
#SPLINE CURVE READ B 0704-0483NA029
#MADSM1 CURVE SMOOTHING ROUTINE B 7090-1241MADSM
THOGONAL #LEAST SQUARES CURVE-FITTING ROUTINE USING OR B 0704-0636RWCF2
#LEAST SQUARES CURVE-FITTING ROUTINE B 0709-0860RWCF
#CURVED BRIDGE PROGRAM B 0650-09.2.018
OGRAM #3-SPAN CURVED CONCRETE SLAB BRIDGE PR B 0650-09.2.060
. INTERPOLATION FOR SURFACES AND CURVES #MINIMUM ARC LGTH B 0704-0483NA029
#PROGRAM CURVES . B 7090-1236IBCUR
#THREE CENTER CURVES FOR SHORT RADIUS TURNS B 0650-09.2.020
LCULATIONS ON THE 305 RAMAC #CUT & FILL-EARTHWORD VOLUME CA B 0305-09.2.001
#OHIO CUT AND FILL B 0650-09.2.030
#CUT AND FILL B 0650-09.2.004
#CUT AND FILL * CARD * B 1620-09.2.003
#CUT AND FILL * TAPE * B 1620-09.2.002
#CUT AND FILL PROGRAM B 0650-09.2.002
N FORM CONT. INTERVAL VELOCITY * CVL * #SEISMOGRAM SY B 0650-09.6.018
RELAXATION PROG LAPLACES EQUA IN CYLINDRICAL COORDINATE SYS # B 0650-04.0.008
UNCLE 1 DIFFUSION EQUATION IN CYLINDRICAL GEO NUCLEAR-CODE B 0650-08.2.010
NUCLEAR-CODE #S4 CYLINDRICAL GEOMETRY CELL CODE B 7090-NUCLEAR
D VOLUMES IN FLAT END HORIZONTAL CYLINDRICAL TANKS #LIQUI B 0650-09.7.005
L SYMMETRIC MATRICES ON THE 1620 D/P SYS #EIGENVALUES OF REA B 1620-05.0.004
REAL SYMMETRIC MATRICES ON 1620 D/P SYSTEM #EIGENVALUES OF B 1620-05.0.003
AND STATISTICAL ANALYSIS PROGRAM DA-1 #PROFILE COMPARISION B 0650-09.2.074
SYS 4 POINT POLY. INTERP. PROG. DA-2 1 #DIGITAL TERRAIN MODEL B 0650-09.2.062
SYSTEM PROFILE SMOOTHING PROGRAM DA-3 #DIGITAL TERRAIN MODEL B 0650-09.2.063
POLYNOMIAL INTERPOLATION PROGRAM DA-5 #GENERAL PURPOSE B 0650-09.2.073
RLO #DAEDALUS NUCLEAR-CODE MONTE CA B 0704-NUCLEAR
#MOVING AVERAGES OF TIME-SERIES DATA B 0704-0335NYMA1
#ANALYZING SYSTEM FAILURE DATA B 0704-1059WLFAI
GAMMA- DISTRIBUTION TO RAINFALL DATA #FITTING OF THE B 0650-06.0.029
RA. GAMMA DIST-SPEC REF RAINFALL DATA #FITTING DATA TO TWO PA B 0650-06.0.051
LOCITY FUNCTION FOR REFRACT. T/D DATA #LEAST SQ. DETER. OF VE B 0650-09.6.020
NES #MUSH DATA ASSEMBLER AND PRINT ROUTI B 0704-0523SCMAP
#P-V-T DATA CALCULATIONS B 0650-09.6.002
#650 TO 704-709 DATA CARD CONVERSION. B 0709-0792AE650
#EARTHWORK DATA CHECK B 0650-09.2.044
#MISSING DATA CORRELATION COEFFICIENTS B 0650-06.0.055
TAL TERRAIN MODEL SYSTEM TERRAIN DATA EDIT PROGRAM TD-1 #DIGI B 0650-09.2.039
INE FOR TRANS FROM REMING TO IBM DATA EQU * #STRIDE * SUBROUT B 1401-01.4.013
#PROGRAM AND DATA FILE SYSTEM B 1401-13.1.005
D DIFFERENTIATE UNEQUALLY SPACED DATA POINTS #SMOOTH AN B 0704-0331CLSMD
#SMOOTH AND DIFFERENTIATE DATA POINTS B 0704-0223CLSMD
#REGRESSION ANALYSIS DATA PREPARATION B 1620-01.6.001
#DATA PROCESSING OUTPUT ROUTINE B 0704-0512DMDPO
#709 DATA PROCESSING PACKAGE A 0709--UT-069
#STRAIN ROSETTE DATA REDUCTION B 0650-09.5.004
#STRAIN GAGE DATA REDUCTION * CARD * B 1620-09.6.001
#STRAIN GAGE DATA REDUCTION * TAPE * B 1620-09.6.002
#ATMOSPHERIC DATA SUBROUTINE B 0704-0341AAATM
#ATMOSPHERIC DATA SUBROUTINE B 0704-0436AAATM
PEC REF RAINFALL DATA #FITTING DATA TO TWO PARA. GAMMA DIST-S B 0650-06.0.051
ELECTOR OF COMBINATIONS OF INPUT DATA. #S B 0704-0648AVSEL
#READ TAPE DATA. B 0704-0587NORTD
#MANIPULATE BCD-CODED DATA, INCLUDING I/O B 0704-0879MI4BC
#DAYS BETWEEN DATES B 0650-01.6.021
#PRODUCTION DAY CALENDAR B 0650-10.3.004
#DAYS BETWEEN DATES B 0650-01.6.021
KUTTA INTEGRATION OF #DBL. PREC. FLOATING PT. RUNGE- B 0704-0610RWDE2
RUNGE-KUTTA INTEGRATION- #DBL. PREC. FLOATING PT. MILNE, B 0704-0610RWDE3
#DE RELATIVIZE PROGRAM B 0704-0230RS012
FORTRAN MONITOR WITH SOURCE LANG DEBUG #OFFLINE EDIT FOR B 7090-1115GPFMS
#DEBUGGING PROGRAMS B 0650-12.0.001
#DEBUGGING ROUTINE B 0704-0270GIDBU
LC W/IMMED ACCESS BELL 111 #FL DEC INTERP SYS 650 MAG DRUM CA B 0650-02.0.021
#SORT 2, DECENDING B 0650-01.5.009
NVERT NO. FROM FLOATING TO FIXED DECIMAL #FIXER, A SUB. TO CO B 7070-08.9.002
NVERT NO. FROM FIXED TO FLOATING DECIMAL #FLOATER-A SUB. TO CO B 7070-08.9.001
#FIXED AND FLOATING DECIMAL CARD INPUT B 0704-0325RS014
#MURA FLOATING DECIMAL DUMP B 0704-0321MUFDD
#RDF3 MURA READ DECIMAL FRACTION B 0704-0283MURDF
#MURA READ DECIMAL FRACTION ROUTINE B 0704-0283MURDF
FORMAT #SCHENECTADY DECIMAL INPUT PROGRAM-VARIABLE B 0704-0204GSIN2
#FLOATING POINT & FIXED POINT DECIMAL INPUT. B 0704-0370RS014
T #WRITE 6-DIGIT DECIMAL INTEGER AND SIGN ON CR B 0704-0362NA117
#MURA READ DECIMAL INTEGER ROUTINE B 0704-0256MURDI
#MURA READ DECIMAL INTEGERS ROUTINE B 0704-0263MURDI
ENSE LIGHT CONTROL #DECIMAL OUTPUT PROGRAM UNDER S B 0704-0206NYOUT
ENSE LIGHT CONTROL #DECIMAL OUTPUT PROGRAM UNDER S B 0709-1026WPK07
#ERCO FLOATING DECIMAL POINT SUBROUTINES B 0650-02.0.009
LOATING BINARY ARITH. #DECIMAL PRINT-EXTENDED RANGE F B 0704-0370RS013
#INTERPRETIVE FLOATING DECIMAL ROUTINE B 0650-01.6.020
#MURA READ FLOATING DECIMAL ROUTINE B 0704-0283MURFD
#SKIPS ONE FILE ON A DECIMAL TAPE AND PUNCHES B 0704-1144NC014
#DECIMAL TAPE DUMP B 0704-0425WBPTD
ROGRAM #DECIMAL-TO-BINARY CONVERSION P B 0704-0768UADBC
#DECIMAL, OCTAL, BCD LOADER B 0704-0756RWINP
#DECIMAL, OCTAL, BCD LOADER B 0704-0756RWINP
#DECIMAL, OCTAL, BCD LOADER B 0704-0073UADBC
#DECIMAL, OCTAL, BCD LOADER B 7090-1138RWINP
CIMALS AND TESTING RANDOMNESS OF DECIMALS #PRINTING CONSTANT DE B 1401-11.0.004
S OF DECIMALS #PRINTING CONSTANT DECIMALS AND TESTING RANDOMNES B 1401-11.0.004
#MANAGEMENT DECISION MAKING EXERCISE B 7070-12.9.002
ND EMPLOYMENT SCHEDULE #LINEAR DECISION RULE FOR PRODUCTION A B 0650-10.3.001
#AN EDITOR FOR SAP SYMBOLIC DECKS. B 0704-0960MIEDS
#TIME SERIES DECOMPOSITION AND ADJUSTMENT B 0704-0861ERTSD
#TIME SERIES DECOMPOSITION AND ADJUSTMENT B 0704-0526TVTSD

#TIME SERIES DECOMPOSITION AND ADJUSTMENT B 7090-1145ERTSD
#FLOATING POINT DEFINITE INTEGRAL EVALUATION B 0704-0624RWDL2
#DEFORT B 0704-0451CLDFR
ION SUBROUTINE #FN II NTH DEGREE LEAST SQU COEF COMPUTAT B 0704-0848ARPLN
ECTORY PROGRAM #SIX DEGREE OF FREEDOM DYNAMIC TRAJ B 0704-0821LRSFD
#RADIANS TO DEGREES CONVERSION B 7070-08.1.009
#DEGREES TO RADIUS CONVERSION B 7070-08.1.008
#SORT DELETE A 0650--UT-106
#CHAIN LOADING ADDITIONS & DELETIONS A 0650--UT-104
#CALENDAR DEMONSTRATION B 0705-IB 0009
#CHECKER DEMONSTRATION PROGRAM B 0704-0282PKCKR
#HUMAN REACTION TIME DEMONSTRATION ROUTINE B 0650-11.0.005
#SELF DEMONSTRATOR B 1620-11.0.010
#BBC-VIK BASEBALL DEMONSTRATOR • CARD • B 1620-11.0.007
#BBC-VIK BASEBALL DEMONSTRATOR • TAPE • B 1620-11.0.008
#TRANSPORTATION PROBLEM • DENNIS TECHNIQUE • B 7070-12.9.001
RRELATION FUNCTION & CROSS-SPECT DENS #CALCULATION OF CROSS-CO B 0650-06.0.050
-CORRELATION FUNCTION & SPECTRAL DENSITY #CALCULATION OF AUTO B 0650-06.0.049
#MAXIMUM DENSITY FO GRANULAR MATERIALS B 0650-09.2.012
#POWER SPECTRAL DENSITY FUNCTION, FLOATING B 0704-0577RWPS2
#POWER DENSITY SPECTRUM B 0704-0897AAPDS
FOR LINEAR INC. OF VELOCITY WITH DEPTH #NORMAL MOVEOUT COMP. B 0650-09.6.019
#SMOOTHED ORDINATE AND DERIVATIVE B 7090-1248MDSOD
UTINE #CONTINUOUS DERIVATIVE INTERPOLATION SUBRO B 0704-0760GECDI
. #COMPUTES THE PARTIAL DERIVATIVE OF A FOURIER SERIES B 0704-0788IBPDF
#RESIDUALS AND DERIVATIVES OF GRAVITY B 0650-09.6.008
#BACK TRACE SUBROUTINE WHICH DESCRIBES FLOW OF CONTROL B 0704-0907NUBAC
#SUCKER ROD PUMP DESIGN B 0650-09.6.007
OVARIANCE FOR NON-ORTH/D & STAT. DESIGN #ANALY OF VARIANCE OR C B 0650-06.0.059
ULTICOMPONENT DISTILLATION TOWER DESIGN CALCULATIONS #M B 1620-09.3.002
#AUTOMATIC MINIMUM WEIGHT DESIGN OF STEEL FRAMES B 0650-09.2.052
#ROAD DESIGN PROGRAM B 0650-09.2.029
#CONTINUOUS BEAM DESIGN PROGRAM B 0650-09.2.064
#DESIGN TEMPLATE PROGRAM B 0650-09.2.032
ANALYSIS OF TWO-LEVEL FACTORIAL DESIGNS #IBM 650 PROGRAM FOR B 0650-07.0.019
#CONTOUR CHART OF TRIP DESIRES B 0650-09.2.016
#CARD SYSTEMS ERROR DETECTION AIDS A 1401--AT-017
#ERROR DETECTION SUBROUTINE B 7090-1217NUTRA
INEAR INC. OF VEL. #LEAST SQ. DETER. FOR A VEL FUNCT. WITH L B 0650-09.6.016
R REFRACT. T/D DATA #LEAST SQ. DETER. OF VELOCITY FUNCTION FO B 0650-09.6.020
#SIMULTANEOUS REAL EQUATIONS, DETERMINANT B 0704-0116CLSME
EAL #DETERMINANT AND EIGENVECTOR, R B 0704-0223CLDET
R COMPLEX MATRIX. #DETERMINANT AND EIGENVECTOR FO B 0704-0116CLDET
R REAL MATRIX #DETERMINANT AND EIGENVECTOR FO B 0704-0116CLDET
#DETERMINANT EVALUATION B 0704-0110GLDEV
INE #DETERMINANT EVALUATING SUBROUT B 0704-0355GMDET
DOUBLE PRECISION DETERMINANT EVALUATION B 0704-0356CA002
T EXTRACTION #DETERMINANT EVALUATION AND ROO B 0704-0514NA029
SUBROUTINE. #DETERMINANT EVALUATOR FORTRAN B 0704-0635RWDET
LY TRIANGULAR MATRICES #DETERMINANT EVALUATOR FOR NEAR B 0704-0635RWDET
#DETERMINANT EXPANSION B 0704-0435MACEQ
#DETERMINANT EXPANSION B 0709-0991MACEQ
#EVALUATION OF DETERMINANTS B 1620-05.0.005
#GRID SYSTEM VOLUME DETERMINATION B 0650-09.6.009
FOR BENEDICT EQUATION OF STATE #DETERMINATION OF COEFFICIENTS B 0650-09.3.001
#EIGENVECTOR DETERMINATOR SUBROUTINE B 0704-0635RWVCT
A FITTED GAMMA DISTRIBUTION #DETERMINING PROBABILITIES FROM B 0650-06.0.040
#RANDOM NORMAL DEVIATE SUBROUTINE. B 0704-0550CSDEV
#RANDOM NORMAL DEVIATES B 0650-06.0.035
RANDOM NUMBERS AND RANDOM NORMAL DEVIATES GENERATOR # B 7070-11.7.001
#WELLBORE DEVIATION RECORD B 0650-09.6.001
#650 DIAGNOSTIC B 0650-01.6.052
#FORTRAN II DIAGNOSTICIAN B 1620-01.6.019
#PRINT BSS LOADER DIAGNOSTICS B 0704-0830MINOL
704-SAP FLOATING-PT. TRAP MATRIX DIAGONALIZATION # B 0704-0705MIHDI
#704-SAP-CODED MATRIX DIAGONALIZATION SUBROUTINE B 0704-0697MIHDI
#FLOW DIAGRAMMING FOR THE IBM 650 B 0650-12.0.003
OGRAM #DIATOMIC MOLECULAR INTEGRAL PR B 0704-0849MIDIA
#SAN DIEGO FREEWAY ASSIGNMENT B 0650-09.2.043
TTA/ #ORDINARY DIFF. EQUNS.SOLUTION /RUNGE-KU B 7090-1205NUDEQ
#DIFFERENTIATION AND PARTIAL DIFFER. OF RATIONAL FUNCT. B 0704-0445PEPAR
#DIVIDED DIFFERENCE INTERPOLATION B 0704-0116CLDDI
#DIVIDED DIFFERENCE TABLE FORMATION B 0704-0116CLDDT
#SIMULATES A DIGITAL DIFFERENTIAL ANALYZER TO SOLVE B 0704-0319GLDAS
LINEAR REGRESSION PROCEDURE WITH DIFFERENTIAL EQNS. #NON- B 0704-1119ERNLR
#TWO POINT BOUNDRY CONDITION DIFFERENTIAL EQU. SOLVER B 0704-0238ATTPI
NTER SUBROU FOR SOLU OF ORDINARY DIFFERENTIAL EQUATION #I B 0650-04.0.005
#SOLUTION OF N SIMULTANEOUS DIFFERENTIAL EQUATIONS B 0650-04.0.011
R N #NUMERICAL SOLUTION OF DIFFERENTIAL EQUATIONS OF ORDE B 0650-04.0.013
#RUNGE-KUTTA ROUTINE FOR SOLVING DIFFERENTIAL EQUATION ON 650 B 0650-07.0.005
#DIFFERENTIAL EQUATIONS ROUTINE B 0704-0248CLDEQ
SYSTEM #DIFFERENTIAL EQUATION SOLVING B 0704-0144PKNID
#SIMULTANEOUS PARTIAL DIFFERENTIAL EQUATIONS SOLVER B 0704-1043JPSRC
NE #SECOND ORDER DIFFERENTIAL EQUATION SUBROUTI B 0704-1073BCDIF
#DIFFERENTIAL EQUATIONS SOLVER B 0704-0825JPDLQ
#FORTRAN DIFFERENTIAL EQUATIONS B 0704-0451CLDEQ
#DIFFERENTIAL EQUATION B 0704-0762RFDOO
#FLOATING POINT ORDINARY DIFFERENTIAL EQUATIONS SYSTEM B 0704-0525PKNID
#FLOATING POINT ORDINARY DIFFERENTIAL EQUATIONS SYSTEM B 0704-0525PKNID
#ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS B 0704-0674RWSPA
#NUMERICAL SOLUTION OF LEGENDRES DIFFERENTIAL EQUATION B 1401-11.0.002
#ADMINT ADAMS INTEGRATION OF DIFFERENTIAL EQUATIONS B 7090-1131AS012
#DIFFERENTIAL FOURIER SYNTHESIS B 0650-08.4.002
YSIS #NUM SOLU OF ORDINARY DIFFERENTIAL W/AUTO ERROR ANAL B 0650-04.0.012
#SMOOTH AND DIFFERENTIATE DATA POINTS B 0704-0223CLSMD
DATA POINTS #SMOOTH AND DIFFERENTIATE UNEQUALLY SPACED B 0704-0331CLSMD
#LAGRANGIAN INTERPOLATION AND/OR DIFFERENTIATION B 0704-0762RFEOO
FFER. OF RATIONAL FUNCT. #DIFFERENTIATION AND PARTIAL DI B 0704-0445PEPAR
ON #DIFFERENTIATION OR INTERPOLATI B 7090-1235RWDIC
#SOLUTION OF HEAT DIFFUSION EQUATION B 0650-08.1.004
CAL GEO NUCLEAR-CODE # UNCLE 1 DIFFUSION EQUATION IN CYLINDRI B 0650-08.2.010
PACE NUCLEAR-CODE # UNCLE 11 DIFFUSION EQUATION IN ZX, Y= S B 0650-08.2.011
NSION NUCLEAR-CODE #UNCLE 3 DIFFUSION EQUATION IN ONE DIME B 0650-08.2.012
#FIRE NUCLEAR-CODE GROUP DIFFUSION ONE-DIMENSIONAL B 0704-NUCLEAR
#WANDA 2,3 NUCLEAR-CODE GROUP DIFFUSION ONE-DIMENSIONAL B 0704-NUCLEAR
#WANDA-4 NUCLEAR-CODE GROUP DIFFUSION ONE-DIMENSIONAL B 0704-NUCLEAR
#ZOOM NUCLEAR-CODE GROUP DIFFUSION ONE-DIMENSIONAL B 0704-NUCLEAR
#COGENT NUCLEAR-CODE GROUP DIFFUSION ONE-DIMENSIONAL B 0704-NUCLEAR
#FOG NUCLEAR-CODE GROUP DIFFUSION ONE-DIMENSIONAL B 7090-NUCLEAR
#AIM-6 NUCLEAR-CODE GROUP DIFFUSION ONE-DIMENSIONAL B 7090-NUCLEAR
#TKO NUCLEAR-CODE GROUP DIFFUSION THREE-DIMENSIONAL B 0704-NUCLEAR
#UFO NUCLEAR-CODE GROUP DIFFUSION THREE-DIMENSIONAL B 0704-NUCLEAR
#CURE NUCLEAR-CODE GROUP DIFFUSION TWO-DIMENSIONAL B 0704-NUCLEAR
#PDQ-2 NUCLEAR-CODE GROUP DIFFUSION TWO-DIMENSIONAL B 0704-NUCLEAR
#PDQ-3 NUCLEAR-CODE GROUP DIFFUSION TWO-DIMENSIONAL B 0704-NUCLEAR
#REM NUCLEAR-CODE GROUP DIFFUSION TWO-DIMENSIONAL B 0704-NUCLEAR
#PDQ2-90 NUCLEAR-CODE GROUP DIFFUSION TWO-DIMENSIONAL B 7090-NUCLEAR
#MODULUS 11 SELF-CHECKING DIGIT CALCULATOR B 7070-02.9.001
#EKACT-10 DIGIT CONVERSION B 0705-EK-002-0
UBROUTINE #A 6 DIGIT FLOATING POINT ARCSINE S B 0704-0649IBASN

TO SOLVE #SIMULATES A DIGITAL DIFFERENTIAL ANALYZER B 0704-0319GLDAS
OF POWER SYS NETWORK #IMPROVED DIGITAL SHORT CIRCUIT SOLUTION B 0650-09.4.004
ERRAIN DATA EDIT PROGRAM TD-1 #DIGITAL TERRAIN MODEL SYSTEM T B 0650-09.2.039
ORIZONTAL ALIGNMENT PROGRAMS #DIGITAL TERRAIN MODEL SYSTEM H B 0650-09.2.040
ERTICAL ALIGNMENT PROGRAMS #DIGITAL TERRAIN MODEL SYSTEM V B 0650-09.2.041
RELIMINARY EARTHWORK PROGRAM #DIGITAL TERRAIN MODEL SYSTEM P B 0650-09.2.042
INT POLY. INTERP. PROG. DA-2 1 #DIGITAL TERRAIN MODEL SYS 4 PO B 0650-09.2.062
ROFILE SMOOTHING PROGRAM DA-3 #DIGITAL TERRAIN MODEL SYSTEM P B 0650-09.2.063
ICLE 3 DIFFUSION EQUATION IN ONE DIMENSION NUCLEAR-CODE #U B 0650-08.2.012
NPUT SUBROUTINE #SINGLE DIMENSION SYMBOLIC FORTRAN II B 0704-0848ARINS
N TAPE #TO WRITE 2 DIMENSIONAL ARRAY BINARY INFO B 0704-0910NUWTB
R #MULTI-MATERIAL ONE DIMENSIONAL HEAT EQUATION SOLV B 0704-0652RWHF2
DURE. #THREE DIMENSIONAL LEAST SQUARES PROC B 0704-0533CF009
E # LIL ABNER A FEW-GROUP ONE DIMENSIONAL PROGRAM NUCLEAR-CO B 0650-08.2.007
#N DIMENSIONAL TABLE LOOK UP B 7090-1204MACUR
#THREE DIMENSIONAL TICK-TACK-TOE B 0650-11.0.002
#COLUMN BINARY DISASSEMBLY PROGRAM B 0704-0784GECDS
#ROW BINARY DISASSEMBLY PROGRAM B 0704-0784GERDS
#7300 DISC IOCS A 7070--IO-905
#IOCS 1405 DISK • SEE 1410-PR-108 • A 1410--IO-911
RT PRO. GENERAT. CARD/TAPE/1405 DISK • SEE 1410-PR-108 • #REP A 1410--RG-910
#DISK FILE PROTECTION A 1410--UT-117
#LOAD AND UNLOAD DISK FILE 1 A 0650--UT-103
#ZERO DISK FILE 1/CD&5/CD A 0650--UT-102
#LOAD 2 UNLOAD DISK FILE 2 A 0650--UT-104
#DISK UTILITIES A 1410--UT-107
E MATRIX TRANSPOSED ON ITSELF OR DISPLACED IN CORE #SQUAR B 0704-0661GDF02
COLUMN FRACTION CATHODE RAY TUBE DISPLAY #MURA SIX B 0704-0310MUSCP
GENERAL ALPHANUMERIC CATHODE RAY DISPLAY # B 0704-0314MUSCP
#FUNCTION DISPLAY PROGRAM. B 0704-0484MIFDP
#ANALYSIS OF COVARIANCE DISPROP. SUBCLASS NUMBERS B 0650-06.0.057
#ANALYSIS OF VARIANCE,DISPROP. SUBCLASS NUMBERS B 0650-06.0.058
NO. GENERATOR, MAXWELL-BOLTZMANN DIST. FT. PT. #RANDOM B 0704-0743ORMAX
#FITTING DATA TO TWO PARA. GAMMA DIST-SPEC REF RAINFALL DATA B 0650-06.0.051
#MULTICOMPONENT DISTILLATION PROGRAM. B 0704-1186IBDST
ULATIONS #MULTICOMPONENT DISTILLATION TOWER DESIGN CALC B 1620-09.3.002
ERS. #NORMALLY DISTRIBUTED PSEUDO-RANDOM NUMB B 0704-0578RWND2
ERS. #NORMALLY DISTRIBUTED PSEUDO-RANDOM NUMB B 0704-0578RWND2
#MOMENT DISTRIBUTION B 0650-09.2.005
#MOMENT DISTRIBUTION B 0650-09.2.009
UM ERROR ROUTINE FOR STEAM TABLE DISTRIBUTION #MINIM B 7090-1095WH058
ROBABILITIES FROM A FITTED GAMMA DISTRIBUTION #DETERMINING P B 0650-06.0.040
P-3 FLUX DISTRIBUTION NUCLEAR-CODE B 0650-08.2.014
E CALCULATION #MOMENT DISTRIBUTION AND INFLUENCE LIN B 0650-09.2.033
NUCLEAR-CODE # TEMPERATURE DISTRIBUTION IN FUEL ELEMENTS B 0650-08.2.026
A PIPE NETWORK #DISTRIBUTION OF WATER FLOW IN B 1620-09.7.001
#DISTRIBUTION PROGRAM GENERATOR B 0650-06.0.060
#OVERHEAD ELECTRICAL DISTRIBUTION SYSTEMS ANALYSIS B 0650-09.4.008
#FITTING OF THE GAMMA- DISTRIBUTION TO RAINFALL DATA B 0650-06.0.029
ANDOM NO. GENERATOR, EXPONENTIAL DISTRIBUTION. FT.PT. #R B 0704-0743OREXP
#RANDOM NO. GENERATOR, GAUSSIAN DISTRIBUTION. FT. PT. B 0704-0743ORGAU
RANDOM NUMBER GENERATOR, CAUCHY DISTRIBUTION. FT. PT. # B 0704-0743ORCAU
OD #FLUID FLOW DISTRIBUTION. HARDY CROSS METH B 0650-09.7.007
#NON-PARAMETRICAL TEST OF DISTRIBUTIONS. B 0704-0815PFTNP
#DIVERSITY STUDY B 1401-09.4.001
#DOUBLE PRECISION FLOATING DIVIDE B 0704-0223CLDPD
#DOUBLE PRECISION FLOATING DIVIDE B 7070-08.4.001
#OVERFLOW, UNDERFLOW, AND DIVIDE CHECK TEST B 0704-0248CLOUD
BINARY ARITH. #NORMALIZED DIVIDE-EXTENDED RANGE FLOATING B 0704-0370RS013
X ELEMENT BY ELEMENT MULTIPLY OR DIVIDE, REAL #MATRI B 0704-0273CLMMD
ON #DIVIDED DIFFERENCE INTERPOLATI B 0704-0116CLDDI
TION #DIVIDED DIFFERENCE TABLE FORMA B 0704-0116CLDDT
#DOUBLE PRECISION FLOATING POINT DIVISION B 0704-0650RWFDV
#PROGRAMMED DIVISION FOR THE RAMAC 305 A 0305--LM-005
S #TIME DOMAIN FILTERING OF SEISMOGRAM B 0650-09.6.021
DONATE NUCLEAR-CODE B 0650-08.2.005
NG POINT SOAP INTERPRETIVE ROU #DOPSIR DOUBLE PRECISION FLOATI B 0650-02.0.010
#VECTOR DOT PRODUCT B 0704-0223CLMVP
#NUMERICAL INTEGRATION OF THE DOUBLE INTEGRAL B 0650-07.0.010
#DOUBLE INTEGRATION SUBROUTINE B 0704-0368NA275
#DOUBLE INTERPOLATION B 0704-0355GMDTA
E #SINGLE OR DOUBLE INTERPOLATION SUBROUTIN B 0704-1129AQALL
RE-ROOT SUBROUTINE. #DOUBLE PREC. FLOATING PT. SQUA B 0704-0727IBSQD
ENTIAL SUBROUTINE #DOUBLE PREC. FLOATING PT EXPON B 0709-0839IBEXD
#ZEROS OF A POLYNOMIAL IN DOUBLE PRECISION B 0704-0766ANC20
#FLOATING POINT DOUBLE PRECISION ABSTRACTION B 0704-0110GLDPA
ED POINT/ #MURA DOUBLE PRECISION ADDITION /FIX B 0704-0256MUDPA
#MURA FLOATING POINT DOUBLE PRECISION ADDITION B 0704-0280MUDPA
SUBROUTINE. #DOUBLE PRECISION ARCSIN/ARCCOS B 0704-0538NOASD
NSTRUCTION #DOUBLE PRECISION ARC TANGENT I B 0704-0423BSATN
#FLOATING POINT DOUBLE PRECISION ARITHMETICS. B 0704-0417PFSDP
CKAGE #FORTRAN DOUBLE PRECISION ARITHMETIC PA B 7090-1122NRNPR
#PK CLAD & PK STOD - DOUBLE PRECISION CLEAR AND ADD B 0704-0525PKCLA
METIC PACKAGE. #DOUBLE PRECISION COMPLEX ARITH B 0704-0647NPDFC
ND FMP #DOUBLE PRECISION COMPLEX FAD A B 0704-0223CLDPC
FMP, AND FDP #DOUBLE PRECISION COMPLEX FAD, B 0704-0223CLDPC
VALUATION # DOUBLE PRECISION DETERMINANT E B 0704-0356CA002
NSTRUCTION #INTERPRETABLE DOUBLE PRECISION EXPONENTIAL I B 0704-0385BSEXP
T SOAP INTERPRETIVE ROU #DOPSIR DOUBLE PRECISION FLOATING POIN B 0650-02.0.010
T INTERPRETIVE SUBROUTINE #DOUBLE PRECISION FLOATING POIN B 0704-0385BSINT
T LOAD SUBROUTINE #DOUBLE PRECISION FLOATING POIN B 0704-0385BSCON
T PRINT SUBROUTINE #DOUBLE PRECISION FLOATING POIN B 0704-0385BSOUT
#DOUBLE PRECISION FLOATING ADD B 0704-0223CLDPA
DE #DOUBLE PRECISION FLOATING DIVI B 0704-0223CLDPD
T PRINT SUBROUTINE #DOUBLE PRECISION FLOATING POIN B 0704-0529BSOUT
T ADDITION #PARTIAL DOUBLE PRECISION FLOATING POIN B 0704-0650RWADD
T ADDITION #DOUBLE PRECISION FLOATING POIN B 0704-0650RWDPF
T DIVISION #DOUBLE PRECISION FLOATING POIN B 0704-0650RWFDV
T MULTIPLICATION #DOUBLE PRECISION FLOATING POIN B 0704-0650RWMUL
T CARD INPUT #DOUBLE PRECISION FLOATING POIN B 0704-0650RWRFA
T EXPONENTIAL SUBROUTINE #DOUBLE PRECISION FLOATING POIN B 0704-0806IBEXD
T EXPONENTIAL ROUTINE. #DOUBLE PRECISION FLOATING POIN B 0704-0931PKEXP
T ARCTANGENT SUBROUTINE #DOUBLE PRECISION FLOATING POIN B 0709-1148NODPA
DE #DOUBLE PRECISION FLOATING DIVI B 7070-08.4.001
IPLY #DOUBLE PRECISION FLOATING MULT B 7070-08.4.002
#DOUBLE PRECISION FLOATING ADD B 7070-08.4.003
#SINGLE PRECISION TO DOUBLE PRECISION FORTRAN INPUT B 0709-1201NRDIC
#DOUBLE PRECISION INPUT. B 0704-0577RWDPN
ION. #DOUBLE PRECISION INPUT CONVERS B 0704-0585CA006
#DOUBLE PRECISION INPUT SCALING B 0704-0334NA022
TRUCTION #INTERPRETABLE DOUBLE PRECISION LOGARITHM INS B 0704-0385BSLNX
ION #DOUBLE PRECISION MATRIX INVERS B 0650-05.2.009
ION #DOUBLE PRECISION MATRIX INVERS B 0704-0405PFIDP
LICATION. #DOUBLE PRECISION MATRIX MULTIP B 0704-0699AMDPM
ON AND SUBTRACTION. #DOUBLE PRECISION MATRIX ADDITI B 0704-0744AMDPA
MULTIPLICATION #DOUBLE PRECISION MATRIX SCALAR B 0704-0759AMDPS
LICATION #DOUBLE PRECISION MATRIX MULTIP B 7070-10.1.001
G #DOUBLE PRECISION OUTPUT SCALIN B 0704-0334NA022
#DOUBLE PRECISION OUTPUT. B 0704-0577RWDPT
RTRAN #DOUBLE PRECISION OUTPUT FOR FO B 0709-1202NRDOC

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OT EXTRACTION PROGRAM            #DOUBLE PRECISION POLYNOMIAL RO B 0709-1215AQE73
          #INTERPRETER FOR 650 DOUBLE PRECISION PROGRAMS.       B 0705-0583BEL1D
ILITY                            #DOUBLE PRECISION SIGN COMPATIB B 0704-0417PFCSF
REAL EQUATIONS,                # DOUBLE PRECISION SIMULTANEOUS  B 0704-0356CA001
EQUATION SOLVER                #LARGE DOUBLE PRECISION SIMULTANEOUS B 7090-1149AS012
NE                               #DOUBLE PRECISION SIN-COS ROUTI B 0704-0929OLDPS
NE                   #INTERPRETABLE DOUBLE PRECISION SINE AND COSI B 0704-0385BSS&C
NSTRUCTION           #INTERPRETABLE DOUBLE PRECISION SQUARE ROOT I B 0704-0385BSSQR
OUTINE                           #DOUBLE PRECISION SQUARE ROOT R B 7070-08.3.006
CKAGE 1.             # UNNORMALIZED DOUBLE-PRECISION ARITHMETIC PA B 0704-0614NUUDP
CKAGE 2.             # UNNORMALIZED DOUBLE-PRECISION ARITHMETIC PA B 0704-0614NUUDP
                 #FLOATING-POINT DOUBLE-PRECISION CUBE ROOT        B 0704-0525PKCBR
T ARITHMETIC PACKAGE             #DOUBLE-PRECISION FLOATING-POIN B 0704-0525PKDOU
T INTERPRETIVE PACKAGE.          #DOUBLE-PRECISION FLOATING-POIN B 0704-0525PKIND
T ARITHMETIC          #INTERPRETIVE DOUBLE-PRECISION FLOATING-POIN B 0704-0525PKINT
T PACKAGE                #FORTRAN II DOUBLE-PRECISION FLOATING-POIN B 0704-0807GDA01
RY MATRIX CONVERSION PROG        #DOUBLE-PRECISION FLOATING BINA B 0704-0329NYDFM
                 #FLOATING-POINT DOUBLE-PRECISION SQUARE ROOT      B 0704-0525PKSQR
       #LINEAR SYSTEM SOLUTION IN DOUBLE-PRECISION USING           B 0704-0543PFSLD
              #ESTIMATION FROM DOUBLY TRUNCATION SAMPLES           B 0704-0878BEMSD
                           #DRACO NUCLEAR-CODE BURNUP              B 0704-NUCLEAR
                 #STOP NUMBER DRUM AND IAS                         B 0650-01.6.027
111   #FL DEC INTERP SYS 650 MAG DRUM CALC W/IMMED ACCESS BELL    B 0650-02.0.021
CAL INTERPRETIVE SYS FOR IBM MAG DRUM CALCULATOR      #STATISTI B 0650-06.0.017
 BELL TRANS PROG FOR 650-653 MAG DRUM CONE STGE COMPU      #MOD B 0650-02.1.011
               #BINARY TAPE OR DRUM DUMP                           B 0704-0213NYBTD
                  #SELF-LOADING DRUM RESET PROGRAM                 B 0704-0376UAZDR
                        #READ WRITE DRUM.                          B 0704-0647NPRWD
          #DUMP STORAGE, CORE, DRUM, AND TAPES                     B 0704-0496CSDS2
          #DUMP STORAGE, CORE, DRUM, AND TAPES                     B 0704-0420CSDS1
SET AND CLEAR CORE AND N LOGICAL DRUMS                        # RE B 0704-0443LL024
ARD IMAGES FROM TAPE TO CORE AND DRUMS           #LOAD BINARY C B 0704-0395LL010
ROGRAM EW-1                      #DTM RECONNAISSANCE EARTHWORK P B 0650-09.2.072
AM EA-2                          #DTM-ZONE COST EVALUATION PROGR B 0650-09.2.086
                       #7070 DUAL PROGRAM PROCESSING SYSTEM B 7070-03.2.001
090, CHANNEL A                   #DUMMY FRONT END CARD FOR 709-7 B 7090-1123WPS02
                        #STORAGE DUMP                              B 0650-01.3.007
                #ON-LINE STORAGE DUMP                              B 0650-01.6.030
         #MURA FLOATING DECIMAL DUMP                               B 0704-0321MUFDD
           #BINARY TAPE OR DRUM DUMP                               B 0704-0213NYBTD
                   #MURA INTEGER DUMP                              B 0704-0251MUIND
                     #MURA OCTAL DUMP                              B 0704-0251MUOCD
                  #MURA FRACTION DUMP                              B 0704-0253MUFRD
               #MEMORY COMPARISON DUMP                             B 0704-0931PKCOM
      #     704 OCTAL-DECIMAL DUMP                                 B 0704-0932EOODD
                    #DECIMAL TAPE DUMP                             B 0704-0425WBPTD
                   #ON LINE OCTAL DUMP                             B 0704-0499CMOCD
TAL MNEMONIC FLOATING POINT CORE DUMP                         #OC B 0709-0633WDOMF
                     #BINARY TAPE DUMP                             B 1401-01.4.008
                      #POST MORTEM DUMP                            B 1620-01.5.004
                          #DYNAMIC DUMP                            B 1620-01.6.015
           #UNIVERSAL MEMORY DUMP AND CONDENSING ROUTINE           B 0650-01.6.028
650 * SOSF *                     #DUMP AND LOAD ROUTINE FOR IBM    B 0650-01.2.012
         #MULTIPLE PROGRAM DUMP AND LOADER                         B 0650-01.5.004
                  #MEMORY DUMP AND RELOAD ROUTINE                  B 0650-01.3.008
                    #TAPE DUMP FOR THE 709/OCTAL PRINT/            B 0709-0502RLTD9
                 #FORTRAN DUMP PROGRAM                             B 0704-0898NUDUM
TAPES                            #DUMP STORAGE, CORE, DRUM, AND    B 0704-0496CSDS2
TAPES                            #DUMP STORAGE, CORE, DRUM, AND    B 0704-0420CSDS1
#FN II FLOATING POINT OR INTEGER DUMP SUBROUTINE                   B 0704-0848ARDMP
                                 #DUMP 01                          B 1401-13.1.007
                 #TAPE DUPLICATE AND COMPARE                       B 0709-0887PPTDA
                 #TAPE DUPLICATION                                 B 0705-IB 0007
                 #TAPE DUPLICATION AND/OR COMPARE.                 B 0709-0717NA098
            #1401 TAPE DUPLICATION OR COMPARE                      B 1401-13.1.001
         #NUMERIC TAPE DUPLICATOR AND CORRECTOR                    A 1620--MI-016
                 #TAPE DUPLICATOR FOR THE 709                      B 0709-0502RLTS9
        #SELECTIVE FILE DUPLICATOR ROUTINE                         B 0709-0922AXSFD
      #TAPE EDITOR AND DUPLICATOR WITH COMPARE                     B 0704-0318GMTED
MMER                     #GMR DYANA DYNAMICS ANALYZER-PROGRA B 0704-0930GMDYA
AM                               #DYNAMIC ACCESS TO MEMORY PROGR B 0704-0395LL002
                                 #DYNAMIC DUMP                     B 1620-01.6.015
     #SIX DEGREE OF FREEDOM DYNAMIC TRAJECTORY PROGRAM             B 0704-0821LRSFD
                       #GMR DYANA DYNAMICS ANALYZER-PROGRAMMER     B 0704-0930GMDYA
MURA FIXED POINT LOGARITHM, BASE E                             # B 0704-0283MULOG
    #MURA EXPONENTIAL, BASE E                                      B 0704-0256MUEXP
                   #LOG 10 A, LN E A                               B 0650-03.1.013
             #FLOATING POINT E A, 10 A, SINH A, COSH A             B 0650-03.1.020
           #A FLOATING POINT E AT 10 AT SINH AT CO                 B 0650-03.1.020
 BINARY ARITH.     #NORMALIZED E TO X-EXTENDED RANGE FLOATING B 0704-0370RS013
DTM-ZONE COST EVALUATION PROGRAM EA-2                          # B 0650-09.2.086
                       #EARTHWORK DATA CHECK                       B 0650-09.2.044
                       #EARTHWORK LINE SHIFT                       B 0650-09.2.022
TERRAIN MODEL SYSTEM PRELIMINARY EARTHWORK PROGRAM     #DIGITAL B 0650-09.2.042
                       #GEORGIA EARTHWORK PROGRAM                  B 0650-09.2.055
          #DTM RECONNAISSANCE EARTHWORK PROGRAM EW-1               B 0650-09.2.072
SFER TRACING                     #EASTMAN KODAK CON. EDISON TRAN B 0705-EK 0003
TELY MAKING PROGRAMMING LANGUAGE EASY         #SYSTEM IMMEDIA B 0704-1096TVSMP
READ A CHRONO-LOG CLOCK VIA 716 ECHO ENTRY       #ROUTINES TO B 0704-0843ORCLK
ENG ELEC SYS PROG 18     #SELEC ECON. COND. SIZE-SPEC CASE NEW B 1620-09.4.004
             #FORECASTING BY ECONOMETRIC SYSTEMS                   B 0704-0963IB3FE
             #FORECASTING BY ECONOMETRIC SYSTEMS                   B 0704-0963IB4FE
             #FORECASTING BY ECONOMETRIC SYSTEMS                   B 0704-0963IB9FE
                       #ECONOMIC CONDUCTOR STUDY                   B 0650-09.4.009
ION BY KELVINS LAW           #ECONOMIC CONDUCTOR SIZE SELECT B 1620-09.4.005
     #SEASONAL ADJUSTMENT OF ECONOMIC TIME SERIES                  B 0650-06.0.041
        #EASTMAN KODAK CON. EDISON TRANSFER TRACING                B 0705-EK 0003
                           #TAPE EDIT                              B 1620-01.5.003
      #SPS TO FORTRAN SUBROUTINE EDIT                              B 1620-01.6.007
      #SPS TO FORTRAN SUBROUTINE EDIT * REVISION *                 B 1620-01.6.009
 SUBROUTINE ADDITIONS TO FORTRAN EDIT DECK                #OPEN B 0704-1081LROSR
              #PRE-ASSEMBLY EDIT FOR AUTOCODER III                 B 0705-SR-003-0
SOURCE LANG DEBUG        #OFFLINE EDIT FOR FORTRAN MONITOR WITH B 7090-1115GPFMS
ERRAIN MODEL SYSTEM TERRAIN DATA EDIT PROGRAM TD-1   #DIGITAL T B 0650-09.2.039
                          #IDA EDIT SUBROUTINE * CARD *            B 1620-01.6.005
                              #EDIT SUBROUTINE * CARD *            B 1620-01.6.011
                         #1620 EDIT SUBROUTINE *TAPE *             B 1620-01.6.010
      #709 SYMBOLIC TAPE EDITING PROGRAM                           B 0709-0995FDEDI
                  #650 FORTRAN EDITOR                              B 0650-01.6.053
                  #SQUOZE TAPE EDITOR                              B 0709-1000RSEDT
#RESTART PROGRAM FOR THE BINARY EDITOR /RL 0400/                   B 0709-1032RL041
PARE                           #TAPE EDITOR AND DUPLICATOR WITH COM B 0704-0318GMTED
                               #EDITOR AND TRANSLATOR              B 0704-0267PKEDI
 CODE SCRAP.             #INPUT EDITOR FOR MULTIPLE REGRESSION B 0704-0749SCIEM
90 COMPATIBILITY             #BI EDITOR FOR PROGRAMMED 704/709/ B 0709-1031RL040
                             #AN EDITOR FOR SAP SYMBOLIC DECKS. B 0704-0960MIEDS
NE                      #MURA EFFECTIVE ADDRESS SEARCH ROUTI B 0704-0253MUEAS
TING EVERYTHING *       #ESCAPE * EFFORTLESS SYS CALCUL AND PRIN B 1401-01.4.010
                        #EIGENVALUE COMPUTATION.                   B 0704-0405PFMVP
CES IN FLOATING POINT          #EIGENVALUE FOR SYMMETRIC MATRI B 0704-0260NA189
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HERMITIAN MATRIX.        #PRELIM. EIGENVALUE PROB. OF A COMPLEX   B 0704-0460MIMAU
                         #EIGENVALUE SOLUTION, REAL               B 0704-0647NPPMC
                         #EIGENVALUE SOLUTION, COMPLEX            B 0704-0248CLPMC
                         #EIGENVALUE SOLUTION, REAL               B 0704-0338CLPMC
                         #EIGENVALUE SUBROUTINE                   B 0704-0225GMEIG
RAM.                 #FORTRAN 2 EIGENVALUE-EIGENVECTOR SUBPROG B 0704-0592NUMLE
        #COMPLEX AND REAL EIGENVALUES                             B 0650-05.2.005
A MATRIX                 #TO OBTAIN EIGENVALUES & EIGENVECTORS OF  B 0650-05.2.025
F  NON-SYMMETRIC SQUARE MATRIX  #EIGENVALUES AND EIGENVECTORS O B 0650-05.2.018
F THE PRODUCT OF A AND X.       #EIGENVALUES AND EIGENVECTORS O B 0704-0652RWEG2
F A REAL SYMMETRIC MATRIX       #EIGENVALUES AND EIGENVECTORS O B 0704-0664ANF20
YMMETRIC MATRIX - FI            #EIGENVALUES AND EIGENVECTORS S B 0704-0474NUMXE
F REAL SYMMETRIC MATRICES       #EIGENVALUES AND EIGENVECTORS O B 0704-1029ANF20
F A HERMITIAN MATRIX.           #EIGENVALUES AND EIGENVECTORS O B 0704-0884PKHME
EAL, SYMMETRIC MATRIX.          #EIGENVALUES AND VECTORS OF A R B 0704-0460MIHDI
MATRICES BY THE JACOBI METHOD   #EIGENVALUES OF REAL SYMMETRIC  B 0650-05.1.006
                          #REAL EIGENVALUES OF REAL MATRICES      B 0704-0635RWEIG
MATRICES ON 1620 D/P SYSTEM     #EIGENVALUES OF REAL SYMMETRIC  B 1620-05.0.003
MATRICES ON THE 1620 D/P SYS    #EIGENVALUES OF REAL SYMMETRIC  B 1620-05.0.004
UTINE                           #EIGENVECTOR DETERMINATOR SUBRO B 0704-0635RWVCT
.               #DETERMINANT AND EIGENVECTOR FOR COMPLEX MATRIX B 0704-0116CLDET
                #DETERMINANT AND EIGENVECTOR FOR REAL MATRIX    B 0704-0116CLDET
                #DETERMINANT AND EIGENVECTOR, REAL              B 0704-0223CLDET
 SQUARE MATRIX  #EIGENVALUES AND EIGENVECTORS OF  NON-SYMMETRIC B 0650-05.2.018
TRIX.           #EIGENVALUES AND EIGENVECTORS OF A HERMITIAN MA B 0704-0884PKHME
      #TO OBTAIN EIGENVALUES & EIGENVECTORS OF A MATRIX           B 0650-05.2.025
IC MATRIX       #EIGENVALUES AND EIGENVECTORS OF A REAL SYMMETR B 0704-0664ANF20
 MATRICES       #EIGENVALUES AND EIGENVECTORS OF REAL SYMMETRIC B 0704-1029ANF20
 A AND X.       #EIGENVALUES AND EIGENVECTORS OF THE PRODUCT OF B 0704-0652RWEG2
- FI            #EIGENVALUES AND EIGENVECTORS SYMMETRIC MATRIX  B 0704-0474NUMXE
                                #EIGHT-PER-CARD LOADING ROUTINE B 0650-01.2.006
                                #EKACT-10 DIGIT CONVERSION        B 0705-EK-002-0
ON. COND. SIZE-SPEC CASE NEW ENG ELEC SYS PROG 18     #SELEC EC B 1620-09.4.004
ACT. OF RECIPROCATING COMP. WITH ELEC. COMP.  #CALC. PERF. CHAR B 0650-09.6.015
APE *                           #ELECTRIC LOAD FLOW PROGRAM * T B 1620-09.4.001
ARD *                           #ELECTRIC LOAD FLOW PROGRAM * C B 1620-09.4.003
RCUIT CURRENTS   #CALCULATION OF ELECTRIC POWER SYSTEM SHORT-CI B 0650-09.4.007
S ANALYSIS              #OVERHEAD ELECTRICAL DISTRIBUTION SYSTEM B 0650-09.4.008
ENT STABILITY CALCULATIONS      #ELECTRICAL POWER SYSTEM TRANSI B 0650-09.4.001
 DIVIDE, REAL            #MATRIX ELEMENT BY ELEMENT MULTIPLY OR B 0704-0273CLMMD
AL              #MATRIX ELEMENT BY ELEMENT MULTIPLY OR DIVIDE, RE B 0704-0273CLMMD
TEMPERATURE DISTRIBUTION IN FUEL ELEMENTS NUCLEAR-CODE       # B 0650-03.2.026
    #COMPUTATION OF BRIDGE SCREED ELEVATIONS                      B 0650-09.2.075
                     #SKEWED BRIDGE ELEVATIONS                    B 1620-09.2.005
    #MATRIX INVERSION BY GAUSSIAN ELIMINATION                     B 0650-05.2.002
D INCOMPLETE.                   #ELLIPTIC INTEGRAL, COMPLETE AN B 0704-0977ALELP
                                #ELLIPTIC INTEGRALS               B 0650-04.0.006
                    #INCOMPLETE ELLIPTIC INTEGRALS                B 0704-0225GMIEF
                 #MURA COMPLETE ELLIPTIC INTEGRALS                B 0704-0668MUCEI
T KIND                 #COMPLETE ELLIPTIC INTEGRALS OF THE FIRS B 0704-1070RMELF
EQUATIONS                       #ELLIPTIC PARTIAL DIFFERENTIAL    B 0704-0674RWSPA
                   #CIRCULAR AND ELLIPTICAL COVERAGE FUNCTION     B 7090-1182DVCIR
DECISION RULE FOR PRODUCTION AND EMPLOYMENT SCHEDULE   #LINEAR B 0650-10.3.001
                                #EN * X * SUBROUTINE              B 0650-07.0.008
 A                    #DUMMY FRONT END CARD FOR 709-7090, CHANNEL B 7090-1123WPS02
                          #FORTRAN END CARD SEARCH.               B 0704-0899MEFEN
KS          #LIQUID VOLUMES IN FLAT END HORIZONTAL CYLINDRICAL TAN B 0650-09.7.005
                                #END-OF FILE FUNCTION             B 0704-0575GIFIL
                                #END-OF-FILE SEARCH               B 0705-LH-007-0
R-CODE                  # NEUTRON ENERGY SPECTRA IN WATER NUCLEA B 0650-08.2.021
C ECON. COND. SIZE-SPEC CASE NEW ENG ELEC SYS PROG 18      #SELE B 1620-09.4.004
NIV OF HOUSTON ASSEMBLR FOR PROC.ENG. INTER CODING SYS     #U B 0650-02.0.017
              #ART I NUCLEAR-CODE ENGINEERING                     B 0704-NUCLEAR
           #ABRAC-01 NUCLEAR-CODE ENGINEERING                     B 0704-NUCLEAR
              #ATBAC NUCLEAR-CODE ENGINEERING                     B 0704-NUCLEAR
             #ART 04 NUCLEAR-CODE ENGINEERING                     B 0704-NUCLEAR
              #BINTO NUCLEAR-CODE ENGINEERING                     B 0704-NUCLEAR
              #F0020 NUCLEAR-CODE ENGINEERING                     B 0704-NUCLEAR
               #HEAT NUCLEAR-CODE ENGINEERING                     B 0704-NUCLEAR
       #PROP AND JET NUCLEAR-CODE ENGINEERING                     B 0704-NUCLEAR
          #SET CODES NUCLEAR-CODE ENGINEERING                     B 0704-NUCLEAR
             #TEMP-2 NUCLEAR-CODE ENGINEERING                     B 0704-NUCLEAR
             #TURF-6 NUCLEAR-CODE ENGINEERING                     B 0704-NUCLEAR
          #WB TSG-1 NUCLEAR-CODE ENGINEERING                      B 0704-NUCLEAR
              #PECAN NUCLEAR-CODE ENGINEERING                     B 0704-NUCLEAR
             #STDY-3 NUCLEAR-CODE ENGINEERING                     B 0704-NUCLEAR
            #AIMFIRE NUCLEAR-CODE ENGINEERING                     B 7090-NUCLEAR
                             #TEXAS ENGINEERING SUBROUTINES       B 0650-09.2.010
                          # ENSIGN CODE  NUCLEAR-CODE             B 0650-08.2.022
ERATURE OF SATURATED LIQUID FROM ENTHALPY                   #TEMP B 7090-1095WHTSH
SSED LIQUID                     #ENTHALPY AND ENTROPY OF COMPRE B 7090-1095WHHCL
ME OF SUPERHEATED STEAM         #ENTHALPY ENTROPY SPECIFIC VOLU B 7090-1095WHHSS
ME OF SATURATED VAPOR           #ENTHALPY ENTROPY SPECIFIC VOLU B 7090-1095WHHSV
                                #ENTHALPY OF SATURATED LIQUID     B 7090-1095WHHSL
SUPERHEAT OR WET REGIONS        #ENTHALPY OR ENTROPY IN LIQUID  B 7090-1095WHSSI
 WET REGIONS           #ENTHALPY OR ENTROPY IN LIQUID SUPERHEAT OR B 7090-1095WHSSI
               #ENTHALPY AND ENTROPY OF COMPRESSED LIQUID         B 7090-1095WHHCL
                                #ENTROPY OF SATURATED LIQUID      B 7090-1095WHSSL
ERHEATED STEAM          #ENTHALPY ENTROPY SPECIFIC VOLUME OF SUP B 7090-1095WHHSS
URATED VAPOR            #ENTHALPY ENTROPY SPECIFIC VOLUME OF SAT B 7090-1095WHHSV
 A CHRONO-LOG CLOCK VIA 716 ECHO ENTRY         #ROUTINES TO READ B 0704-0843ORCLK
E INTERPRETIVE ROUTINE          #ENTRY AND EXIT INSERTER FOR TH B 0704-0525PKINT
UNGE-KUTTA INTEGRAT. OF 2ND ORD. EQ.          #FLOAT. PT. MILNE, R B 0704-0450RWDE3
SION PROCEDURE WITH DIFFERENTIAL EQNS.     #NON-LINEAR REGRES B 0704-1119ERNLR
OR TRANS FROM REMING TO IBM DATA EQU *   #STRIDE * SUBROUTINE F B 1401-01.4.013
                                #EQU SOLV                         B 0650-05.2.020
ION OF SPECIAL FORM OF 2ND ORDER EQU.                   #INTEGRAT B 0704-0141LAS88
T BOUNDRY CONDITION DIFFERENTIAL EQU. SOLVER         #TWO POIN B 0704-0238ATTPI
SYS    #RELAXATION PROG LAPLACES EQUA IN CYLINDRICAL COORDINATE B 0650-04.0.008
     #AITKENS INTERPOLATION FOR N EQUAL INTERVALS                 B 0704-0122PKANI
T  #CURVE AND SURFACE FITTING ON EQUALLY FOR UNEQUALLY SPACED P B 0650-06.0.021
 SOLUTION OF SIMULTANEOUS LINEAR EQUAT    #MATRIX INVERSION AND B 0650-05.2.011
ES        #RELAXATION PROG LAPLACES EQUAT IN RECTANGULAR COORDINAT B 0650-04.0.007
ES        #RELAXATION PROG POISSONS EQUAT IN RECTANGULAR COORDINAT B 0650-04.0.009
     #SOLUTION OF HEAT DIFFUSION EQUATION                         B 0650-08.1.004
#SOLUTION OF  RADIAL SCHRODINGER EQUATION                         B 0704-1072NUSCH
IT SOLUTION OF THE GENERAL CUBIC EQUATION                  #EXPLIC B 0704-1028GC000
                #DIFFERENTIAL EQUATION                            B 0704-0762RFD00
#SOLUTION OF SIMULTANEOUS LINEAR EQUATION                         B 7070-10.4.001
LUTION OF LEGENDRES DIFFERENTIAL EQUATION              #NUMERICAL SO B 1401-11.0.002
OR SOLUTION OF ORDINARY DIFFERENTIAL EQUATION        #INTER SUBROU F B 0650-04.0.005
OF LAPLACE POISSON AND HEAT FLOW EQUATION  #NUMERICAL SOLUTION  B 0650-04.0.010
     #SOLUTION OF GENERAL MATRIX EQUATION AX - B.                 B 0704-0141LAS88
RITH.        #SOLUTION OF MATRIX EQUATION AX-B USING INTERVAL A B 0704-0880IBSME
RITH.        #SOLUTION OF MATRIX EQUATION AX-B USING INTERVAL A B 0704-0880IBSME
AR-CODE      # UNCLE 11 DIFFUSION EQUATION IN %X, Y¤ SPACE NUCLE B 0650-08.2.011
CLEAR-CODE   # UNCLE 1 DIFFUSION EQUATION IN CYLINDRICAL GEO NU B 0650-08.2.010
EAR-CODE     #UNCLE 3 DIFFUSION EQUATION IN ONE DIMENSION NUCL B 0650-08.2.012
IGROUP P3, THE NEUTRON TRANSPORT EQUATION NUCLEAR-CODE # A MULT B 0650-08.2.028
ION OF COEFFICIENTS FOR BENEDICT EQUATION OF STATE  #DETERMINAT B 0650-09.3.001
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ROUTINE FOR SOLVING DIFFERENTIAL EQUATION ON 650  #RUNGE-KUTTA  B 0650-07.0.005
                  #SIMULTANEOUS EQUATION PROGRAM * TAPE *       B 1620-05.0.001
                  #SIMULTANEOUS EQUATION SOLUTION * CARD *      B 1620-05.0.002
      #FN II SIMULTANEOUS LINEAR EQUATION SOLUTION SUBROUTINE   B 0704-0848ARNXN
                        #LINEAR EQUATION SOLVER                 B 0704-0742RWLE3
                 #LINEAR MATRIX EQUATION SOLVER                 B 0704-0635RWMAT
TI-MATERIAL ONE DIMENSIONAL HEAT EQUATION SOLVER           #MUL B 0704-0652RWHF2
GE DOUBLE PRECISION SIMULTANEOUS EQUATION SOLVER           #LAR B 7090-1149AS012
ES                      #LINEAR EQUATION SOLVER OF BAND MATRIC B 0709-0990RWLE4
                  #DIFFERENTIAL EQUATION SOLVING SYSTEM         B 0704-0144PKNID
      #SECOND ORDER DIFFERENTIAL EQUATION SUBROUTINE            B 0704-1073BCDIF
METHOD           #SOLUTION OF AN EQUATION WITH NEWTON-RAPHSONS  B 1401-11.0.001
#PRINCIPAL COMPONENTS PREDICTION EQUATION.                      B 0704-1168TVPCP
              #TIME SERIES TREND EQUATIONS                      B 0650-09.2.049
       #SOLUTION OF SIMULTANEOUS EQUATIONS                      B 0650-07.0.003
N OF N SIMULTANEOUS DIFFERENTIAL EQUATIONS             #SOLUTIO B 0650-04.0.011
#SOLUTION OF SIMULTANEOUS LINEAR EQUATIONS                      B 0650-05.1.002
  #SYMMETRIC SIMULTANEOUS LINEAR EQUATIONS                      B 0650-05.2.010
              #SIMULTANEOUS REAL EQUATIONS                      B 0704-0116CLSME
AST SQUARES SOL. OF SIMULTANEOUS EQUATIONS                  #LE B 0704-0116CLLSQ
    #MATRIX INVERSION AND LINEAR EQUATIONS                      B 0704-1030ANF40
NVERSION WITH SOLUTION OF LINEAR EQUATIONS           #MATRIX I B 0704-0664ANF40
  #ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS                      B 0704-0674RWSPA
           #FORTRAN DIFFERENTIAL EQUATIONS                      B 0704-0451CLDEC
AM FOR SOLVING SYSTEMS OF LINEAR EQUATIONS             #A PROGR B 1401-11.0.003
#SOLUTION OF SIMULTANEOUS LINEAR EQUATIONS                      B 1620-05.0.007
ATRIX INVERSION AND SIMULTANEOUS EQUATIONS              #7070 M B 7070-10.1.002
DAMS INTEGRATION OF DIFFERENTIAL EQUATIONS            #ADMINT A B 7090-1131AS012
F SYSTEMS OF SIMULTANEOUS LINEAR EQUATIONS          #SOLUTION O B 0650-05.2.021
                  #SIMULTANEOUS EQUATIONS COMPLEX               B 0704-0116CLSME
MERICAL SOLUTION OF DIFFERENTIAL EQUATIONS OF ORDER N       #NU B 0650-04.0.013
         #BENEDICT-WEBB-RUBIN EQUATIONS OF STATE.               B 0704-1187IBTEQ
                  #DIFFERENTIAL EQUATIONS ROUTINE               B 0704-0248CLDEQ
           #GENERAL SIMULTANEOUS EQUATIONS SOLUTION             B 0650-05.2.019
7090                    #LINEAR EQUATIONS SOLUTION  FAP CODED   B 7090-1206NULEQ
IMULTANEOUS PARTIAL DIFFERENTIAL EQUATIONS SOLVER            #S B 0704-1043JPSRC
                  #SIMULTANEOUS EQUATIONS SOLVER                B 0704-0962SQSIM
                  #DIFFERENTIAL EQUATIONS SOLVER                B 0704-0825JPDEQ
                  #SIMULTANEOUS EQUATIONS SUBROUTINE            B 0704-0355GMSIM
TING POINT ORDINARY DIFFERENTIAL EQUATIONS SYSTEM         #FLOA B 0704-0525PKNID
TING POINT ORDINARY DIFFERENTIAL EQUATIONS SYSTEM         #FLOA B 0704-0525PKNID
SLEP, SOLVES SIMULTANEOUS LINEAR EQUATIONS WITH PIVOTING      # B 7070-10.4.002
UBLE PRECISION SIMULTANEOUS REAL EQUATIONS,               #  DO B 0704-0356CA001
              #SIMULTANEOUS REAL EQUATIONS, DETERMINANT         B 0704-0116CLSME
                  #SIMULTANEOUS EQUATIONS, REAL                 B 0704-0223CLSME
                  #SIMULTANEOUS EQUATIONS, REAL                 B 0704-0223CLSME
        #NON-LINEAR SIMULTANEOUS EQUATIONS, REAL                B 0704-0273CLSME
        #NON-LINEAR SIMULTANEOUS EQUATIONS, REAL                B 0704-0273CLSME
TE A GIVEN VECTOR             #EQUATOR-ECLIPTIC ROTATION-ROTA B 0709-0953RWROB
                              #EQUATOR-ECLIPTIC ROTATION        B 0709-0954RWFOB
                              #EQUILIBRIUM FLASH CALCULATION    B 0650-09.6.003
ROTATE A GIVEN VECTOR X FROM THE EQUINOX OF                 #TO B 0709-0945RWREQ
             #SIMULATE PERIPHERAL EQUIPMENT                     A 0709--SI-071
        #1401 SCRAMBLE PERIPHERAL EQUIPMENT SIMULATOR           B 1401-13.3.001
                     #PERIPHERAL EQUIPMENT SYMBOLIC TRANSLATOR  B 0709-0961PPPES
                              #EQUIPOISE NUCLEAR-CODE           B 7090-NUCLEAR
E INFORMATION PROCESSING PACKAGE EQUIVALENCE          #VARIABL B 0704-0856CVVIP
            #650 FORTRAN SYMBOL EQUIVALENCE TABLE               B 0650-01.6.038
                #ORDINARY DIFF. EQUNS.SOLUTION /RUNGE-KUTTA/    B 7090-1205NUDEQ
BROUTINES                     #ERCO FLOATING DECIMAL POINT SU B 0650-02.0.009
                              #ERCO SPACE SAVER                 B 0650-02.0.007
                              #ERL GENERAL UTILITY PROGRAM      B 0650-01.6.035
    #INTEGRATION WITH CONTROLLED ERROR                          B 0704-1232AAICE
 OF ORDINARY DIFFERENTIAL W/AUTO ERROR ANALYSIS       #NUM SOLU B 0650-04.0.012
                             # ERROR CORRECTION CODE READER     B 0709-0938VGREC
                              #ERROR CORRECTION CODE WRITER     B 0709-0938VGWEC
                  #CARD SYSTEMS ERROR DETECTION AIDS            A 1401--AT-017
                              #ERROR DETECTION SUBROUTINE       B 7090-1217NUTRA
 INTERPRETIVE SUBROUTINE FOR THE ERROR FUNCTION             #AN B 0650-03.2.003
                              #ERROR FUNCTION                   B 0704-0897AAERF
                        #FORTRAN ERROR PACKAGE                  B 0704-0752GMEPA
         #LEAST MAXIMAL ABSOLUTE ERROR POLYNOMIAL FIT           B 0704-0500BSBFP
                              #ERROR PROCEDURE FOR FORTRAN II B 0704-0785GEGER
             #STER * SIMPLE TAPE ERROR ROUTINE *                B 1401-01.4.018
DISTRIBUTION            #MINIMUM ERROR ROUTINE FOR STEAM TABLE  B 7090-1095WH058
                          #FN II ERROR WALK-BACK SUBROUTINE     B 0704-0848ARFER
           #CONSTRUCT A TABLE OF ERRORS FOR PRINTING--ERTBL     B 0704-0391NOERT
                #PRINT TABLE OF ERRORS--PRETB                   B 0704-0391NOPRT
 AND PRINTING EVERYTHING *      #ESCAPE * EFFORTLESS SYS CALCUL B 1401-01.4.010
AM                              #ESSO STEPWISE REGRESSION PROGR B 0650-06.0.056
 ONLY LESS F. BACKER #LEAST COST EST. & SCHEDULING-SCHED. PHASE B 0650-10.3.005
* M. C. FRISHBERG    #LEAST COST EST.&SCHED. PHASE ONLY * LESS  B 0650-10.3.009
      #1401 LESS 4K * LEAST COST ESTIMATING AND SCHEDULING *    B 1401-10.3.001
401 LESS 8K,12K,16K * LEAST COST ESTIMATING AND SCHED *      #1 B 1401-10.3.002
LING PORTION *#LESS * LEAST COST ESTIMATING SCHEDULING * SCHEDU B 1620-10.3.002
PORTION#LESS * CARD * LEAST COST ESTIMATING SCHEDULING * SCHED  B 1620-10.3.003
       #1620 LESS * LEAST COST ESTIMATING&SCHEDULING * TAPE * B 1620-10.3.001
                      #NON-LINEAR ESTIMATION /PRINCETON-IBM/    B 0704-0687IBNL1
DIES               #MULTI-PURPOSE ESTIMATION FOR RELIABILITY STU B 0704-1058WLREL
ION SAMPLES                     #ESTIMATION FROM DOUBLY TRUNCAT B 0704-0878BEMSD
ARLO                            #EURIPUS-3 NUCLEAR-CODE MONTE C B 0704-NUCLEAR
ERV./                   #INTEGRAL EVAL., SIMPSONS RULE /EQU. INT B 0704-0116CLINT
RVALS/                  #INTEGRAL EVAL., TRAPEZ. RULE /EQU. INTE B 0704-0116CLINT
                                #EVALUATES A FOURIER SERIES.    B 0704-0788IBEFS
NCE                             #EVALUATING COMPRESSOR PERFORMA B 0650-09.5.005
                     #DETERMINANT EVALUATING SUBROUTINE         B 0704-0355GMDET
 #  DOUBLE PRECISION DETERMINANT EVALUATION                     B 0704-0356CA002
        #UNIVARIATE POLYNOMIAL EVALUATION                       B 0704-0375UAUPE
                     #DETERMINANT EVALUATION                    B 0704-0110GLDEV
FLOATING POINT DEFINITE INTEGRAL EVALUATION                   # B 0704-0624RWDL2
  #A GENERAL PROGRAM FOR SYSTEMS EVALUATION                     B 0704-1244ANC00
                     #DETERMINANT EVALUATION AND ROOT EXTRACTION B 0704-0514NA029
AMS        #UNIVARIATE POLYNOMIAL EVALUATION FOR FORTRAN I PROGR B 0704-0375UAUPE
                                #EVALUATION OF DETERMINANTS     B 1620-05.0.005
                    #DTM-ZONE COST EVALUATION PROGRAM EA-2      B 0650-09.2.086
     #FLOATING POINT POLYNOMIAL EVALUATION ROUTINE FOR 709      B 0709-0841RCPEV
                #GENERAL INTERGRAL EVALUATOR                    B 0704-0825JPINT
R MATRICES           #DETERMINANT EVALUATOR FOR NEARLY TRIANGULA B 0704-0635RWDET
                     #DETERMINANT EVALUATOR FORTRAN SUBROUTINE. B 0704-0635RWDET
FORTLESS SYS CALCUL AND PRINTING EVERYTHING *      #ESCAPE * EF B 1401-01.4.010
RECONNAISSANCE EARTHWORK PROGRAM EW-1                      #DTM B 0650-09.2.072
                        #101X AND EX                            B 7070-08.2.001
                   #SUBROUTINE LOG EX FOR THE 7070              B 7070-08.2.004
             #MATES * MASTER TAPE EXECUTARY PROGRAMS *          B 7070-03.4.003
 READING OF FORMAT STATEMENTS AT EXECUTION TIME.              # B 0704-0732PFMOD
                                #EXECUTIVE GAME * TAPE *        B 1620-11.0.004
                       #1401 TAPE EXECUTIVE PROGRAM             B 1401-01.4.015
     #MANAGEMENT DECISION MAKING EXERCISE                       B 7070-12.9.002
US                              #EXFIT NUCLEAR-CODE MISCELLANEO B 0704-NUCLEAR
TIVE ROUTINE            #ENTRY AND EXIT INSERTER FOR THE INTERPRE B 0704-0525PKINT
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                       #MATRIX EXPAND                           B 0704-0085CLMEX
UARE SYMMETRIC FORM.          #EXPAND TRIANGULAR MATRIX TO SQ B 0704-0460MIEXA
A FOURIER SERIES.             #EXPANDS THE REPRESENTATION OF  B 0704-0788IBERF
                   #POLYNOMIAL EXPANSION                        B 0704-0435MAPOL
                  #DETERMINANT EXPANSION                        B 0704-0435MACEQ
                  #DETERMINANT EXPANSION                        B 0709-0991MACEQ
   #CALCULATION OF PIPING SYSTEM EXPANSION STRESSES             B 0650-09.5.001
                   #POLYNOMIAL EXPANSION SUBROUTINE.            B 0704-0611AVPOL
AL CUBIC EQUATION             #EXPLICIT SOLUTION OF THE GENER B 0704-1028GC000
                #FLOATING POINT EXPONENTIAL                     A 0650--LM-008
                              #EXPONENTIAL                      B 0650-03.1.004
                              #EXPONENTIAL                      B 0650-03.1.005
                      #FLOATING EXPONENTIAL                     B 0704-0069LAS81
PT.       #RANDOM NO. GENERATOR, EXPONENTIAL DISTRIBUTION.  FT. B 0704-0743OREXP
 #INTERPRETABLE DOUBLE PRECISION EXPONENTIAL INSTRUCTION        B 0704-0385BSEXP
                              #EXPONENTIAL INTEGRAL             B 0704-0753NUEXP
                              #EXPONENTIAL INTEGRAL             B 0704-0753NUEXP
                              #EXPONENTIAL INTEGRAL.            B 7090-1228NOEI
              #TRIPLE PRECISION EXPONENTIAL ROUTINE             B 0704-0565CA004
#DOUBLE PRECISION FLOATING POINT EXPONENTIAL ROUTINE.           B 0704-0931PKEXP
                              #EXPONENTIAL SMOOTHING            B 1620-10.2.004
#DOUBLE PRECISION FLOATING POINT EXPONENTIAL SUBROUTINE         B 0704-0806IBEXD
                    #FIXED POINT EXPONENTIAL SUBROUTINE         B 0704-0510IBEXP
      #DOUBLE PREC. FLOATING PT EXPONENTIAL SUBROUTINE          B 0709-0839IBEXD
                              #EXPONENTIAL SUBROUTINE           B 7070-08.2.006
                              #EXPONENTIAL SUBROUTINE           B 7070-08.2.007
                #FLOATING POINT EXPONENTIAL.                    B 0704-1209RWEX2
                              #EXPONENTIAL/3/ROUTINE FOR NLLS B 0704-0837ORX3N
                         #MURA EXPONENTIAL, BASE E              B 0704-0256MUEXP
                         #MURA EXPONENTIAL, BASE 2              B 0704-0256MUEXP
                        #HASTY EXPONENTIAL, FLOATING POINT      B 0704-0630WBHEX
                              #EXPONENTIAL,FLOATING             B 0704-0224ASASO
                              #EXTENDED FORTRAN 2 BSS LOADER    B 0704-0902NULUC
TIC PACKAGE                   #EXTENDED RANGE COMPLEX ARITHME B 0704-0609CA034
 ARITH.          #NORMALIZED ADD  EXTENDED RANGE FLOATING BINARY B 0704-0370RS013
 ARITH.        #NORMALIZED MULT.  EXTENDED RANGE FLOATING BINARY B 0704-0370RS013
/.                      #ZEROS, EXTENDED RANGE POLYNOMIAL/ZERP B 0704-0565CA004
                              #EXTENDED TRANSFER FUNCTION       B 0704-0575GIGOT
LANGUAGE                      #EXTENTION OF FORTRAN 2 SOURCE    B 0704-0812GPFMG
#DETERMINANT EVALUATION AND ROOT EXTRACTION                     B 0704-0514NA029
               #POLYNOMIAL ROOT EXTRACTION * TIREX *            B 7070-09.1.001
DOUBLE PRECISION POLYNOMIAL ROOT EXTRACTION PROGRAM           # B 0709-1215AQE73
 OF ONE VARIABLE              #EXTREMUM OF UNIMODAL FUNCTIONS B 0704-0878BEMIM
   #COMPUTES A SPECIAL FUNCTION F OF THE INDICES.               B 0704-0788IBSPF
                           #THE F SYSTEM                        B 0704-0352GMFS1
CHEDULING-SCHED. PHASE ONLY LESS F. BACKER #LEAST COST EST. & S B 0650-10.3.005
                              #F/F AFP SUBROUTINE *CARD*        A 1620--LM-022
                              #F/F AFP SUBROUTINE *TAPE*        A 1620--LM-023
ONT TEST OPTIMIZING ROUT *    #FACTOR * FOURTEEN O ONE AUTO C B 1401-01.4.007
                              #FACTOR ANALYSIS                  B 0650-06.0.020
    #THE WHERRY-WINER METHOD OF FACTOR ANALYSIS                 B 0650-06.0.028
                              #FACTOR ANALYSIS                  B 0704-0521PFAF1
         #7070 - PRINCIPAL AXIS FACTOR ANALYSIS                 B 7070-11.3.005
D METHOD                      #FACTOR ANALYSIS BY THE CENTROI B 0650-05.1.008
 #PATERN QUARTIMAX ROTATION OF A FACTOR MATRIX                  B 0650-05.1.007
APHY         #A GENERAL STRUCTURE FACTOR PROGRAM FOR CRYSTALLOGR B 7070-07.5.001
            #NORMALIZED VARIMAX FACTOR ROTATION                 B 7070-11.3.008
NE                       #FN II FACTORIAL COMPUTATION SUBROUTI B 0704-0848ARTOR
ROGRAM FOR ANALYSIS OF TWO-LEVEL FACTORIAL DESIGNS   #IBM 650 P B 0650-07.0.019
              #FLOATING POINT N FACTORIAL SUBROUTINE            B 0704-0525PKFAK
                     #STRUCTURE FACTORS                         B 0650-08.4.001
#TRANSMISSION LOSSES AND PENALTY FACTORS                        B 1620-09.4.008
      #DOUBLE PRECISION COMPLEX FAD AND FMP                     B 0704-0223CLDPC
      #DOUBLE PRECISION COMPLEX FAD, FMP, AND FDP               B 0704-0223CLDPC
              #ANALYZING SYSTEM FAILURE DATA                    B 0704-1059WLFAI
BM 704                        #FAP ASSEMBLY PROGRAM FOR THE I B 0704-1193AFFAP
                              #FAP ASSEMBLY PROGRAM             B 0709-0949WDFAP
                              #FAP ASSEMBLY PROGRAM             B 0709-1033BEFAP
     #LINEAR EQUATIONS SOLUTION  FAP CODED 7090                 B 7090-1206NULEQ
                              #FARGO REPORT PROGRAM             A 1401--RG-045
D SYSTEM OF TESTING *         #FAST * FOURTEEN O ONE AUTOMATE B 1401-01.4.004
 PRECISION COMPLEX FAD, FMP, AND FDP                    #DOUBLE B 0704-0223CLDPC
RAM NUCLEAR-CODE   # LIL ABNER A FEW-GROUP ONE DIMENSIONAL PROG B 0650-08.2.007
 EIGENVECTORS SYMMETRIC MATRIX - FI           #EIGENVALUES AND B 0704-0474NUMXE
                 #BCD TO BINARY FIELD CONVERSION                B 0704-0387CEI32
                # A VARIABLE FIELD PERIPHERAL INPUT             B 0704-0209NOVNP
                     #VARIABLE FIELD SQUARE ROOT SUBROUTINE     B 1620-03.0.001
        #MOVE VARIABLE, GROUPED FIELDS                          B 0705-PG-010-0
                     #SELECTIVE FILE DUPLICATOR ROUTINE         B 0709-0922AXSFD
                        #END OF FILE FUNCTION                   B 0704-0575GIFIL
                           #BIG FILE GENERATOR * BFG *@         B 7070-04.3.001
                          #TAPE FILE GENERATOR FOR TESTING      A 7070--MI-084
CHES                  #SKIPS ONE FILE ON A DECIMAL TAPE AND PUN B 0704-1144NC014
                              #FILE ORGANIZATION ROUTINES       A 1401--UT-057
                          #DISK FILE PROTECTION                 A 1410--UT-117
   #SORT 54 MODIFICATION TO USE FILE SIZE                       B 0705-XE-002-0
            #PROGRAM AND DATA FILE SYSTEM                       B 1401-13.1.005
                              #FILE UTILITIES                   A 1401--UT-051
        #LOAD AND UNLOAD DISK FILE 1                            A 0650--UT-103
                   #ZERO DISK FILE 1/CD&5/CD                    A 0650--UT-102
           #LOAD 2 UNLOAD DISK FILE 2                           A 0650--UT-104
   #BACKSPACE FILE,FORWARD SPACE FILE.                          B 0704-1003GNBSP
                      #BACKSPACE FILE,FORWARD SPACE FILE.       B 0704-1003GNBSP
                         #CUT AND FILL                          B 0650-09.2.004
                     #OHIO CUT AND FILL                         B 0650-09.2.030
                         #CUT AND FILL * CARD *                 B 1620-09.2.003
                         #CUT AND FILL * TAPE *                 B 1620-09.2.002
                         #CUT AND FILL PROGRAM                  B 0650-09.2.002
IONS ON THE 305 RAMAC      #CUT & FILL-EARTHWORD VOLUME CALCULAT B 0305-09.2.001
                   #TIME DOMAIN FILTERING OF SEISMOGRAMS         B 0650-09.6.021
                           #MATH FIN                            B 0650-07.0.007
                     #READS THE FINAL SORTED BIBLIOGRAPHY TAPE B 0704-1144NC014
                     #READS THE FINAL SORTED TAPE FROM NC 139   B 0704-1144NC014
                  #GENERAL ROOT FINDER FORTRAN SUBROUTINE       B 0704-0635RWGRT
               #POLYNOMIAL ROOT FINDER ROUTINES                 B 7090-1124MLHPR
                  #TAPE PROGRAM FINDER,WRITER,AND SALVAGE       B 0650-01.5.011
            #NEWTONS METHOD FOR FINDING ROOTS OF POLYNOMIALS    B 0704-0110GLROP
                           #ROOT FINDING SUBROUTINE             B 0650-07.0.004
AX POLYNOMIAL APPROXIMATION ON A FINITE POINT SET        #MINIM B 0650-06.0.043
RD IMAGE READ ROUTINE /CSH/S FOR FINPS 704          #FORTRAN CA B 0704-0820RWCSH
RD IMAGE READ ROUTINE /CSH/S FOR FINPS 709          #FORTRAN CA B 0709-0820RWCSH
ION ONE-DIMENSIONAL           #FIRE NUCLEAR-CODE GROUP DIFFUS B 0704-NUCLEAR
 REGISTER SIMULATOR WITH TRACE * FIRS#FLOATING PT. AND INDEXING B 0650-01.6.050
                              #FIRSIR                           B 0650-01.6.049
MPLETE ELLIPTIC INTEGRALS OF THE FIRST KIND                 #CO B 0704-1070RMELF
      #BESSEL FUNCTIONS OF THE FIRST KIND FOR NLLS.             B 0704-0837ORBFN
            #KWIC SORT PROGRAM FIRST PART                       B 0704-0914NCKSP
SE                  #VIPP SORTER. FIRST PHASE OF A GENERAL PURPO B 0704-0926TAVIP
#RANDOM NO. GEN., NERENSON-ROSEN FISSION SPECTRUM. FT.PT        B 0704-0743ORFIS
                           #SINH FIT                            B 0650-06.0.012
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         #LEAST SQUARES POLYNOMIAL FIT                                  B 0704-0116CLLSQ
                  #SPLINE CURVE FIT                                     B 0704-0483NA029
AXIMAL ABSOLUTE ERROR POLYNOMIAL FIT                         #LEAST M B 0704-0500BSBFP
LEAST SQUARE LEGENDRE POLYNOMIAL FIT                         #ARGONNE B 0704-0424ANE20
              #POLYNOMIAL CURVE FIT                                     B 1620-07.0.004
                   #POLYNOMIAL FIT                                      B 7090-1242S1PYF
     #LEAST SQUARE POLYNOMIAL FIT /FORTRAN II/                          B 0704-0772ANE20
        #POLYNOMIAL OF BEST FIT BY LEAST SQUARES METHOD                 B 0650-06.0.006
        #POLLY-POLYNOMIAL FIT BY LEAST SQUARES                          B 0650-06.0.010
TPUT TAPE CONTROL SYSTEM *       #FITS * FOURTEEN 0 ONE INPUT-OU B 1401-01.4.011
DETERMINING PROBABILITIES FROM A FITTED GAMMA DISTRIBUTION      # B 0650-06.0.040
     #ORTHOGONAL POLYNOMIAL CURVE FITTER                                B 0650-06.0.039
 SQUARES RATIONAL FUNCTION CURVE FITTING                       #LEAST B 0704-0859GSL16
R SERIES RATIONAL FUNCTION CURVE FITTING                       #TAYLO B 7090-1150RLRAT
           #POLYNOMIAL CURVE FITTING * CARD *                           B 1620-07.0.002
           #POLYNOMIAL CURVE FITTING * TAPE *                           B 1620-07.0.001
      #CONTINUED FRACTIONS CURVE FITTING AND INTERPOLATION              B 0704-0858GS541
A DIST-SPEC REF RAINFALL DATA    #FITTING DATA TO TWO PARA. GAMM B 0650-06.0.051
                  #LQC SURFACE FITTING FOR BASIC 650                    B 0650-08.3.001
TION TO RAINFALL DATA            #FITTING OF THE GAMMA- DISTRIBU B 0650-06.0.029
LY SPACED PT  #CURVE AND SURFACE FITTING ON EQUALLY FOR UNEQUAL B 0650-06.0.021
        #A GENERAL LEAST SQUARES FITTING PROCEDURE                      B 0704-1076ANE20
     #GENERAL LEAST SQUARE CURVE FITTING ROUTINE                        B 0704-0775RWGLS
  #LEAST SQUARES POLYNOMIAL CURVE FITTING ROUTINE                       B 0705-A0-003-0
     #GENERAL LEAST SQUARE CURVE FITTING ROUTINE.                       B 0704-0742RWLS3
 GENERAL POLYNOMIAL              #FITTING TO SELECTED TERMS OF A B 0704-1077GC000
MIALS     #LEAST SQUARES CURVE FITTING WITH ORTHOGONAL POLYNO B 0650-06.0.023
D METHOD                  #CURVE FITTING- SIMULATED PLANT RECOR B 1620-09.4.009
                                 #FIVE LAND SURVEYING PROGRAMS      B 0650-09.6.012
NE                               #FIVE-PER-CARD CONDENSING ROUTI B 0650-01.6.007
NE                               #FIVE-PER-CARD CONDENSING ROUTI B 0650-01.6.022
                                 #FIVE-PER-CARD LOADING ROUTINE     B 0650-01.2.003
                         #1620 FIX POINT SQUARE ROOT                    B 1620-07.0.003
     #INT OP 4 CONV OF NO FROM FIX PT REPRE TO FLT PT REPRE             B 0650-01.6.017
                                 #FIX SUBROUTINE                        B 1620-01.6.013
D INPUT'                         #FIXED AND FLOATING DECIMAL CAR B 0704-0325RS014
 TO CONVERT NO. FROM FLOATING TO FIXED DECIMAL   #FIXER, A SUB. B 7070-08.9.002
                       #VARIABLE FIXED FORMAT CARD READ                 B 0704-0381ASAS5
     #RANDOM NUMBER GENERATOR,  FIXED POINT                             B 0704-0743ORFXR
   #MURA MATRIX ADD OR SUBTRACT,  FIXED POINT                           B 0704-0432MUMAS
INE FOR 7070 * FLOATING POINT TO FIXED POINT *          #SUBROUT B 7070-02.4.003
                           #MURA FIXED POINT ARCTANGENT ROUTINE B 0704-0263MUATN
                           #MURA FIXED POINT CUBE ROOT                  B 0704-0314MUCRT
        #FLOATING POINT & FIXED POINT DECIMAL INPUT.                    B 0704-0370RS014
TINE                             #FIXED POINT EXPONENTIAL SUBROU B 0704-0510IBEXP
TS                               #FIXED POINT FOURIER COEFFICIEN B 0704-0250NYFSC
                       #MURA FIXED POINT LOGARITHM, BASE 2.  B 0704-0357MULOG
                       #MURA FIXED POINT LOGARITHM, BASE 2   B 0704-0280MULOG
                       #MURA FIXED POINT LOGARITHM, BASE E   B 0704-0283MULOG
                            #FIXED POINT LOGARITHM                      B 0704-0466RL017
ATURE                        #NCI2 FIXED POINT NEWTON-COTES QUADR B 0704-0357MUNCI
ER GENERATOR                    # FIXED POINT PSEUDO RANDOM NUMB B 0704-0373BSRN
                       #MURA FIXED POINT RUNGE-KUTTA                    B 0704-0280MURKY
                       #MURA FIXED POINT RUNGE-KUTTA                    B 0704-0891MURKY
                       #MURA FIXED POINT SINE                           B 0704-0280MUSIN
                       #MURA FIXED POINT SINE                           B 0704-0280MUSIN
E                      #MURA FIXED POINT SQUARE ROOT ROUTIN B 0704-0263MUSQR
E                      #MURA FIXED POINT SQUARE ROOT ROUTIN B 0704-0283MUSQR
ED * SUBROUTINE                 #FIXED POINT SQUARE ROOT * CLOS B 1620-03.0.002
                   #NTH ROOT FIXED POINT SUBROUTINE                     A 0650--LM-007
*        #SUBROUTINE FOR 7070 * FIXED POINT TO FLOATING POINT B 7070-02.4.003
BER GENERATOR,  AZIMUTHAL ANGLE. FIXED POINT.       #RANDOM NUM B 0704-0743ORAZI
OATER-A SUB. TO CONVERT NO. FROM FIXED TO FLOATING DECIMAL  #FL B 7070-08.9.001
ROM FLOATING TO FIXED DECIMAL   #FIXER, A SUB. TO CONVERT NO. F B 7070-08.9.002
 CALC W/IMMED ACCESS BELL 111    #FL DEC INTERP SYS 650 MAG DRUM B 0650-02.0.021
 SYMBOLIC SUBROUTINE LOADER WITH FL.PT.OFL.        #FN II BINARY B 0704-0848ARBSS
RD *   #S-100 STRESS ANALYSIS OF A FLANGE WITH A TAPERED HUB * CA B 1620-09.7.004
    #S-109 STRESS ANALYSIS OF A FLANGED TAPERED HUB * CARD *    B 1620-09.7.005
                       #EQUILIBRIUM FLASH CALCULATION                   B 0650-09.6.003
L TANKS       #LIQUID VOLUMES IN FLAT END HORIZONTAL CYLINDRICA B 0650-09.7.005
                                 #FLATRAN                               B 0650-02.1.009
                                 #FLEER NUCLEAR-CODE                    B 0704-NUCLEAR
IBLE OPERATION ROUTINE           #FLICOR FLOATING INTERP. COMPAT B 0650-02.0.020
                                 #FLIP NUCLEAR-CODE TRANSPORT           B 0704-NUCLEAR
                                 #FLOAT A FRACTION                      B 0704-0743ORFLO
POINT HARDWARE SIMULATOR.    #AB FLOAT SIM-ABREVIATED FLOATING  B 7070-05.2.001
                                 #FLOAT SUBROUTINE                      B 1620-01.6.012
INTEGRAT. OF 2ND ORD. EQ.        #FLOAT. PT. MILNE, RUNGE-KUTTA  B 0704-0450RWDE3
FROM FIXED TO FLOATING DECIMAL  #FLOATER-A SUB. TO CONVERT NO.  B 7070-08.9.001
      #HYPERBOLIC SINE-COSINE, FLOATING                                 B 0704-0224ASAS3
                    #EXPONENTIAL,FLOATING                               B 0704-0224ASAS0
         #SINE AND COSINE, FLOATING                                     B 0704-0577RWSC5
POWER SPECTRAL DENSITY FUNCTION, FLOATING                            # B 0704-0577RWPS2
S-CORRELATION FUNCTION GENERATOR,FLOATING           #AUTO- AND CROS B 0704-0577RWAC2
704 FORTRAN SAP CODED.          #FLOATING  POINT TRAP ROUTINE   B 0704-1071NUEFM
         #DOUBLE PRECISION FLOATING ADD                                 B 0704-0223CLDPA
         #DOUBLE PRECISION FLOATING ADD                                 B 7070-08.4.003
 #NORMALIZED ADD  EXTENDED RANGE FLOATING BINARY ARITH.                 B 0704-0370RS013
NORMALIZED MULT.  EXTENDED RANGE FLOATING BINARY ARITH.               # B 0704-0370RS013
NORMALIZED DIVIDE-EXTENDED RANGE FLOATING BINARY ARITH.               # B 0704-0370RS013
NORMALIZED ARCTAN-EXTENDED RANGE FLOATING BINARY ARITH.               # B 0704-0370RS013
  #NORMALIZED LOG-EXTENDED RANGE FLOATING BINARY ARITH.                 B 0704-0370RS013
NORMALIZED E TO X-EXTENDED RANGE FLOATING BINARY ARITH.               # B 0704-0370RS013
ORMALIZED SQ.ROOT-EXTENDED RANGE FLOATING BINARY ARITH           #N B 0704-0370RS013
   #DECIMAL PRINT-EXTENDED RANGE FLOATING BINARY ARITH.                 B 0704-0370RS013
ION PROG     #DOUBLE-PRECISION FLOATING BINARY MATRIX CONVERS B 0704-0329NYDFM
UB. TO CONVERT NO. FROM FIXED TO FLOATING DECIMAL  #FLOATER-A S B 7070-08.9.001
                     #FIXED AND FLOATING DECIMAL CARD INPUT             B 0704-0325RS014
                          #MURA FLOATING DECIMAL DUMP                   B 0704-0321MUFDD
INES                             #ERCO FLOATING DECIMAL POINT SUBROUT B 0650-02.0.009
              #INTERPRETIVE FLOATING DECIMAL ROUTINE                    B 0650-01.6.020
                     #MURA READ FLOATING DECIMAL ROUTINE                B 0704-0283MURFD
         #DOUBLE PRECISION FLOATING DIVIDE                              B 0704-0223CLDPD
         #DOUBLE PRECISION FLOATING DIVIDE                              B 7070-08.4.001
                                 #FLOATING EXPONENTIAL                  B 0704-0069LAS81
ERATION ROUTINE           #FLICOR FLOATING INTERP. COMPATIBLE OP B 0650-02.0.020
         #DOUBLE PRECISION FLOATING MULTIPLY                            B 7070-08.4.002
                                 #FLOATING NATURAL LOGARITHM            B 0704-0069LAS82
NVALUE FOR SYMMETRIC MATRICES IN FLOATING POINT           #EIGE B 0704-0260NA189
              #HASTY EXPONENTIAL, FLOATING POINT                        B 0704-0630WBHEX
          #SQUARE ROOT, FLOATING POINT                                  B 0704-0641CSSQT
RCH                              #FLOATING POINT  UNIVARIATE SEA B 0704-0692JPTAR
ECIMAL INPUT.                    #FLOATING POINT & FIXED POINT D B 0704-0370RS014
SCIENTIFIC 1401 PROGRAMMING WITH FLOATING POINT *     #SCION * B 1401-03.0.002
OUTINE FOR 7070 * FIXED POINT TO FLOATING POINT *       #SUBR B 7070-02.4.003
BABILITY INTEGRAL                #FLOATING POINT /N/ VARIATE PRO B 0704-0794RWNP3
RUNGE-KUTTA INTEGRATION          #FLOATING POINT ADAMS-MOULTON,  B 0704-0450RWDE2
     #PARTIAL DOUBLE PRECISION FLOATING POINT ADDITION              B 0704-0650RWADD
         #DOUBLE PRECISION FLOATING POINT ADDITION                      B 0704-0650RWDPF
UTINE                            #FLOATING POINT ARCCOSINE SUBRO B 0709-0507IBACS
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INE                    #A 6 DIGIT FLOATING POINT ARCSINE SUBROUT B 0704-0649IBASN
                                 #FLOATING POINT ARCTANGENT             A 0650--LM-005
OUTINE        #DOUBLE PRECISION FLOATING POINT ARCTANGENT SUBR B 0709-1148NODPA
H                                #FLOATING POINT BIVARIATE SEARC B 0704-0692JPWEI
         #DOUBLE PRECISION FLOATING POINT CARD INPUT                    B 0704-0650RWREA
TIC ABSTRACTION                  #FLOATING POINT COMPLEX ARITHME B 0704-0715RWCA2
TICS.                            #FLOATING POINT COMPLEX ARITHME B 0704-0417PFSAC
              #OCTAL MNEMONIC FLOATING POINT CORE DUMP                  B 0709-0633WDOMF
                         #MURA FLOATING POINT CUBE ROOT.                B 0704-0280MUCRT
AL EVALUATION                    #FLOATING POINT DEFINITE INTEGR B 0704-0624RWDL2
         #DOUBLE PRECISION FLOATING POINT DIVISION                      B 0704-0650RWFDV
N ARITHMETICS.                   #FLOATING POINT DOUBLE PRECISIO B 0704-0417PFSDP
N ADDITION                  #MURA FLOATING POINT DOUBLE PRECISIO B 0704-0280MUDPA
N ABSTRACTION                    #FLOATING POINT DOUBLE PRECISIO B 0704-0110GLDPA
A, COSH A                        #FLOATING POINT E A, 10 A, SINH B 0650-03.1.020
AT CO                          #A FLOATING POINT E AT 10 AT SINH B 0650-03.1.020
                                 #FLOATING POINT EXPONENTIAL            A 0650--LM-008
ROUTINE       #DOUBLE PRECISION FLOATING POINT EXPONENTIAL SUB B 0704-0806IBEXD
TINE.         #DOUBLE PRECISION FLOATING POINT EXPONENTIAL ROU B 0704-0931PKEXP
                                 #FLOATING POINT EXPONENTIAL.           B 0704-1209RWEX2
 RUNGE-KUTTA INTEGRATION         #FLOATING POINT GILL METHOD FOR B 0704-0491RWDE4
TOR.    #AB FLOAT SIM-ABREVIATED FLOATING POINT HARDWARE SIMULA B 7070-05.2.001
BROUTINE      #DOUBLE PRECISION FLOATING POINT INTERPRETIVE SU B 0704-0385BSINT
              #DOUBLE PRECISION FLOATING POINT LOAD SUBROUTINE B 0704-0385BSCON
                                 #FLOATING POINT LOG AND LN A       B 0650-03.1.019
              #DOUBLE PRECISION FLOATING POINT MULTIPLICATION       B 0704-0650RWMUL
ROUTINE                          #FLOATING POINT N FACTORIAL SUB B 0704-0525PKFAK
HM                               #FLOATING POINT NATURAL LOGARIT B 0709-0507IBLOG
HM OF NORMALIZED                 #FLOATING POINT NATURAL LOGARIT B 0709-0665IBLG3
TINE                             #FLOATING POINT NTH ROOT SUBROU B 0704-0525PKNOO
RATION SUBROUTINE                #FLOATING POINT NUMERICAL INTEG B 0704-0525PKLAQ
RATION SUBROUTINE                #FLOATING POINT NUMERICAL INTEG B 0704-0525PKLEQ
KUTTA                            #FLOATING POINT OPTIMIZED RUNGE B 0704-1147ECRKO
-KUTTA INTEGRATION.              #FLOATING POINT OPTIMIZED RUNGE B 0709-1170ATRKS
 SUBROUTINE                #FN II FLOATING POINT OR INTEGER DUMP B 0704-0848ARDMP
ENTIAL EQUATIONS SYSTEM          #FLOATING POINT ORDINARY DIFFER B 0704-0525PKNID
ENTIAL EQUATIONS SYSTEM          #FLOATING POINT ORDINARY DIFFER B 0704-0525PKNIU
 IBM 650        #A MODIFIED SOAP FLOATING POINT PACKAGE FOR THE B 0650-01.1.009
UATION ROUTINE FOR 709           #FLOATING POINT POLYNOMIAL EVAL B 0709-0841RCPEV
E             #DOUBLE PRECISION FLOATING POINT PRINT SUBROUTIN B 0704-0529BSOUT
E             #DOUBLE PRECISION FLOATING POINT PRINT SUBROUTIN B 0704-0385BSOUT
                         #MURA FLOATING POINT RUNGE-KUTTA               B 0704-0314MURKY
EGRATION.                #FORTRAN FLOATING POINT RUNGE-KUTTA INT B 0709-1171ATRKS
NE A                             #FLOATING POINT SINE A AND COSI A 0650--LM-004
VE ROU  #DOPSIR DOUBLE PRECISION FLOATING POINT SOAP INTERPRETI B 0650-02.0.010
ROUTINE                          #FLOATING POINT SQUARE ROOT SUB B 0650-07.0.011
ROUTINE                          #FLOATING POINT SQUARE ROOT SUB A 0650--LM-010
ROUTINE                          #FLOATING POINT SQUARE ROOT SUB B 0709-0619IBSQR
THE IBM RAMAC 305                #FLOATING POINT SUBROUTINE FOR  A 0305--LM-006
                     #NTH ROOT FLOATING POINT SUBROUTINE                A 0650--LM-009
NATURAL LOGARITHM FOR            #FLOATING POINT SUBROUTINE FOR  B 0704-0525PKLGA
MALIZED                          #FLOATING POINT SUBROUTINES NOR B 1401-03.0.004
*         #SUBROUTINE FOR 7070 * FLOATING POINT TO FIXED POINT  B 7070-02.4.002
                                 #FLOATING POINT TRAP ROUTINE       B 0704-0462SCFPT
                                 #FLOATING POINT TRAP ROUTINE       B 0704-0652RWFT2
                #SQUARE ROOT, FLOATING POINT 709 ONLY                   B 0709-0485MISRT
                #SQUARE ROOT, FLOATING POINT.                           B 0704-0653CSSQT
      #RANDOM NUMBER GENERATOR, FLOATING POINT.                         B 0704-0743ORFLR
 NUMBER GENERATOR,  POLAR ANGLE. FLOATING POINT.           #RANDOM B 0704-0743ORPOL
     #HYPERBOLIC SINE AND COSINE,FLOATING POINT.                        B 0704-0417PFCSH
MULTANEOUS MULTIPLE INTEGRATION, FLOATING POINT.              #SI B 0704-0240NOSIG
ATION          #ARCSINE, ARCOSINE FLOATING POINT--QUADRANT ALLOC B 0704-0825JPASN
ATION              #ARCTANGENT, FLOATING POINT--QUADRANT ALLOC B 0704-0825JPATN
TINE              #DOUBLE PREC. FLOATING PT EXPONENTIAL SUBROU B 0709-0839IBEXD
STER SIMULATOR WITH TRACE * FIRS#FLOATING PT. AND INDEXING REGI B 0650-01.6.050
 RUNGE-KUTTA INTEGRATION         #FLOATING PT. COWELL /2ND SUM/, B 0704-0775RWDE6
A INTEGRATION-          #DBL. PREC. FLOATING PT. MILNE, RUNGE-KUTT B 0704-0610RWDE3
RATION OF               #DBL. PREC. FLOATING PT. RUNGE-KUTTA INTEG B 0704-0610RWDE2
UTINE.              #DOUBLE PREC. FLOATING PT. SQUARE-ROOT SUBRO B 0704-0727IBSQD
IXER, A SUB. TO CONVERT NO. FROM FLOATING TO FIXED DECIMAL   #F B 7070-08.9.002
                               # FLOATING TRAP SIMULATION.              B 0704-0735PFMCF
#FORTRAN II /RTN/ AND /LEV/ WITH FLOATING TRAP TEST                     B 0704-0848ARR/L
OUTINES   #WISCONSIN FUNDAMENTAL FLOATING-DECIMAL FUNCTION SUBR B 0650-03.1.032
                  #SQUARE ROOT, FLOATING-POINT                          B 0704-0399MISRT
ROUTINE                          #FLOATING-POINT ARCFUNCTION SUB B 0709-0893RWAF3
AGE                #DOUBLE-PRECISION FLOATING-POINT ARITHMETIC PACK B 0704-0525PKDOU
  #INTERPRETIVE DOUBLE-PRECISION FLOATING-POINT ARITHMETIC          B 0704-0525PKINT
N CUBE ROOT                      #FLOATING-POINT DOUBLE-PRECISIO B 0704-0525PKCBR
N SQUARE ROOT                    #FLOATING-POINT DOUBLE-PRECISIO B 0704-0525PKSQR
               #SIMPSONS RULE FLOATING-POINT INTEGRATION                B 0709-0982RWSI2
CKAGE.           #DOUBLE-PRECISION FLOATING-POINT INTERPRETIVE PA B 0704-0525PKIND
LOW ROUTINE FOR NLLS.            #FLOATING-POINT OVERFLOW/UNDERF B 0704-0837OROUN
   #FORTRAN II DOUBLE-PRECISION FLOATING-POINT PACKAGE                  B 0704-0807GDA01
ROUTINE                          #FLOATING-POINT SQUARE-ROOT SUB B 0704-0817GIFPS
CORRECTION                #704-SAP FLOATING-POINT TRAP UNDERFLOW    B 0704-0705MIFLT
SINE AND HYPERBOLIC              #FLOATING-POINT 709 HYPERBOLIC  B 0709-0941RWHY3
ARITHM SUBROUTINE                #FLOATING-POINT 709 NATURAL LOG B 0709-0892RWLN3
 SUBROUTINE COMPUTES             #FLOATING-POINT 7090 ARCTANGENT B 0709-1016RWAT3
ERSION             #SQUARE ROOT, FLOATING-POINT, FORTRAN LIB. V B 0704-0399MISRT
NALIZATION                #704-SAP FLOATING-PT. TRAP MATRIX DIAGO B 0704-0705MIHDI
RRECTION             #704-FORTRAN II FLOATING-PT. TRAP UNDERFLOW CO B 0704-0705MIFLT
                                 #GAS FLOW ANALYSIS                     B 0650-09.7.006
 MATRIX MANIPULATION             #FLOW CHART ANALYSIS BY BOOLEAN B 0709-0824LLFLC
LY PROG  PRINT RECORD TAPE 40K   #FLOW CHART LISTING FROM ASSEMB B 0705-IB 0003
50                               #FLOW DIAGRAMMING FOR THE IBM 6 B 0650-12.0.003
 METHOD                   #FLUID FLOW DISTRIBUTION. HARDY CROSS B 0650-09.7.007
TION OF LAPLACE POISSON AND HEAT FLOW EQUATION  #NUMERICAL SOLU B 0650-04.0.010
        #DISTRIBUTION OF WATER FLOW IN A PIPE NETWORK               B 1620-09.7.001
 #HARDY-CROSS SOLUTION OF WATER FLOW NETWORK                           B 0650-09.7.003
TRACE SUBROUTINE WHICH DESCRIBES FLOW OF CONTROL           #BACK  B 0704-0907NUBAC
                  #50 BUS LOAD FLOW PROGRAM                             B 0650-09.4.003
                  #99-BUS LOAD FLOW PROGRAM                             B 0650-09.4.005
             #30 SERIES BUS LOAD FLOW PROGRAM                           B 0650-09.4.012
           #CAPACITATED NETWORK FLOW PROGRAM                            B 0704-0511MICNF
                 #ELECTRIC LOAD FLOW PROGRAM * CARD *                   B 1620-09.4.003
                 #ELECTRIC LOAD FLOW PROGRAM * TAPE *                   B 1620-09.4.001
       #OUT OF KILTER NETWORK FLOW ROUTINE ONE                          B 0709-1084RSOKF
                                 #FLOW TRACE                            A 1620--AT-013
                                 #FLOW TRACE PROGRAM                    B 0704-0767UASPO
                                 #FLOW TRACER                           B 0650-01.4.002
    #THE TRANSPORTATION PROBLEM, FLOW- OR HUNGARIAN METHOD              B 0704-0464IBTFL
                                 #FLT NUCLEAR-CODE                      B 0704-NUCLEAR
 CONV OF NO FROM FIX PT REPRE TO FLT PT REPRE           #INT OP 4 B 0650-01.6.017
 CROSS METHOD                    #FLUID FLOW DISTRIBUTION. HARDY B 0650-09.7.007
E                        # P-3 FLUX DISTRIBUTION  NUCLEAR-COD B 0650-08.2.014
GN,STRIP,VMCTR          #GSEL,FMCTR,LINK,MOVE,OPHLT,SEQCK,SI B 0705-BW-002-0
DOUBLE PRECISION COMPLEX FAD AND FMP                                # B 0704-0223CLDPC
 #DOUBLE PRECISION COMPLEX FAD, FMP, AND FDP                            B 0704-0223CLDPC
UTINE.                           #FN II AREA SET GENERATOR SUBRO B 0704-0848ARGEN
AT 12F6.0,4I2                    #FN II BCD TAPE OUTPUT FOR FORM B 0704-1057TVMEP
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NE LOACER WITH FL.PT.OFL.        #FN II BINARY SYMBOLIC SUBROUTI B 0704-0848ARBSS
NE                               #FN II ERROR WALK-BACK SUBROUTI B 0704-0848ARFER
BROUTINE                         #FN II FACTORIAL COMPUTATION SU B 0704-0848ARTOR
R DUMP SUBROUTINE                #FN II FLOATING POINT OR INTEGE B 0704-0848ARDMP
F COMPUTATION SUBROUTINE         #FN II NTH DEGREE LEAST SQU COE B 0704-0848ARPLN
TION SOLUTION SUBROUTINE         #FN II SIMULTANEOUS LINEAR EQUA B 0704-0848ARNXN
ROUTINE                          #FN II SINE-COSINE INTEGRAL SUB B 0704-0848ARCSI
              #MAXIMUM DENSITY FO GRANULAR MATERIALS              B 0650-09.2.012
ON ONE-DIMENSIONAL               #FOG NUCLEAR-CODE GROUP DIFFUSI B 7090-NUCLEAR
                                 #FORBOOLEIT                      B 0650-03.2.010
ENTED 650    #LINEAR PROGRAMMING FORCED INVERSION CODE FOR AUGM B 0650-10.1.009
CODE FOR AUGMENT 650#LINEAR PRG. FORCED INVERSION VECTOR PART.  B 0650-10.1.010
                           #1620 FORCOM CARD                      B 1620-01.6.006
TEMS                             #FORECASTING BY ECONOMETRIC SYS B 0704-0963IB3FE
TEMS                             #FORECASTING BY ECONOMETRIC SYS B 0704-0963IB4FE
TEMS                             #FORECASTING BY ECONOMETRIC SYS B 0709-0963IB9FE
MES                              #FORECASTING ZONAL TRAFFIC VOLU B 0650-09.2.011
  #FRACTION REDUCTION TO NORMAL FORM                              B 0704-0900NUFRE
 CVL *           #SEISMOGRAM SYN FORM CONT. INTERVAL VELOCITY * B 0650-09.6.018
NS                               #FORM NUCLEAR-CODE CROSS-SECTIO B 7090-NUCLEAR
        #INTEGRATION OF SPECIAL FORM OF 2ND ORDER EQU.            B 0704-0141LAS88
RTS A FOURIER SERIES TERM TO BCD FORM.                    #CONVE B 0704-0788IBCFT
GULAR MATRIX TO SQUARE SYMMETRIC FORM.             #EXPAND TRIAN B 0704-0460MIEXA
E SYMMETRIC MATRIX TO TRIANGULAR FORM.             #CONTRACT SQUAR B 0704-0460MICNT
Y DECIMAL INPUT PROGRAM-VARIABLE FORMAT                #SCHENECTAD B 0704-0204GSIN2
            #VARIABLE FIXED FORMAT CARD READ                      B 0704-0381ASAS5
RTRAN INPUT/OUTPUT ROUTINE USING FORMAT CONTROL            #1620 FO B 1620-01.6.008
CARD FORTRAN                     #FORMAT CONTROL SUBROUTINE FOR  B 1620-01.6.017
                #FORTRAN WITH FORMAT FOR CARDS                    A 1620--FO-004
                #FORTRAN WITH FORMAT FOR PAPER TAPE               A 1620--FO-003
 TIME.                    # READING OF FORMAT STATEMENTS AT EXECUTION B 0704-0732PFMOD
        #OPTIMIZED TAPE READ FOR FORMAT 12F6.0                    B 0704-0791TVMEO
     #FN II BCD TAPE OUTPUT FOR FORMAT 12F6.0,4I2                 B 0704-1057TVMEP
      #DIVIDED DIFFERENCE TABLE FORMATION                         B 0704-0116CLDDT
           #TRANSLATOR AND OTHER FORMATS TO SOAP RELOKS           B 0650-01.6.048
                                 #FORSCAN                         B 0650-01.6.054
       #SWCHF SUBROUTINE FOR 650 FORTRAN                          B 0650-01.6.042
                                 #FORTRAN                         A 0650--FO-306
     #DOUBLE PRECISION OUTPUT FOR FORTRAN                         B 0709-1202NRDOC
              #BINARY SEARCH, FORTRAN                             B 0709-0935NGBSF
                                 #FORTRAN                         A 1401--FO-050
RMAT CONTROL SUBROUTINE FOR CARD FORTRAN                      #FO B 1620-01.6.017
           #ADDITION TO BASIC FORTRAN                             B 7070-01.2.001
                          #BASIC FORTRAN                          A 7070--FO-073
BCD TAPE RECORDS ACCORDING TO A FORTRAN                # CONVERTS B 0704-0495CVI02
* FUNCTION SUBROUTINE FOR BASIC FORTRAN *                   #RSTR B 7070-01.9.001
#XRANF * SUBROUTINE FOR A BASIC FORTRAN * FUNCTION              C 7070-01.9.002
CONTROL *                 #BASIC FORTRAN * PUNCH WITH CARRIAGE  B 7070-01.2.002
                           #FULL FORTRAN *SEE 7070-PR-075*        A 7070--FO-901
              #RELOCATABLE FORTRAN BSS LOADER                     B 0704-0909MPBSS
                                 #FORTRAN BUTLER                  B 1620-01.5.002
E /CSH/S FOR FINP5 704           #FORTRAN CARD IMAGE READ ROUTIN B 0704-0820RWCSH
E /CSH/S FOR FINP5 709           #FORTRAN CARD IMAGE READ ROUTIN B 0709-0820RWCSH
OR COLUMN BINARY/ LOADER.        #FORTRAN CARD OR TAPE /ROW AND/ B 0709-1163MWRCT
                                 #FORTRAN DIFFERENTIAL EQUATIONS B 0704-0451CLDEQ
METIC PACKAGE                    #FORTRAN DOUBLE PRECISION ARITH B 7090-1122NRNPR
                                 #FORTRAN DUMP PROGRAM            B 0704-0898NUDUM
   #OPEN SUBROUTINE ADDITIONS TO FORTRAN EDIT DECK                B 0704-1081LROSR
                            #650 FORTRAN EDITOR                   B 0650-01.6.053
                                 #FORTRAN END CARD SEARCH.        B 0704-0899MEFEN
                                 #FORTRAN ERROR PACKAGE           B 0704-0752GMEPA
UTTA INTEGRATION.                #FORTRAN FLOATING POINT RUNGE-K B 0709-1171ATRKS
                                 #FORTRAN FOR CARDS               A 1620--FO-002
                                 #FORTRAN FOR PAPER TAPE          A 1620--FO-001
                        #COMPLEX FORTRAN FOR THE 1620             B 1620-06.0.008
ARIATE POLYNOMIAL EVALUATION FOR FORTRAN I PROGRAMS         #UNIV B 0704-0375UAUPE
 1               #FORTRAN II AND/OR FORTRAN I TO SELF-LOADING TAPE B 0704-0769TVF2T
          #ERROR PROCEDURE FOR FORTRAN II                         B 0704-0785GEGER
H FLOATING TRAP TEST             #FORTRAN II /RTN/ AND /LEV/ WIT B 0704-0848ARR/L
 SELF-LOADING TAPE 1             #FORTRAN II AND/OR FORTRAN I TO B 0704-0769TVF2T
T SUBROUTINE                     #FORTRAN II BINOMIAL COEFFICIEN B 0704-0918MEPYR
T FUNCTION SUBPROGRAM            #FORTRAN II BINOMIAL COEFFICIEN B 0704-0919MEPYR
                                 #FORTRAN II DIAGNOSTICIAN        B 1620-01.6.019
OATING-POINT PACKAGE             #FORTRAN II DOUBLE-PRECISION FL B 0704-0807GDA01
   #SINGLE DIMENSION SYMBOLIC FORTRAN II INPUT SUBROUTINE         B 0704-0848ARINS
     #MULTI-DIMENSION SYMBOLIC FORTRAN II INPUT SUBROUTINE        B 0704-0848ARSYM
 OUTPUT MODIFYING SUBR.          #FORTRAN II OFF-LINE TO ON-LINE B 0704-0637ANZ01
 OUTPUT MODIFYING SUBR.          #FORTRAN II ON-LINE TO OFF-LINE B 0704-0637ANZ01
 INPUT MODIFYING SUBR.           #FORTRAN II ON-LINE TO OFF-LINE B 0704-0637ANZ01
OLUTE BINARY          #GENERATE A FORTRAN II PROGRAM TAPE OR ABS B 0704-0754CEF2L
         #PAGE HEADING OUTPUT FORTRAN II SUBROUTINE               B 0704-0848ARHED
                     #ARCTAN A/B, FORTRAN II VERSION,SAP CODED.  B 0704-0603WH005
LE PRECISION TO DOUBLE PRECISION FORTRAN INPUT             #SING B 0709-1201NRDIC
                                 #FORTRAN INPUT/OUTPUT PACKAGE   B 0704-1134ELFIO
ATION                            #FORTRAN INPUT/OUTPUT TRANSFORM B 0704-0809PFTES
SING FORMAT CONTROL        #1620 FORTRAN INPUT/OUTPUT ROUTINE U B 1620-01.6.008
  #SQUARE ROOT, FLOATING-POINT, FORTRAN LIB. VERSION              B 0704-0399MISRT
   #MODIFIED NUBES1 PROGRAM FOR FORTRAN LIBRARY                   B 0704-0547PFBES
E.                               #FORTRAN LINEAR PROGRAMMING COD B 0704-0480CEFLP
                            #709 FORTRAN LOAD/UNLOAD PACKAGE     B 0709-1133EL9LU
ABLE OCTAL-COLUMN BINARY ON LINE FORTRAN LOADER          #RELOCAT B 0704-0912ASAS8
                                 #FORTRAN LOADER/PACKAGE          A 7070--FO-116
TINE PRINT-OUT PROGRAM           #FORTRAN MAP AND MISSING SUBROU B 0704-0909MPMAP
                                 #FORTRAN MAPPER ROUTINE          B 1620-01.6.016
NG SYSTEM ONE                    #FORTRAN MATHEMATICAL PROGRAMMI B 0704-0863RSM1
WORD 650                    #650 FORTRAN MODIFIED FOR THE 4000   B 0650-02.1.008
NG DEBUG          #OFFLINE EDIT FOR FORTRAN MONITOR WITH SOURCE LA B 7090-1115GPFMS
NALYSIS PROGRAM                  #FORTRAN MULTIPLE CORRELATION A B 0709-1121NRNRM
NTER PLOT BCD TEXT GENERATOR FOR FORTRAN OUTPUT             #PRI B 0709-1118URPLO
                                 #FORTRAN OUTPUT MERGE PROGRAM   B 0704-0853MEO20
                                 #FORTRAN OVERLOADER SUBPROGRAM  B 0704-0830MISLA
 TAPE                            #FORTRAN PRE-COMPILER FOR PAPER A 1620--FO-005
                                 #FORTRAN PRE-COMPILER FOR CARD  A 1620--FO-006
LOATING  POINT TRAP ROUTINE  704 FORTRAN SAP CODED.          #F B 0704-1071NUEFM
                                 #FORTRAN SNAP SHOT ROUTINE.     B 0704-0595ERSNA
PORT                             #FORTRAN SN6 NUCLEAR-CODE TRANS B 7090-NUCLEAR
                                 #FORTRAN SOURCE TAPE CORRECTOR  B 1620-01.5.001
          #GENERAL LEAST SQUARES FORTRAN SUBPROGRAM.              B 0704-0635RWGLS
             #GENERAL ROOT FINDER FORTRAN SUBROUTINE              B 0704-0635RWGRT
                         #SPS TO FORTRAN SUBROUTINE EDIT          B 1620-01.6.007
SION *                   #SPS TO FORTRAN SUBROUTINE EDIT * REVI B 1620-01.6.009
                                 #FORTRAN SUBROUTINE PACKAGE      A 0650--LM-011
        #DETERMINANT EVALUATOR FORTRAN SUBROUTINE.                B 0704-0635RWDET
LE                          #650 FORTRAN SYMBOL EQUIVALENCE TAB B 0650-01.6.038
                                 #FORTRAN TAPE WRITE PROGRAM.     B 0704-0899MEFEF
                                 #FORTRAN TO SQUOZE CONVERTER     B 0709-0875RCFNS
RY MANAGEMENT SIMULATOR7070 FULL FORTRAN VERSION          #INVENTO B 7070-12.1.001
TAPE                             #FORTRAN WITH FORMAT FOR PAPER  A 1620--FO-003
                                 #FORTRAN WITH FORMAT FOR CARDS  A 1620--FO-004
ACE REQUIRED-122 CELLS           #FORTRAN WRITE-UP OF RW REQX.SP B 0709-0946RWFEQ

                  #EXTENDED FORTRAN 2 BSS LOADER                  B 0704-0902NULUC
OR SUBPROGRAM.                  #FORTRAN 2 EIGENVALUE-EIGENVECT B 0704-0592NUMLE
NE.                             #FORTRAN 2 INTEGRATION SUBROUTI B 0704-0539GLGAU
              #EXTENTION OF FORTRAN 2 SOURCE LANGUAGE             B 0704-0812GPFMG
                     #709/90 FORTRAN 32K                          A 0709--FO-062
                                #FORTRAN 32K-STORAGE              A 0704--FO-039
                                #FORTRAN 4K-STORAGE               A 0704--FO-037
                                #FORTRAN 8K-STORAGE               A 0704--FO-038
DPC BUFFERED I/O PACKAGE FOR 709 FORTRAN.                     # W B 0709-0978WDIOF
 ON TO TAPE.            #INTERRUPT FORTRAN-LOADING TO COPY MEMORY B 0709-1164MWFOT
EM              #MODIFIED 650 FORTRAN-SCRUB PROGRAMMING SYST B 0650-02.1.010
                                #FORTRAN-TO-SHARE                 B 0704-0634TVFNS
                                #FORTRANSIT SCANNING ROUTINE      B 0650-01.6.055
                                #FORTRANSIT SUBROUTINE PACKAGE    A 0650--LM-012
                                #FORTRANSIT 1                     A 0650--FO-301
                                #FORTRANSIT 1S                    A 0650--FO-302
                                #FORTRANSIT 2                     A 0650--FO-303
                                #FORTRANSIT 2S                    A 0650--FO-304
                                #FORTRANSIT 3                     A 0650--FO-305
            #BACKSPACE FILE,FORWARD SPACE FILE.                   B 0704-1003GNBSP
                                #FOTRAN *SEE 1410-PR-108*         A 1410--FO-913
ER CARD LOADER              #709 FOUR CARD ROW BINARY-OCTAL UPP B 0709-0819GDBOC
                                #FOUR WAY ANALYSIS OF VARIANCE   B 0650-06.0.053
                                #FOUR-PER-CARD LOADER             B 0650-01.2.001
              #FIXED POINT FOURIER COEFFICIENTS                   B 0704-0250NYFSC
AL REPRESENTATION     #GIVEN A FOURIER HALF-SERIES IN CANONIC B 0704-0788IBGFL
ECORD ON TAPE.        #WRITES A FOURIER SERIES AS ONE BINARY R B 0704-0788IBWFS
E      #READS, WITH CHECKING, A FOURIER SERIES FROM BINARY TAP B 0704-0788IBRFS
PRESENTATION       #INTEGRATES A FOURIER SERIES IN CANONICAL RE B 0704-0788IBIFS
PRESENTATION.          #SEARCH A FOURIER SERIES IN CANONICAL RE B 0704-0788IBSFS
PRESENTATION.        #CONVERTS A FOURIER SERIES IN CANONICAL RE B 0704-0788IBWFS
       #UNPACKS THE INDICES FROM FOURIER SERIES INDEX WORDS,     B 0704-0788IBSPF
OCATABLE CARDS.       #PUNCHES A FOURIER SERIES ONTO BINARY REL B 0704-0788IBPUF
M.                   #CONVERTS A FOURIER SERIES TERM TO BCD FOR B 0704-0788IBCFT
          #ADDS OR SUBTRACTS TWO FOURIER SERIES.                  B 0704-0788IBASF
                #ADDS A TERM TO A FOURIER SERIES.                 B 0704-0788IBATF
         #COMBINES INDICES IN A FOURIER SERIES.                   B 0704-0788IBCIF
                   #EVALUATES A FOURIER SERIES.                   B 0704-0788IBEFS
#EXPANDS THE REPRESENTATION OF A FOURIER SERIES.                  B 0704-0788IBERF
               #MULTIPLIES TWO FOURIER SERIES.                    B 0704-0788IBMFS
UTES THE PARTIAL DERIVATIVE OF A FOURIER SERIES.           #COMP B 0704-0788IBPDF
                    #SPLITS A FOURIER SERIES.                     B 0704-0788IBSPS
                #DIFFERENTIAL FOURIER SYNTHESIS                   B 0650-08.4.002
        #COMBINES INDICES IN A FOURIER TERM.                      B 0704-0788IBCIF
OPTIMIZING ROUT *         #FACTOR * FOURTEEN O ONE AUTO CONT TEST B 1401-01.4.007
M OF TESTING *              #FAST * FOURTEEN O ONE AUTOMATED SYSTE B 1401-01.4.004
PE CONTROL SYSTEM *         #FITS * FOURTEEN O ONE INPUT-OUTPUT TA B 1401-01.4.011
RATION           #SECOND,THIRD,AND FOURTH ORDER RUNGE-KUTTA INTEG B 0704-1233AAINT
                        #FLOAT A FRACTION                         B 0704-0743ORFLO
        #RDF3 MURA READ DECIMAL FRACTION                          B 0704-0283MURDF
LAY               #MURA SIX COLUMN FRACTION CATHODE RAY TUBE DISP B 0704-0310MUSCP
                            #MURA FRACTION DUMP                   B 0704-0253MUFRD
              #MURA SIX COLUMN FRACTION PRINT                     B 0704-0314MUPRF
         #MURA VARIABLE COLUMN FRACTION PRINT                     B 0704-0357MUPRF
         #MURA VARIABLE COLUMN FRACTION PRINT                     B 0704-0357MUPRF
ORM                          #FRACTION REDUCTION TO NORMAL F B 0704-0900NUFRE
              #MURA READ DECIMAL FRACTION ROUTINE                 B 0704-0283MURDF
                   #CONTINUED FRACTION SUBROUTINE                 B 0704-0225GMCFR
TERPOLATION           #CONTINUED FRACTIONS CURVE FITTING AND IN B 0704-0858GS541
                                #FRAME CONSTANTS                  B 0650-09.2.068
ANALYSIS OF CONTINUOUS BEAMS AND FRAMES                  #COMPUTER B 0650-09.2.067
C MINIMUM WEIGHT DESIGN OF STEEL FRAMES                 #AUTOMATI B 0650-09.2.052
                                #FRATS                            B 0650-03.1.026
GRAM                  #SIX DEGREE OF FREEDOM DYNAMIC TRAJECTORY PRO B 0704-0821LRSFD
                     #GENERAL FREEWAY ASSIGNMENT                  B 0650-09.2.036
                   #SAN DIEGO FREEWAY ASSIGNMENT                  B 0650-09.2.043
                                #FREEWAY ASSIGNMENT               B 0650-09.2.081
                                #FREEWAY ASSIGNMENT PROGRAM       B 0650-09.2.017
EVISION              #GENERAL FREEWAY ASSIGNMENT, STOCKTON R B 0650-09.2.079
                #TREE OUTPUT TO FREEWAY INPUT                     B 0650-09.2.082
                                #FREQUALIZER                      B 1620-06.0.005
SCHED. PHASE ONLY * LESS * M. C. FRISHBERG        #LEAST COST EST.& B 0650-10.3.009
HANNEL A                  #DUMMY FRONT END CARD FOR 709-7090, C B 7090-1123WPS02
ENERATOR, GAUSSIAN DISTRIBUTION. FT. PT.           #RANDOM NO. G B 0704-0743ORGAU
ERATOR, MAXWELL-BOLTZMANN DIST.  FT. PT.        #RANDOM NO. GEN B 0704-0743ORMAX
GENERATOR, CAUCHY DISTRIBUTION.  FT. PT.        #RANDOM NUMBER B 0704-0743ORCAU
NERENSON-ROSEN FISSION SPECTRUM. FT.PT       #RANDOM NO. GEN., B 0704-0743ORFIS
ATOR, EXPONENTIAL DISTRIBUTION.  FT.PT.      #RANDOM NO. GENER B 0704-0743OREXP
  # TEMPERATURE DISTRIBUTION IN FUEL ELEMENTS NUCLEAR-CODE      B 0650-08.2.026
                                #FUGUE NUCLEAR-CODE               B 7090-NUCLEAR
                                #FULL FORTRAN *SEE 7070-PR-075* A 7070--FO-901
VENTORY MANAGEMENT SIMULATOR7070 FULL FORTRAN VERSION        #IN B 7070-12.1.001
SEMBLY OF SPS TWO *        #FULL MAST *FULL MINNEAPOLIS AS B 1401-01.1.006
 AND PARTIAL DIFFER. OF RATIONAL FUNCT.      #DIFFERENTIATION B 0704-0445PEPAR
     #LEAST SQ. DETER. FOR A VEL FUNCT. WITH LINEAR INC. OF VEL B 0650-09.6.016
PRETIVE SUBROUTINE FOR THE ERROR FUNCTION                #AN INTER B 0650-03.2.003
                     #END OF FILE FUNCTION                        B 0704-0575GIFIL
              #EXTENDED TRANSFER FUNCTION                         B 0704-0575GIGOT
                       #TRANSFER FUNCTION                         B 0704-0575GITRA
                          #ERROR FUNCTION                         B 0704-0897AAERF
SUBROUTINE FOR A BASIC FORTRAN * FUNCTION               #XRANF * B 7070-01.9.002
CIRCULAR AND ELLIPTICAL COVERAGE FUNCTION                     # B 7090-1182DVCIR
CALCULATION OF CROSS-CORRELATION FUNCTION & CROSS-SPECT DENS # B 0650-06.0.050
#CALCULATION OF AUTO-CORRELATION FUNCTION & SPECTRAL DENSITY   B 0650-06.0.049
             #LEAST SQUARES RATIONAL FUNCTION CURVE FITTING       B 0704-0859GSL16
             #TAYLOR SERIES RATIONAL FUNCTION CURVE FITTING       B 7090-1150RLRAT
                               #FUNCTION DISPLAY PROGRAM.         B 0704-0484MIFDP
          #COMPUTES A SPECIAL FUNCTION F OF THE INDICES.          B 0704-0788IBSPF
                        #    PSI FUNCTION FOR COMPLEX ARGUMENTS B 0704-0493LAS85
       #LOGARITHM OF THE GAMMA FUNCTION FOR COMPLEX ARGUMENTS B 0704-0493LAS86
  #LEAST SQ. DETER. OF VELOCITY FUNCTION FOR REFRACT. T/D DATA B 0650-09.6.020
     #AUTO- AND CROSS-CORRELATION FUNCTION GENERATOR,FLOATING   B 0704-0577RWAC2
          #ALL ORDERS OF BESSEL FUNCTION J SUB K TIMES Z OR I  B 0709-0984RWBF7
                       #BESSEL FUNCTION J1/X/ AND Y1/X/           B 0704-0833RWBJY
                 #ROOTS OF A FUNCTION OF A REAL VARIABLE          B 0650-07.0.002
ND ORDER.             # BESSEL FUNCTION OF COMPLEX ARGUMENT A B 0704-0979NUBES
     #MINIMIZATION ROUTINE FOR A FUNCTION OF N VARIABLES          B 0704-0804RWMIN
                        #HANKEL FUNCTION ROUTINE                  B 0704-0530CSHNK
#FORTRAN II BINOMIAL COEFFICIENT FUNCTION SUBPROGRAM              B 0704-0919MEPYR
FORTRAN *                 #RSTR * FUNCTION SUBROUTINE FOR BASIC  B 7070-01.9.001
                 #TRIGONOMETRIC FUNCTION SUBROUTINE               B 7070-08.1.007
SIN FUNDAMENTAL FLOATING-DECIMAL FUNCTION SUBROUTINES     #WISCON B 0650-03.1.032
     #NORMALIZED INCOMPLETE GAMMA FUNCTION WITH POISSON TERM      B 7090-1177URGAM
                        #BESSEL FUNCTION Y SUB N /X/.             B 0704-0704RWBF4
              #INCOMPLETE GAMMA FUNCTION.                         B 0704-0516LAS86
       #OFFSET CIRCLE PROBABILITY FUNCTION.                       B 0704-0869RCOCI
              #ZEROS,ARBITRARY FUNCTION/ZARF/                     B 0704-0565CA005
     #POWER SPECTRAL DENSITY FUNCTION, FLOATING                   B 0704-0577RWPS2
             #IRREGULAR BESSEL FUNCTIONS                          B 0650-03.2.002
                        #BESSEL FUNCTIONS                         B 0704-0415ATBFS
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          # ASSOCIATED LEGENDRE FUNCTIONS                                   B 0704-1040JPASL
SCHEDULING WITH ARBITRARY PROFIT FUNCTIONS                                # B 0709-1086IBAPF
       #INVERSE NORMAL PROBABILITY FUNCTIONS                                B 0709-1002NA861
ERPRETIVE SUBROUTINES FOR BESSEL FUNCTIONS          #A SET OF INT B 0650-03.2.007
ERBOLIC FUNCTIONS REGULAR BESSEL FUNCTIONS     #CIRCULAR AND HYP B 0650-03.2.001
 SINE INTEGRAL & COSINE INTEGRAL FUNCTIONS         #INTER SUBROU FOR B 0650-03.2.004
               #SINE AND COSINE FUNCTIONS FOR NLLS.                 B 0704-0837ORSCN
D ORDER              #  BESSEL FUNCTIONS FOR REAL ARGUMENT AN B 0704-0469NUBES
                    #BESSEL FUNCTIONS JO/X/AND YO/X/                B 0704-0833RWBJY
         #THE TRANSCENDENTAL FUNCTIONS MU AND NU                    B 0704-0311GMMUF
                   #NEUMANN FUNCTIONS OF LARGE ARGUMENTS            B 0704-0416CSNMD
      #EXTREMUM OF UNIMODAL FUNCTIONS OF ONE VARIABLE               B 0704-0878BEMIM
                    #BESSEL FUNCTIONS OF ORDER ONE.                 B 0704-0636RWBF3
                    #BESSEL FUNCTIONS OF ORDER ZERO.                B 0704-0636RWBF2
R NLLS.             #BESSEL FUNCTIONS OF THE FIRST KIND FO B 0704-0837ORBFN
IONS   #CIRCULAR AND HYPERBOLIC FUNCTIONS REGULAR BESSEL FUNCT B 0650-03.2.001
                    #BESSEL FUNCTIONS SUBROUTINE                    B 0650-03.2.005
 #MATHIEU AND MODIFIED MATHIEU FUNCTIONS SUBROUTINE                 B 0650-03.2.006
      #ALL ORDERS OF THE BESSEL FUNCTIONS Y SUB K TIMES Z           B 0709-0985RWBF8
UNCTION SUBROUTINES   #WISCONSIN FUNDAMENTAL FLOATING-DECIMAL F B 0650-03.1.032
         #APPROXIMATION OF FUTURE TRIP TRANSFERS                    B 0650-09.2.035
                         #F0020 NUCLEAR-CODE ENGINEERING B 0704-NUCLEAR
US                       #F0031 NUCLEAR-CODE MISCELLANEO B 0704-NUCLEAR
                         #G & L POST PROCESSOR                      B 0650-10.3.008
                #STRAIN GAGE DATA REDUCTION * CARD *                B 1620-09.6.001
                #STRAIN GAGE DATA REDUCTION * TAPE *                B 1620-09.6.002
              #ROOT AND GAIN LOCUS                                  B 0650-09.8.001
ONS                      #GAM-I NUCLEAR-CODE CROSS-SECTI B 7090-NUCLEAR
             #BLACK JACK GAME * CARD *                              B 1620-11.0.006
              #EXECUTIVE GAME * TAPE *                              B 1620-11.0.004
             #BLACK JACK GAME * TAPE *                              B 1620-11.0.005
ATA   #FITTING DATA TO TWO PARA. GAMMA DIST-SPEC REF RAINFALL D B 0650-06.0.051
NING PROBABILITIES FROM A FITTED GAMMA DISTRIBUTION     #DETERMI B 0650-06.0.040
UMENTS        #LOGARITHM OF THE GAMMA FUNCTION FOR COMPLEX ARG B 0704-0493LAS86
RM      #NORMALIZED INCOMPLETE GAMMA FUNCTION WITH POISSON TE B 7090-1177URGAM
                #INCOMPLETE GAMMA FUNCTION.                         B 0704-0516LAS86
L DATA         #FITTING OF THE GAMMA- DISTRIBUTION TO RAINFAL B 0650-06.0.029
          #REPRODUCE, GANG PUNCH AND PRINT * RGCP *                 B 1401-13.1.009
                         #GAS FLOW ANALYSIS                         B 0650-09.7.006
                         #GAS NETWORK ANALYSIS PROGRAM              B 0650-09.7.001
 AUTO RECYCLING * IBM 650 *    #A GAS NETWORK ANALYSIS PROG WITH B 0650-09.7.008
                         #GAS NETWORK ANALYSIS * TAPE *             B 1620-09.3.001
                         #GAS NETWORK ANALYSIS * CARD *             B 1620-09.3.003
NERALIZED ALGEBRAIC TRANSLATOR * GAT *                        #GE B 0650-02.1.007
                         #GAUSS APPROXIMANT GENERATOR               B 0704-1048JPGIN
 #INTEGRATION SUBROUTINE, 10 PT. GAUSS QUADRATURE METHOD            B 0704-0237GLGAU
HOD          #A PROGRAM FOR THE GAUSS-SOUTHWELL RELAXATION MET B 0650-09.6.014
       #RANDOM NO. GENERATOR, GAUSSIAN DISTRIBUTION. FT. PT. B 0704-0743ORGAU
         #MATRIX INVERSION BY GAUSSIAN ELIMINATION                  B 0650-05.2.002
E                 #4-POINT GAUSSIAN INTEGRATION SUBROUTIN B 7090-1230EOGAS
          #INTEGRATION BY GAUSSIAN QUADRATURE                       B 0704-0423BSGQI
 TAPE LBL&TRAILER CKN         #GEN. TRA ROUTINE PROG TAPE OPR B 0705-SR-002-0
PECTRUM. FT.PT         #RANDOM NO. GEN., NERENSON-ROSEN FISSION S B 0704-0743ORFIS
OR * GAT *               #GENERALIZED ALGEBRAIC TRANSLAT B 0650-02.1.007
TINE                     #GENERALIZED INTEGRATION SUBROU B 7090-1132MAGIN
 PRINT 1 *               #GENERALIZED MATRIX INVERSION * B 0705-IB 0010
UNBLOCKED RECORDS        #GENERALIZED MERGE PROGRAM FOR  B 1401-01.2.002
                       # GENERALIZED OUTPUT SUBROUTINE      B 0704-0988NUOUT
                         #GENERALIZED PLOT ROUTINE          B 7090-1146AMPLO
                         #GENERALIZED PLOTTER II            B 1620-09.7.002
                         #GENERALIZED PLOTTER               B 1620-09.7.003
                         #GENERALIZED RAMAC SORT PROGRAM A 1410--SM-110
NE                     #  GENERALIZED TAPE SORTING ROUTI B 0704-0468CF006
NE                       #GENERALIZED TRANSFER ANY ROUTI B 0705-PG-001-0
CORD SORT           #709/7090 GENERALIZED VARIABLE LENGTH RE B 0709-1159MDSOR
INPUT-OUTPUT SUBROUTINE  #GENERALIZED,PACKAGED,OFF-LINE  B 0704-0620CF009
NPUT-OUTPUT SUBROUTINE   #GENERALIZED,PACKAGED,ON-LINE I B 0704-0573CF001
 SEE 1410-PR-108 *  #REPORT PRC. GENERAT. CARD/TAPE/1405 DISK * A 1410--RG-910
TAPE OR ABSOLUTE BINARY  #GENERATE A FORTRAN II PROGRAM  B 0704-0754CEF2L
 BY NU TPL1              #GENERATE MATRICES TO BE SOLVED B 0704-1110NUGEN
PUT TAPES.      #704 PROGRAM TO GENERATE 1401 T/P PROG. ON OUT B 0704-1231TVTPP
     #KINEMATIC SYNTHESIS OF PATH GENERATING MECHANISMS             B 0650-09.5.003
       #PRINT CONTROL FOR REPORT GENERATION                         B 0709-1038RWPCR
PROGRAMS * GOOP *          #7070 GENERATIONS OF 1401 OPTIMIZED B 7070-01.9.003
& HORNET REACTOR CODE SPHERICAL GEO NUCLEAR-CODE     # BEEHIVE B 0650-08.2.009
IFFUSION EQUATION IN CYLINDRICAL GEO NUCLEAR-CODE    # UNCLE 1 D B 0650-08.2.010
                 #MODEL 4 GEODIMETER                                B 0650-09.2.085
                         #GEODIMETER COMPUTATIONS                   B 0650-09.2.065
E                 #S4 CYLINDRICAL GEOMETRY CELL CODE NUCLEAR-COD B 7090-NUCLEAR
ALL A REACTOR CODE FOR SPHERICAL GEOMETRY NUCLEAR-CODE     # B B 0650-08.2.016
                         #GEORGIA EARTHWORK PROGRAM                 B 0650-09.2.055
                         #GEORGIA SKEWED BRIDGE PROGRAM             B 0650-09.2.008
                         #GET/PUT * SEE 0705-IO-047 *               A 0705-
             #TRAP TRACE, GI TRAP.                                  B 0704-0593GITRA
TEGRATION        #FLOATING POINT GILL METHOD FOR RUNGE-KUTTA IN B 0704-0491RWDE4
FLU LINE ORDINATE FROM CONTINUOS GIRD. BRIDGE  #MOMENT REACT IN B 0650-09.2.057
 CANONICAL REPRESENTATION      #GIVEN A FOURIER HALF-SERIES IN B 0704-0788IBGFL
UATOR-ECLIPTIC ROTATION-ROTATE A GIVEN VECTOR                  #EQ B 0709-0953RWROB
X OF              #TO ROTATE A GIVEN VECTOR X FROM THE EQUINO B 0709-0945RWREQ
ES LN X TO 20D OR 20S.         #GIVEN X, THIS PROGRAM CALCULAT B 0704-0498CA004
            #GS REVISION OF GL OUT2                                 B 0704-0204GSOUT
                         #GMITR3 ITERATION SUBROUTINE               B 0704-0259GMITR
OGRAMMER                 #GMR DYANA DYNAMICS ANALYZER-PR B 0704-0930GMDYA
                         #GO SOAP II                                B 0650-12.0.004
                         #GOHOT                                     B 1620-01.6.018
ONS OF 1401 OPTIMIZED PROGRAMS * GOOP *         #7070 GENERATI B 7070-01.9.003
                         #GOTRAN FOR CARDS                          A 1620--PR-011
                         #GOTRAN FOR PAPER TAPE                     A 1620--PR-010
                         #GOUTY 2A                                  B 0650-01.6.044
                         #GRACE-I NUCLEAR-CODE PHYSICS              B 7090-NUCLEAR
                         #GRACE-II NUCLEAR-CODE PHYSICS             B 7090-NUCLEAR
                 #PROFILE GRADE                                     B 0650-09.2.046
                 #PROFILE GRADE                                     B 0650-09.2.061
       #MAXIMUM DENSITY FO GRANULAR MATERIALS                       B 0650-09.2.012
  #RESIDUALS AND DERIVATIVES OF GRAVITY                             B 0650-09.6.008
                   #SCOPE GRID PLOTTER                              B 0704-0357MUSCP
                   #SCOPE GRID PLOTTER                              B 0704-0432MUSCO
        #STRAIGHT LINE BRIDGE GRID SYSTEM                           B 0650-09.2.058
ON                       #GRID SYSTEM VOLUME DETERMINATI B 0650-09.6.009
    #7070 SIMULATOR THE 650 * GRONK *                               B 7070-05.1.003
 #GENERAL CARD LOADER SUBROUTINE GROUP                              B 0704-0446PECSM
L          #WANDA-4 NUCLEAR-CODE GROUP DIFFUSION ONE-DIMENSIONA B 0704-NUCLEAR
L             #ZOOM NUCLEAR-CODE GROUP DIFFUSION ONE-DIMENSIONA B 0704-NUCLEAR
L           #COGENT NUCLEAR-CODE GROUP DIFFUSION ONE-DIMENSIONA B 0704-NUCLEAR
L             #FIRE NUCLEAR-CODE GROUP DIFFUSION ONE-DIMENSIONA B 0704-NUCLEAR
L        #WANDA 2,3 NUCLEAR-CODE GROUP DIFFUSION ONE-DIMENSIONA B 7090-NUCLEAR
L              #FOG NUCLEAR-CODE GROUP DIFFUSION ONE-DIMENSIONA B 7090-NUCLEAR
L            #AIM-6 NUCLEAR-CODE GROUP DIFFUSION ONE-DIMENSIONA B 7090-NUCLEAR
NAL            #TKO NUCLEAR-CODE GROUP DIFFUSION THREE-DIMENSIO B 0704-NUCLEAR
NAL            #UFO NUCLEAR-CODE GROUP DIFFUSION THREE-DIMENSIO B 0704-NUCLEAR
L                    #CURE NUCLEAR-CODE GROUP DIFFUSION TWO-DIMENSIONA B 0704-NUCLEAR
L                   #PDQ-2 NUCLEAR-CODE GROUP DIFFUSION TWO-DIMENSIONA B 0704-NUCLEAR
L                   #PDQ-3 NUCLEAR-CODE GROUP DIFFUSION TWO-DIMENSIONA B 0704-NUCLEAR
L                     #REM NUCLEAR-CODE GROUP DIFFUSION TWO-DIMENSIONA B 0704-NUCLEAR
L                #PDQ2-90 NUCLEAR-CODE GROUP DIFFUSION TWO-DIMENSIONA B 7090-NUCLEAR
                               #GROUP RECORDS                       B 0705-PG-008-0
             #MOVE VARIABLE, GROUPED FIELDS                         B 0705-PG-010-0
                               #GS REVISION OF GL OUT2              B 0704-0204GSOUT
CK,SIGN,STRIP,VMCTR            #GSEL,FMCTR,LINK,MOVE,OPHLT,SEC B 0705-BW-002-0
CKAGE                          #H.Q. USAF TAPE INPUT/OUTPUT PA B 0705-AF-003-1
                               #HAFEVER NUCLEAR-CODE                B 0704-NUCLEAR
SENTATION       #GIVEN A FOURIER HALF-SERIES IN CANONICAL REPRE B 0704-0788IBGFL
                        #TITLE, HALT AND SWITCH PROGRAM             B 0705-DE-002-0
                               #HANKEL FUNCTION ROUTINE             B 0704-0530CSHNK
AT SIM-ABREVIATED FLOATING POINT HARDWARE SIMULATOR.     #AB FLO B 7070-05.2.001
     #FLUID FLOW DISTRIBUTION. HARDY CROSS METHOD                   B 0650-09.7.007
FLOW NETWORK                   #HARDY-CROSS SOLUTION OF WATER  B 0650-09.7.003
                               #HARMONIC ANALYSIS SUBROUTINE        B 0704-0121GMHAS
                               #HASH TOTAL                          A 1620--MI-015
INT                            #HASTY EXPONENTIAL, FLOATING PO B 0704-0630WBHEX
OUTINE                    #PAGE HEADING OUTPUT FORTRAN II SUBR B 0704-0848ARHFD
                        #MATRIX HEADING REMOVAL                     B 0704-0085CLMBH
                  #SOLUTION OF HEAT DIFFUSION EQUATION              B 0650-08.1.004
 #MULTI-MATERIAL ONE DIMENSIONAL HEAT EQUATION SOLVER               B 0704-0652RWHF2
 SOLUTION OF LAPLACE POISSON AND HEAT FLOW EQUATION  #NUMERICAL B 0650-04.0.010
                               #HEAT NUCLEAR-CODE ENGINEERING       B 0704-NUCLEAR
              #TRANSIENT HEAT TRANSFER PROGRAM                      B 0650-08.1.002
                               #HECTIC NUCLEAR-CODE                 B 0704-NUCLEAR
RANSPORT                       #HERD-1,2, AND 3 NUCLEAR-CODE T B 0704-NUCLEAR
             #INTEGRATION BY HERMITE QUADRATURE                     B 0704-0423BSHQI
M. EIGENVALUE PROB. OF A COMPLEX HERMITIAN MATRIX.         #PRELI B 0704-0460MIMAU
IGENVALUES AND EIGENVECTORS OF A HERMITIAN MATRIX.             #E B 0704-0884PKHME
                      #STORAGE HISTORY TRACE                        B 0704-0264ASAS4
                       #BCD TO HOLLERITH                            B 0704-0235NYDHL
                               #HOLLERITH CARD TO TAPE              B 0704-0525PKCTH
INCREMENT COLUMN BINARY IMAGE OF HOLLERITH NUMBER               # B 0704-0843ORICB
                               #HOLLERITH TO BCD CONVERSION         B 0704-0235NYDBD
RDS                            #HOLLERITH TO BCD INPUT FROM CA B 0704-0387CEI41
                               #HOLLERITH WORD GENERATOR            B 0709-1219WDHOL
   #DIGITAL TERRAIN MODEL SYSTEM HORIZONTAL ALIGNMENT PROGRAMS      B 0650-09.2.040
        #BPR REVISION OF OREGON HORIZONTAL ALIGNMENT PROGRAM        B 0650-09.2.053
            #REVISED TRAVERSE AND HORIZONTAL ALIGNMENT              B 0650-09.2.084
     #LIQUID VOLUMES IN FLAT END HORIZONTAL CYLINDRICAL TANKS       B 0650-09.7.005
GEO NUCLEAR-CODE     # BEEHIVE & HORNET REACTOR CODE SPHERICAL B 0650-08.2.009
 INTER CODING SYS        #UNIV OF HOUSTON ASSEMBLR FOR PROC.ENG. B 0650-02.0.017
SS ANALYSIS OF A FLANGED TAPERED HUB * CARD *        #S-109 STRE B 1620-09.7.005
NALYSIS OF FLANGE WITH A TAPERED HUB * CARD *    #S-100 STRESS A B 1620-09.7.004
ION ROUTINE                    #HUMAN REACTION TIME DEMONSTRAT B 0650-11.0.005
TRANSPORTATION PROBLEM, FLOW- OR HUNGARIAN METHOD            #THE B 0704-0464IBTFL
                               #HYDRAULIC NETWORK ANALYSIS          B 0650-09.7.002
OPS AND PHASE BEHAVIOR OF  LIGHT HYDROCARBON M#THERMODYNAMIC PR B 0650-09.3.002
NG-POINT 709 HYPERBOLIC SINE AND HYPERBOLIC               #FLOATI B 0709-0941RWHY3
ESSEL FUNCTIONS    #CIRCULAR AND HYPERBOLIC FUNCTIONS REGULAR B B 0650-03.2.001
ATING POINT.                   #HYPERBOLIC SINE AND COSINE,FLO B 0704-0417PFCSH
          #FLOATING-POINT 709 HYPERBOLIC SINE AND HYPERBOLIC B 0709-0941RWHY3
NG                             #HYPERBOLIC SINE-COSINE, FLOATI B 0704-0224ASAS3
TANGENT SUBROUTINE             #HYPERBOLIC SINE, COSINE AND CO B 7070-08.1.020
                               #HYPERBOLIC TANGENT SUBROUTINE       B 7070-08.1.013
#MATHEMATICAL PROGRAMMING SYSTEM I-ALL SOLUTIONS                    B 0704-1092RSMIA
PULATE BCD-CODED DATA, INCLUDING I/O                          #MANI B 0704-0879MI4BC
                     #BASIC 709 I/O CONVERSION SUBROUTINES.         B 0709-0388GS710
          # WDPC BUFFERED I/O PACKAGE FOR 709 FORTRAN.              B 0709-0978WDIOF
         #STOP NUMBER DRUM AND IAS                                  B 0650-01.6.027
                          #SOS IBM-32K ASSEMBLY AND COMPILER A 0709--PR-063
                               #IBSFAP ASSEMBLY PROGRAM             A 7090--SP-920
                               #IBSYS MONITOR                       A 7090--SV-918
                               #ID-3 INTERPRETIVE SYSTEM            B 0650-02.0.022
                               #IDA EDIT SUBROUTINE * CARD *        B 1620-01.6.005
                               #IDA-EDIT SUBROUTINE *TAPE*          B 1620-01.6.002
CATION           # BINARY SUBROUTINE IDENTIFICATION AND MEMORY ALLO B 0704-0739ARPFK
 *                #AUTOMATIC PERSONAL IDENTIFICATION CODE * AUTO-PIC B 0650-01.6.041
AUTOPIC 1401 *AUTOMATIC PERSONAL IDENTIFICATION CODE *            # B 1401-01.4.014
                               #IFS * AFTER SETTING * XX            B 0705-PG-005-0
T SQUARE POLYNOMIAL FIT /FORTRAN II/                          #LEAS B 0704-0772ANE20
        #INCREMENT COLUMN BINARY IMAGE OF HOLLERITH NUMBER          B 0704-0843ORICB
                     #WRITE CORE IMAGE ON TAPE                      B 0704-0830MIWTP
                          #CARD IMAGE PROGRAM                       B 0705-IB 0002
FINP5 704          #FORTRAN CARD IMAGE READ ROUTINE /CSH/S FOR  B 0704-0820RWCSH
FINP5 709          #FORTRAN CARD IMAGE READ ROUTINE /CSH/S FOR  B 0709-0820RWCSH
              #TRANSLATE CARD IMAGE TO BCD IN COMMON.               B 0709-0778AEIBC
RUMS            #LOAD BINARY CARD IMAGES FROM TAPE TO CORE AND D B 0704-0395LL010
 LANGUAGE EASY           #SYSTEM IMMEDIATELY MAKING PROGRAMMING B 0704-1096TVSMP
 SOLUTION OF POWER SYS NETWORK  #IMPROVED DIGITAL SHORT CIRCUIT B 0650-09.4.004
#MATRIX INVERSION WITH ITERATIVE IMPROVEMENT OF ACCURACY            B 0650-05.2.022
ER. FOR A VEL FUNCT. WITH LINEAR INC. OF VEL.      #LEAST SQ. DET B 0650-09.6.016
#NORMAL MOVEOUT COMP. FOR LINEAR INC. OF VELOCITY WITH DEPTH        B 0650-09.6.019
    #MANIPULATE BCD-CODED DATA, INCLUDING I/O                       B 0704-0879MI4BC
PAIRED COMPARISONS FROM BALANCED INCOMPLETE BLOCKS                # B 0650-06.0.038
                               #INCOMPLETE ELLIPTIC INTEGRALS       B 0704-0225GMIEF
                               #INCOMPLETE GAMMA FUNCTION.          B 0704-0516LAS86
 POISSON TERM        #NORMALIZED INCOMPLETE GAMMA FUNCTION WITH B 7090-1177URGAM
#ELLIPTIC INTEGRAL, COMPLETE AND INCOMPLETE.                        B 0704-0977ALELP
OF HOLLERITH NUMBER            #INCREMENT COLUMN BINARY IMAGE B 0704-0843ORICB
                               #INDEPENDANT TABLE LOADER            B 0650-01.2.011
NNECTOR AND REDUNDANCY PROGS FOR INDERTERMINATE TRUSS ANAL  #CO B 0650-09.2.007
          #BELL LABS PERMUTATION INDEX PROGRAM                      B 7090-1239BEPIP
  #READS THE SORTED AUTHOR CROSS INDEX TAPE                         B 0704-1144NC014
#UNPACKS UP TO 6 INDICES FROM AN INDEX WORD.                        B 0704-0788IBUPF
 THE INDICES FROM FOURIER SERIES INDEX WORDS,             #UNPACKS B 0704-0788IBSPF
                #SIMULATION OF AN INDEXING REGISTER IN SIR          B 0650-02.0.016
TH TRACE * FIRS#FLOATING PT. AND INDEXING REGISTER SIMULATOR WI B 0650-01.6.050
M TRACING ROUTINE FOR 650 SYSTEM INDEXING REGISTERS            #SY B 0650-01.4.007
TO CALCULATE SEASONALLY ADJUSTED INDICES                  #PROGRAM B 0650-06.0.042
              #UNPACKS UP TO 6 INDICES FROM AN INDEX WORD.          B 0704-0788IBUPF
DEX WORDS,         #UNPACKS THE INDICES FROM FOURIER SERIES IN B 0704-0788IHSPF
                     #COMBINES INDICES IN A FOURIER SERIES.         B 0704-0788IBCIF
                     #COMBINES INDICES IN A FOURIER TERM.           B 0704-0788IBCIF
UTES A SPECIAL FUNCTION F OF THE INDICES.                    #COMP B 0704-0788IHSPF
                               #INDIVIDUAL CARD/TAPE UTILITIES A 1410--UT-106
S * CARD *          #M-100 MOMENT OF INERTIA & CENTROID CALCULATION B 1620-09.3.004
S * TAPE *          #M-100 MOMENT OF INERTIA & CENTROID CALCULATION B 1620-09.3.005
S                     #MOMENTS OF INERTIA OF POLYATOMIC MOLECULE B 0650-09.3.005
UE AND RATE OF RETURN * PVIA * * INF. CHAIN MACH * #PRESENT VAL B 0650-07.0.017
NUOS GIRD. BRIDGE  #MOMENT REACT INFLU LINE ORDINATE FROM CONTI B 0650-09.2.057
       #MOMENT DISTRIBUTION AND INFLUENCE LINE CALCULATION          B 0650-09.2.033
WRITE 2 DIMENSIONAL ARRAY BINARY INFO ON TAPE                  #TO B 0704-0910NUWTH
E V INTERPRETIVE SYSTEM        #INFORMATION PROCESSING LANGUAG B 0704-1006RSIPL
 EQUIVALENCE             #VARIABLE INFORMATION PROCESSING PACKAGE B 0704-0856CVVIP
                         #VARIABLE INFORMATION PROCESSING PACKAGE B 0704-0856CVVIP
                     #709 VARIABLE INFORMATION PROCESSING PACKAGE B 0709-1135RWVIP
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                    #AUTOMATIC INFORMATION RETRIEVAL PROGRAM  B 0650-12.0.007
A CONDENSER ROUTINE FOR SYMBOLIC INFORMATION.                 # B 0704-0959MICND
                                 #INITA                         B 0705-SR-005-0
          #TREE OUTPUT TO FREEWAY INPUT                         B 0650-09.2.082
    # A VARIABLE FIELD PERIPHERAL INPUT                         B 0704-0209NOVNP
#FIXED AND FLOATING DECIMAL CARD INPUT                          B 0704-0325RS014
LE PRECISION FLOATING POINT CARD INPUT                    #DOUB B 0704-0650RWREA
SION TO DOUBLE PRECISION FORTRAN INPUT            #SINGLE PRECI B 0709-1201NRDIC
ELATION MATRIX, CORR2 - FOR CARD INPUT          #7070 INTERCORR B 7070-11.3.004
            #DOUBLE PRECISION INPUT CONVERSION.                 B 0704-0585CA006
           #LP/90 TO SCROL 704 INPUT CONVERTER                  B 0704-0937ERCON
    #SELECTOR OF COMBINATIONS OF INPUT DATA.                    B 0704-0648AVSEL
ESSION CODE SCRAP.               #INPUT EDITOR FOR MULTIPLE REGR B 0704-0749SCIEM
            #HOLLERITH TO BCD INPUT FROM CARDS                  B 0704-0387CEI41
 #FORTRAN II ON-LINE TO OFF-LINE INPUT MODIFYING SUBR.          B 0704-0637ANZ01
 READS BCD           #SIMULATES INPUT PLUGBOARD OF BASIC 650.   B 0704-0480CE650
CH CONTROL                       #INPUT PROGRAM UNDER SENSE SWIT B 0704-0206NYINP
T CONTROL                        #INPUT PROGRAM UNDER SENSE LIGH B 0704-0206NYINP
T CONTROL                        #INPUT PROGRAM UNDER SENSE LIGH B 0709-1025WPK06
         #SCHENECTADY DECIMAL INPUT PROGRAM-VARIABLE FORMAT     B 0704-0204GSIN2
            #DOUBLE PRECISION INPUT SCALING                     B 0704-0334NA022
LE DIMENSION SYMBOLIC FORTRAN II INPUT SUBROUTINE         #SING B 0704-0848ARINS
TI-DIMENSION SYMBOLIC FORTRAN II INPUT SUBROUTINE          #MUL B 0704-0848ARSYM
            #DOUBLE PRECISION INPUT.                            B 0704-0577RWDPN
TING POINT & FIXED POINT DECIMAL INPUT.                   #FLOA B 0704-0370RS014
GRAMMING CODE FOR 1620 WITH CARD INPUT&OUTPUT       #LINEAR PRO B 1620-10.1.002
                        #STUDENT INPUT-OUTPUT                   B 0709-1007RL039
   #GENERALIZED,PACKAGED,ON-LINE INPUT-OUTPUT SUBROUTINE        B 0704-0573CF001
  #GENERALIZED,PACKAGED,OFF-LINE INPUT-OUTPUT SUBROUTINE        B 0704-0620CF009
                                 #INPUT-OUTPUT SYSTEM           B 0704-0261GMIOS
EM *       #FITS * FOURTEEN O ONE INPUT-OUTPUT TAPE CONTROL SYST B 1401-01.4.011
                           #TAPE INPUT/OUTPUT                   B 0704-0690GDTIO
                           #TAPE INPUT/OUTPUT                   B 0705-SB-005-0
       #TRACE PROGRAM FOR CARD INPUT/OUTPUT                     B 1620-01.4.002
                      #7090 IOCS INPUT/OUTPUT CONTROL           A 7090--IO-919
                        #FORTRAN INPUT/OUTPUT PACKAGE           B 0704-1134ELFIO
                 #H.Q. USAF TAPE INPUT/OUTPUT PACKAGE           B 0705-AF-003-1
                           #7090 INPUT/OUTPUT PACKAGE           B 7090-1218NUSNU
MAT CONTROL        #1620 FORTRAN INPUT/OUTPUT ROUTINE USING FOR B 1620-01.6.008
/CD                              #INPUT/OUTPUT SHCEDULING 1/CD&5 A 0650--UT-105
                        #FORTRAN INPUT/OUTPUT TRANSFORMATION    B 0704-0809PFTES
                           #VIPP INSERT LEADING BLANKS.         B 0704-0895TAVIL
ROUTINE            #ENTRY AND EXIT INSERTER FOR THE INTERPRETIVE B 0704-0525PKINT
                         #ZIP * INSTANT PRINTING *              B 1401-01.4.009
TABLE DOUBLE PRECISION LOGARITHM INSTRUCTION           #INTERPRE B 0704-0385BSLNX
   #DOUBLE PRECISION ARC TANGENT INSTRUCTION                    B 0704-0423BSATN
BLE DOUBLE PRECISION EXPONENTIAL INSTRUCTION         #INTERPRETA B 0704-0385BSEXP
BLE DOUBLE PRECISION SQUARE ROOT INSTRUCTION         #INTERPRETA B 0704-0385BSSQR
                         #TRACE INSTRUCTION ALTERATION          B 0704-1079NOTIA
                         #TRACE INSTRUCTION ALTERATION FOR 709  B 0709-1090NOTIA
          #NINE OPERATION SPLIT INSTRUCTION ROUTINE NOSIR       B 0650-02.0.006
RAM                  #CROWN LIFE INSURANCE COMPANY SORTING PROG B 0650-01.5.006
T REPRE TO FLT PT REPRE          #INT OP 4 CONV OF NO FROM FIX P B 0650-01.6.017
                                 #INT 580                       A 7080--CV-090
        #WRITE 6-DIGIT DECIMAL INTEGER AND SIGN ON CRT          B 0704-0362NA117
               #BCD TO BINARY INTEGER CONVERSION                B 0704-1056TVME2
                          #MURA INTEGER DUMP                    B 0704-0251MUIND
      #FN II FLOATING POINT OR INTEGER DUMP SUBROUTINE          B 0704-0848ARDMP
                                 #INTEGER PROGRAMMING 3,        B 0704-1190PKIP9
                                 #INTEGER PROGRAMMING 3,        B 0704-1190PKIPM
                                 #INTEGER PROGRAMMING 2,        B 0704-1191PKIP9
                                 #INTEGER PROGRAMMING 2,        B 0704-1191PKIPM
                                 #INTEGER PROGRAMMING 1,        B 0704-1192PKIP9
                                 #INTEGER PROGRAMMING 1,        B 0704-1192PKIPM
                                 #INTEGER PROGRAMMING 1         B 0704-0969PKIP8
                                 #INTEGER PROGRAMMING 2         B 0704-0970PKIP0
                                 #INTEGER PROGRAMMING 2         B 0704-0970PKIP8
                                 #INTEGER PROGRAMMING 3         B 0704-0971PKIP0
            #MURA READ DECIMAL INTEGER ROUTINE                  B 0704-0256MURDI
RSION.                  #BINARY INTEGER TO ROMAN NUMERAL CONVE B 0704-0870ORROM
            #MURA READ DECIMAL INTEGERS ROUTINE                 B 0704-0263MURDI
INARY CONVERSION OF UNRESTRICTED INTEGERS.             #BCD TO B B 0704-0423BSDCH
O BCD CONVERSION OF UNRESTRICTED INTEGERS.             #BINARY T B 0704-0423BSFRE
ERICAL INTEGRATION OF THE DOUBLE INTEGRAL                   #NUM B 0650-07.0.010
NG POINT /N/ VARIATE PROBABILITY INTEGRAL                 #FLOATI B 0704-0794RWNP3
                    #EXPONENTIAL INTEGRAL                       B 0704-0753NUEXP
                    #EXPONENTIAL INTEGRAL                       B 0704-0753NUEXP
CTIONS    #INTER SUBROU FOR SINE INTEGRAL & COSINE INTEGRAL FUN B 0650-03.2.004
/EQU. INTERV./                   #INTEGRAL EVAL., SIMPSONS RULE B 0704-0116CLINT
EQU. INTERVALS/                  #INTEGRAL EVAL., TRAPEZ. RULE / B 0704-0116CLINT
      #FLOATING POINT DEFINITE INTEGRAL EVALUATION              B 0704-0624RWDL2
UBROU FOR SINE INTEGRAL & COSINE INTEGRAL FUNCTIONS    #INTER S B 0650-03.2.004
           #DIATOMIC MOLECULAR INTEGRAL PROGRAM                 B 0704-0849MIDIA
            #FN II SINE-COSINE INTEGRAL SUBROUTINE              B 0704-0848ARCSI
                    #EXPONENTIAL INTEGRAL.                      B 7090-1228NOEI
ETE.                   #ELLIPTIC INTEGRAL, COMPLETE AND INCOMPL B 0704-0977ALELP
                       #ELLIPTIC INTEGRALS                      B 0650-04.0.006
         #INCOMPLETE ELLIPTIC INTEGRALS                         B 0704-0225GMIEF
       #MURA COMPLETE ELLIPTIC INTEGRALS                        B 0704-0668MUCEI
           #COMPLETE ELLIPTIC INTEGRALS OF THE FIRST KIND       B 0704-1070RMELF
  #FLOAT. PT. MILNE, RUNGE-KUTTA INTEGRAT. OF 2ND ORD. EQ.      B 0704-0450RWDE3
 CANONICAL REPRESENTATION        #INTEGRATES A FOURIER SERIES IN B 0704-0788IBIFS
           #MULTIPLE NUMERICAL INTEGRATION                      B 0650-04.0.002
POINT ADAMS-MOULTON, RUNGE-KUTTA INTEGRATION          #FLOATING B 0704-0450RWDE2
IRD,AND FOURTH ORDER RUNGE-KUTTA INTEGRATION         #SECOND,TH B 0704-1233AAINT
   #SIMPSONS RULE FLOATING-POINT INTEGRATION                    B 0709-0982RWSI2
OINT GILL METHOD FOR RUNGE-KUTTA INTEGRATION         #FLOATING P B 0704-0491RWDE4
T. COWELL /2ND SUM/, RUNGE-KUTTA INTEGRATION         #FLOATING P B 0704-0775RWDE6
TURE                             #INTEGRATION BY GAUSSIAN QUADRA B 0704-0423BSGQI
URE                              #INTEGRATION BY HERMITE QUADRAT B 0704-0423BSHQI
URE                   #NUMERICAL INTEGRATION BY MIDPOINT PROCED B 0704-1017AND10
. PREC. FLOATING PT. RUNGE-KUTTA INTEGRATION OF            #DBL B 0704-0610RWDE2
UATIONS              #ADMINT ADAMS INTEGRATION OF DIFFERENTIAL EQ B 7090-1131AS012
 2ND ORDER EQU.                  #INTEGRATION OF SPECIAL FORM OF B 0704-0141LAS88
GRAL                  #NUMERICAL INTEGRATION OF THE DOUBLE INTE B 0650-07.0.010
D POINTS              #NUMERICAL INTEGRATION OF UNEQUALLY SPACE B 0704-1157TU900
     #FLOATING POINT NUMERICAL INTEGRATION SUBROUTINE           B 0704-0525PKLAQ
     #FLOATING POINT NUMERICAL INTEGRATION SUBROUTINE           B 0704-0525PKLEQ
                    #FORTRAN 2 INTEGRATION SUBROUTINE.          B 0704-0539GLGAU
 GAUSS QUADRATURE METHOD         #INTEGRATION SUBROUTINE, 10 PT. B 0704-0237GLGAU
                         #SINGLE INTEGRATION SUBROUTINE         B 0704-0368NA274
                         #DOUBLE INTEGRATION SUBROUTINE         B 0704-0368NA275
                         #TRIPLE INTEGRATION SUBROUTINE         B 0704-0368NA276
                    #GENERALIZED INTEGRATION SUBROUTINE         B 7090-1132MAGIN
             #4-POINT GAUSSIAN INTEGRATION SUBROUTINE           B 7090-1230EOGAS
ROR                              #INTEGRATION WITH CONTROLLED ER B 0704-1232AAICE
TING POINT OPTIMIZED RUNGE-KUTTA INTEGRATION.              #FLOA B 0709-1170ATRKS
RTRAN FLOATING POINT RUNGE-KUTTA INTEGRATION.                #FO B 0709-1171ATRKS
 FLOATING PT. MILNE, RUNGE-KUTTA INTEGRATION-       #DBL. PREC. B 0704-0610RWDE3
     #N-STRIP TRAPEZOIDAL RULE INTEGRATION/EQUAL INTERVALS/     B 0704-0931PKMTZ
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          #SIMULTANEOUS MULTIPLE INTEGRATION, FLOATING POINT.   B 0704-0240NOSIG
F HOUSTON ASSEMBLR FOR PROC.ENG. INTER CODING SYS        #UNIV O B 0650-02.0.017
 & COSINE INTEGRAL FUNCTIONS     #INTER SUBROU FOR SINE INTEGRAL B 0650-03.2.004
ARY DIFFERENTIAL EQUATION        #INTER SUBROU FOR SOLU OF ORDIN B 0650-04.0.005
R USE OF SPECIAL CHAR   #MODS OF INTER TRANS * IT * COMPILER FO B 0650-02.1.002
S                        #MATRIX INTERCHANGE OF ROWS AND COLUMN B 0704-0085CLMIN
                           #7070 INTERCORRELATION MATRIX, CORR1 B 7070-11.3.003
 - FOR CARD INPUT          #7070 INTERCORRELATION MATRIX, CORR2 B 7070-11.3.004
                 #BINARY TO BCS INTERGER CONVERSION             B 0709-0997MLCVR
                                 #INTERGER PROGRAMMING 1.       B 0704-0969PKIPO
                        #GENERAL INTERGRAL EVALUATOR            B 0704-0825JPINT
                       #WOLONTIS INTERNAL TRANSLATOR * WIT *    B 0650-02.0.019
OMPILER FOR THE 650              #INTERNAL TRANSLATOR * IT * A C B 0650-02.1.001
                           #SORT INTERNALLY                     B 0705-PG-009-0
EAL & COMPLEX ARITHMETIC * #SYMB INTERP SYS FOR IBM 650-653 * R B 0650-07.0.016
/IMMED ACCESS BELL 111   #FL DEC INTERP SYS 650 MAG DRUM CALC W B 0650-02.0.021
OUTINE              #FLICOR FLOATING INTERP. COMPATIBLE OPERATION R B 0650-02.0.020
 TERRAIN MODEL SYS 4 POINT POLY. INTERP. PROG. DA-2 1  #DIGITAL B 0650-09.2.062
ERATIONS WITH COMPLEX NUMBERS    #INTERP. SYS. FOR PERFORMING OP B 1620-02.0.003
                        #CONTOUR INTERPOLATION                  B 0650-09.2.025
                      #PARABOLIC INTERPOLATION                  B 0650-03.1.030
            #DIVIDED DIFFERENCE INTERPOLATION                   B 0704-0116CLDDI
           #BIVARIATE PARABOLIC INTERPOLATION                   B 0704-0248CLPIN
                         #DOUBLE INTERPOLATION                  B 0704-0355GMDTA
                          #TABLE INTERPOLATION                  B 0704-0355GMTAB
NUED FRACTIONS CURVE FITTING AND INTERPOLATION           #CONTI B 0704-0858GS541
                       #LAGRANGE INTERPOLATION                  B 0704-1035SCLAG
            #DIFFERENTIATION OR INTERPOLATION                   B 7090-1235RWDIC
IATION               #LAGRANGIAN INTERPOLATION AND/OR DIFFERENT B 0704-0762RFE00
RVALS                   #AITKENS INTERPOLATION FOR N EQUAL INTE B 0704-0122PKANI
                     #LAGRANGIAN INTERPOLATION FOR STEAM TABLES B 7090-1095WHLDI
 CURVES        #MINIMUM ARC LGTH. INTERPOLATION FOR SURFACES AND B 0704-0483NA029
     #GENERAL PURPOSE POLYNOMIAL INTERPOLATION PROGRAM DA-5     B 0650-09.2.073
                     #LAGRANGIAN INTERPOLATION ROUTINE          B 0704-0692JPGNA
                          #TABLE INTERPOLATION ROUTINE          B 7070-08.6.002
                     #LAGRANGIAN INTERPOLATION SUBROUTINE       B 0704-0197WKLIN
  #TABLE READ IN & TABLE LOOKUP, INTERPOLATION SUBROUTINE       B 0704-0659GCTLU
        #CONTINUOUS DERIVATIVE INTERPOLATION SUBROUTINE         B 0704-0760GECDI
            #SINGLE OR DOUBLE INTERPOLATION SUBROUTINE          B 0704-1129AQALL
                                 #INTERPOLATION SUBROUTINE      B 7070-08.6.001
 SINE AND COSINE                 #INTERPRETABLE DOUBLE PRECISION B 0704-0385BSS&C
 EXPONENTIAL INSTRUCTION         #INTERPRETABLE DOUBLE PRECISION B 0704-0385BSEXP
 LOGARITHM INSTRUCTION           #INTERPRETABLE DOUBLE PRECISION B 0704-0385BSLNX
 SCUARE ROOT INSTRUCTION         #INTERPRETABLE DOUBLE PRECISION B 0704-0385BSSQR
LCULATION FROM RADIOACTIVITY LOG INTERPRETATION    #POROSITY CA B 0650-09.6.006
ION                              #INTERPRETATION MATRIX ABSTRACT B 0704-0085CLMTX
                     #705 MEMORY INTERPRETER                    B 0705-A0-009-0
                       #CHRYSLER INTERPRETER AND 650 SIMULATOR  B 0704-0486CMCIS
                                 #INTERPRETER FOR 650 PROGRAMS  B 0704-0513BEL1A
CISION PROGRAMS.                 #INTERPRETER FOR 650 DOUBLE PRE B 0704-0583BEL1D
FLOATING-POINT ARITHMETIC        #INTERPRETIVE DOUBLE-PRECISION B 0704-0525PKINT
ROUTINE                          #INTERPRETIVE FLOATING DECIMAL B 0650-01.6.020
#DOUBLE-PRECISION FLOATING-POINT INTERPRETIVE PACKAGE.          B 0704-0525PKIND
ARITHMETIC            #COMPLEX 1 * INTERPRETIVE PKGE FOR COMPLEX B 0650-07.0.014
ARITHMETIC           #COMPLEX 11 * INTERPRETIVE PKGE FOR COMPLEX B 0650-07.0.015
09              #MATRIX MANIPULATING INTERPRETIVE PROGRAM FOR THE 7 B 0709-0936LLMMI
M * IPS * * TAPE *               #INTERPRETIVE PROGRAMMING SYSTE B 1620-02.0.001
M * IPS * * CARD *               #INTERPRETIVE PROGRAMMING SYSTE B 1620-02.0.002
LE PRECISION FLOATING POINT SOAP INTERPRETIVE ROU  #DOPSIR DOUB B 0650-02.0.010
                       #SIR SOAP INTERPRETIVE ROUTINE           B 0650-02.0.001
            #COMPLEX ARITHMETIC INTERPRETIVE ROUTINE            B 0650-02.0.003
#ENTRY AND EXIT INSERTER FOR THE INTERPRETIVE ROUTINE           B 0704-0525PKINT
                                 #INTERPRETIVE ROUTINE.         B 0704-0788IBFIR
BM 1620                          #INTERPRETIVE ROUTINE FOR THE I B 1620-02.0.006
E ERROR FUNCTION             #AN INTERPRETIVE SUBROUTINE FOR TH B 0650-03.2.003
ESSEL FUNCTIONS        #A SET OF INTERPRETIVE SUBROUTINES FOR B B 0650-03.2.007
#DOUBLE PRECISION FLOATING POINT INTERPRETIVE SUBROUTINE        B 0704-0385BSINT
RUM CALCULATOR        #STATISTICAL INTERPRETIVE SYS FOR IBM MAG D B 0650-06.0.017
LAB TAPE SYS   #REVISED BELL LAB INTERPRETIVE SYS REVISED BELL  B 0650-02.0.015
                           #ID-3 INTERPRETIVE SYSTEM            B 0650-02.0.022
EX ARITH OPERATIONS IN BELL LAB. INTERPRETIVE SYSTEM     #COMPL B 0650-02.0.012
POINT/            #COMPLEX NUMBER INTERPRETIVE SYSTEM /FLOATING B 0704-0832BECPK
704 COMPILER FOR BELL LABORATORY INTERPRETIVE SYSTEM          # B 0704-0470ELBEL
NFORMATION PROCESSING LANGUAGE V INTERPRETIVE SYSTEM         #I B 0704-1006RSIPL
                #709/7090 IPL-V INTERPRETIVE SYSTEM             B 0709-1027RSIPL
                  #LINCOLN IPLV INTERPRETIVE SYSTEM - 709,7090 B 7090-1196LLIPL
OPY MEMORY ON TO TAPE.           #INTERRUPT FORTRAN-LOADING TO C B 0709-1164MWFOT
                #TALBOT SPIRAL INTERSECTIONS                    B 0650-09.2.077
                #TALBOT SPIRAL INTERSECTIONS                    B 0650-09.2.045
EGRAL EVAL., SIMPSONS RULE /EQU. INTERV./                   #INT B 0704-0116CLINT
ROOTS OF A REAL POLYNOMIAL USING INTERVAL ARITH.           #REAL B 0704-0880IBRRP
ROOTS OF A REAL POLYNOMIAL USING INTERVAL ARITH.           #REAL B 0704-0880IBRRP
ON OF MATRIX EQUATION AX-B USING INTERVAL ARITH.         #SOLUTI B 0704-0880IBSME
ON OF MATRIX EQUATION AX-B USING INTERVAL ARITH.         #SOLUTI B 0704-0880IBSME
                                 #INTERVAL ARITHMETIC SUBROUTINE B 0704-0880IBINT
      #SEISMOGRAM SYN FORM CONT. INTERVAL VELOCITY * CVL *      B 0650-09.6.018
          #ITERATION SUBROUTINE, INTERVAL-HALVING METHOD        B 0704-0327GMITR
ITKENS INTERPOLATION FOR N EQUAL INTERVALS                   #A B 0704-0122PKANI
TEGRAL EVAL., TRAPEZ. RULE /EQU. INTERVALS/                 #IN B 0704-0116CLINT
APEZOIDAL RULE INTEGRATION/EQUAL INTERVALS/        #N-STRIP TR B 0704-0931PKMTZ
 * CARD *                    #AN INVENTORY MANAGEMENT SIMULATOR B 1620-10.2.001
 * TAPE *                        #INVENTORY MANAGEMENT SIMULATOR B 1620-10.2.002
 * CARD *                        #INVENTORY MANAGEMENT SIMULATOR B 1620-10.2.003
7070 FULL FORTRAN VERSION        #INVENTORY MANAGEMENT SIMULATOR B 7070-12.1.001
                         #MATRIX INVERSE                        B 0704-0085CLMIV
ERT                              #INVERSE LAPLACE TRANSFORM, INV B 7090-1125MLCLI
                        #PRODUCT INVERSE LINEAR PROGRAMMING     B 0705-E2-005-0
CTIONS                           #INVERSE NORMAL PROBABILITY FUN B 0709-1002NA801
OUTINE                           #INVERSE TANGENT/COTANGENT SUBR B 7070-08.1.017
                                 #INVERSE, REAL                 B 0704-0223CLMIV
                                 #INVERSE, REAL OR COMPLEX.     B 0704-0223CLMIV
                         #MATRIX INVERSION                      B 0650-05.1.001
     #COMPLEX ARITHMETIC MATRIX INVERSION                       B 0650-05.1.003
                         #MATRIX INVERSION                      B 0650-05.2.001
            #LARGE SCALE MATRIX INVERSION                       B 0650-05.2.007
                         #MATRIX INVERSION                      B 0650-05.2.008
       #DOUBLE PRECISION MATRIX INVERSION                       B 0650-05.2.009
            #SYMMETRICAL MATRIX INVERSION                       B 0650-05.2.013
                         #MATRIX INVERSION                      B 0650-05.2.015
                         #MATRIX INVERSION                      B 0704-0232NYDMI
                         #MATRIX INVERSION                      B 0704-0058UAINV
       #DOUBLE PRECISION MATRIX INVERSION                       B 0704-0405PFIDP
NERAL PROGRAM FOR COMPLEX MATRIX INVERSION                 #A GE B 0704-1075ANF10
                         #MATRIX INVERSION                      B 0705-E2-004-0
                         #MATRIX INVERSION                      B 1620-05.0.006
       #SINGLE PRECISION MATRIX INVERSION                       B 7070-10.1.003
            #GENERALIZED MATRIX INVERSION *  PRINT 1 *          B 0705-IB 0010
                         #MATRIX INVERSION AND LINEAR EQUATIONS B 0704-1030ANF40
ATIONS              #7070 MATRIX INVERSION AND SIMULTANEOUS EQU B 7070-10.1.002
LTANEOUS LINEAR EQUAT    #MATRIX INVERSION AND SOLUTION OF SIMU B 0650-05.2.011
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ION                              #MATRIX INVERSION BY GAUSSIAN ELIMINAT B 0650-05.2.002
                                 #MATRIX INVERSION BY PARTITIONING      B 0704-0324NYDMI
50    #LINEAR PROGRAMMING FORCED INVERSION CODE FOR AUGMENTED 6 B 0650-10.1.009
                                 #MATRIX INVERSION ROUTINE 1 * MIR 1 *  B 0650-05.2.012
R AUGMENT 650#LINEAR PRG. FORCED INVERSION VECTOR PART. CODE FO B 0650-10.1.010
VEMENT OF ACCURACY       #MATRIX INVERSION WITH ITERATIVE IMPRO B 0650-05.2.022
EAR EQUATIONS            #MATRIX INVERSION WITH SOLUTION OF LIN B 0704-0664ANF40
            #SYMMETRIC MATRIX INVERSION.                        B 0704-0573CF009
                         #MATRIX INVERSION.                     B 0704-0405PFELI
     #INVERSE LAPLACE TRANSFORM, INVERT                         B 7090-1125MLCLI
 OF RET-PV2A-FINITE CHAIN OF ONE INVESTMENT       #PRES VAL-RATE B 0650-07.0.018
                       #705 111 IOCS                            A 0705--IO-047
                             #IOCS                              A 1401--IO-065
                      #SIMPLE IOCS                              B 7070-03.4.002
                   #7300 DISC IOCS                              A 7070--IO-905
                        #7080 IOCS                              A 7080--IO-086
              #7070-729 IOCS *SEE 7070-PR-075*                  A 7070--IO-904
08 *                    #IOCS CARD/TAPE * SEE 1410-PR-1         A 1410--IO-909
                   #7090 IOCS INPUT/OUTPUT CONTROL              A 7090--IO-919
08 *                    #IOCS 1405 DISK * SEE 1410-PR-1         A 1410--IO-911
                        #IOMRSD * SEE 0705-IO-047 *             A 0705-
              #709/7090 IPL-V INTERPRETIVE SYSTEM               B 0709-1027RSIPL
,7090                #LINCOLN IPLV INTERPRETIVE SYSTEM - 709    B 7090-1196LLIPL
NTERPRETIVE PROGRAMMING SYSTEM * IPS * * CARD *              #I B 1620-02.0.002
NTERPRETIVE PROGRAMMING SYSTEM * IPS * * TAPE *              #I B 1620-02.0.001
                        #IQ MOD LOADER                          B 7090-1211IQMDL
ROUTINE SAVES THE CONSOLE /AC,MQ,IRA,IRB,IRC,          #THIS SUB B 0704-0345ELSAV
ROUTINE SAVES THE CONSOLE /AC,MQ,IRA,IRB,IRC,          #THIS SUB B 0704-0345ELSAV
INE SAVES THE CONSOLE /AC,MQ,IRA,IRB,IRC,          #THIS SUBROUT B 0704-0345ELSAV
INE SAVES THE CONSOLE /AC,MQ,IRA,IRB,IRC,          #THIS SUBROUT B 0704-0345ELSAV
SAVES THE CONSOLE /AC,MQ,IRA,IRB,IRC,          #THIS SUBROUTINE B 0704-0345ELSAV
SAVES THE CONSOLE /AC,MQ,IRA,IRB,IRC,          #THIS SUBROUTINE B 0704-0345ELSAV
                        #IRREGULAR BESSEL FUNCTIONS             B 0650-03.2.002
UNIT USAGE OTHER THAN THAT WHICH IS            #TO ASSIGN TAPE  B 7090-1199PEIBL
ROUTINE                 #ISENTROPIC PRESSURE CHANGE SUB         B 7090-1095WHISD
       #INTERNAL TRANSLATOR * IT * A COMPILER FOR THE 650       B 0650-02.1.001
AL CHAR   #MODS OF INTER TRANS * IT * COMPILER FOR USE OF SPECI B 0650-02.1.002
                        #IT - 2                                 B 0650-02.1.003
      #SORT, ALGEBRAIC. KEY AND ITEM LENGTH - 1 WORD. OPEN.     B 0704-0570ORSRT
      #SORT, ALGEBRAIC. KEY AND ITEM LENGTH - 1 WORD. CLOSED.   B 0704-0570ORSRT
                   #WEGSTEIN ITERATION                          B 0704-1234AWEG
          #A LEAST SQUARES ITERATION                            B 0709-0934NOLSQ
-HALVING METHOD         #ITERATION SUBROUTINE, INTERVAL         B 0704-0327GMITR
                        #ITERATION SUBROUTINE                   B 0704-0355GMITR
                  #GMITR3 ITERATION SUBROUTINE                  B 0704-0259GMITR
S                       #ITERATION, ONE OR TWO VARIABLE         B 0704-0433MCITR
ACY     #MATRIX INVERSION WITH ITERATIVE IMPROVEMENT OF ACCUR   B 0650-05.2.022
         #MATRIX TRANSPOSED ON ITSELF                           B 0704-0290GEMTO
   #SQUARE MATRIX TRANSPOSED ON ITSELF                          B 0704-0290GESTO
    #SQUARE MATRIX TRANSPOSE ON ITSELF                          B 0704-0432MUMTR
   #SQUARE MATRIX TRANSPOSED ON ITSELF OR DISPLACED IN CORE     B 0704-0661GDF02
                        #COR IV                                 B 0650-06.0.025
  #ALL ORDERS OF BESSEL FUNCTION J SUB K TIMES Z OR I           B 0709-0984RWBF7
                      #BLACK JACK GAME * CARD *                 B 1620-11.0.006
                      #BLACK JACK GAME * TAPE *                 B 1620-11.0.005
F REAL SYMMETRIC MATRICES BY THE JACOBI METHOD   #EIGENVALUES O B 0650-05.1.006
                   #PROP AND JET NUCLEAR-CODE ENGINEERING       B 0704-NUCLEAR
           #BESSEL FUNCTIONS JO/X/AND YO/X/                     B 0704-0833RWBJY
           #BESSEL FUNCTION J1/X/ AND Y1/X/                     B 0704-0833RWBJY
                      #K TIMES UNIT MATRIX                      B 0704-0085CLMKO
RS OF THE BESSEL FUNCTIONS Y SUB K TIMES Z            #ALL ORDE B 0709-0985RWBF8
 ORDERS OF BESSEL FUNCTION J SUB K TIMES Z OR I           #ALL B 0709-0984RWBF7
                       # K-CODE  NUCLEAR-CODE                   B 0650-08.2.008
CE FOR PART. OR SING. REPLICATED KBY      #ANALYSIS OF VARIAN B 0650-06.0.063
OMIC CONDUCTOR SIZE SELECTION BY KELVINS LAW             #ECON B 1620-09.4.005
OPEN.       #SORT, ALGEBRAIC. KEY AND ITEM LENGTH - 1 WORD.     B 0704-0570ORSRT
CLOSED.     #SORT, ALGEBRAIC. KEY AND ITEM LENGTH - 1 WORD.     B 0704-0570ORSRT
                        #KEY WORD IN CONTEXT                    B 0704-0884PKKWI
         #READS THE SORTED KEY WORDS FROM NC 139                B 0704-1144NC014
      #PROGRAM TO SORT THE KEY WORDS FROM NC138                 B 0704-1144NC013
AIC. MULTIWORD KEYS. /WHOLE WORD KEYS ONLY/      #SORT, ALGEBR B 0704-0570ORSRT
ROUTINE                 #KEYS SEARCH BCD LISTING TAPE           B 0709-0921VGKEY
    #SORT, ALGEBRAIC. MULTIWORD KEYS. /WHOLE WORD KEYS ONLY/    B 0704-0570ORSRT
E                    #OUT OF KILTER NETWORK FLOW ROUTINE ON     B 7090-1084RSOKF
                        #KIN * X * SUBROUTINE                   B 0650-07.0.009
NERATING MECHANISMS     #KINEMATIC SYNTHESIS OF PATH GE         B 0650-09.5.003
CODE            # ARMOUR REACTOR KINETICS %ARK-1¤ CODE NUCLEAR- B 0650-08.2.019
CING                   #EASTMAN KODAK CON. EDISON TRANSFER TRA  B 0705-EK 0003
 #FLOATING POINT OPTIMIZED RUNGE KUTTA                          B 0704-1147ECRKO
             #MODIFIED PK KWIC PROGRAM /SDA 884/                B 0704-1144NC013
NCHING                  #KWIC REPORT FOR PRINTING OR PU         B 0704-0913NCKRF
                        #KWIC SORT PROGRAM FIRST PART           B 0704-0914NCKSP
                        #KWIC SORT PROGRAM SECOND PART          B 0704-0914NCKSP
                      #G & L POST PROCESSOR                     B 0650-10.3.008
ELL LAB TAPE SYS   #REVISED BELL LAB INTERPRETIVE SYS REVISED B B 0650-02.0.015
AB INTERPRETIVE SYS REVISED BELL LAB TAPE SYS   #REVISED BELL L B 0650-02.0.015
COMPLEX ARITH OPERATIONS IN BELL LAB. INTERPRETIVE SYSTEM     # B 0650-02.0.012
                   #TAPE LABEL,TRA,CHECK POINT ROUTINE          B 0705-SR-001-0
      #704 COMPILER FOR BELL LABORATORY INTERPRETIVE SYSTEM     B 0704-0470ELBEL
                   #BELL LABS PERMUTATION INDEX PROGRAM         B 7090-1239BEPIP
                        #LADPAC UTILITY ROUTINES                B 0650-01.6.039
                        #LAGRANGE INTERPOLATION                 B 0704-1035SCLAG
NE                      #LAGRANGIAN INTERPOLATION ROUTI         B 0704-0692JPGNA
R DIFFERENTIATION       #LAGRANGIAN INTERPOLATION AND/O         B 0704-0762RFE00
UTINE                   #LAGRANGIAN INTERPOLATION SUBRO         B 0704-0197WKLIN
TEAM TABLES             #LAGRANGIAN INTERPOLATION FOR S         B 7090-1095WHLDI
                        #LAMP-LESS ARITHMETIC PROGRAM           B 1620-01.1.001
                        #LAND AREA - SURVEY TRAVERSE            B 0650-09.2.054
                   #FIVE LAND SURVEYING PROGRAMS                B 0650-09.6.012
 FOR FORTRAN MONITOR WITH SOURCE LANG DEBUG       #OFFLINE EDIT B 7090-1115GPFMS
  #EXTENTION OF FORTRAN 2 SOURCE LANGUAGE                       B 0704-0812GPFMG
M IMMEDIATELY MAKING PROGRAMMING LANGUAGE EASY           #SYSTE B 0704-1096TVSMP
ON     #COMIT - GENERAL PURPOSE LANGUAGE FOR SYMBOL MANIPULATI B 0709-1198MICOM
        #INFORMATION PROCESSING LANGUAGE V INTERPRETIVE SYSTEM  B 0704-1006RSIPL
EQUATION  #NUMERICAL SOLUTION OF LAPLACE POISSON AND HEAT FLOW  B 0650-04.0.010
                 #INVERSE LAPLACE TRANSFORM, INVERT             B 7090-1125MLCLI
                        #LAPLACE TRANSFORMATION                 B 0650-04.0.004
OORDINATE SYS    #RELAXATION PROG LAPLACES EQUA IN CYLINDRICAL C B 0650-04.0.008
COORDINATES      #RELAXATION PROG LAPLACES EQUAT IN RECTANGULAR B 0650-04.0.007
        #NEUMANN FUNCTIONS OF LARGE ARGUMENTS                   B 0704-0416CSNMB
NEOUS EQUATION SOLVER   #LARGE DOUBLE PRECISION SIMULTA         B 7090-1149AS012
     #STORE ROW MATRICES INTO A LARGE MATRIX                    B 0704-0223CLMST
                        #LARGE SCALE MATRIX INVERSION           B 0650-05.2.007
MATRIX                  #LATENT ROOTS AND VECTORS OF A          B 0650-05.2.016
MATRIX   #MOLECULAR SPECTROSCOPY LATENT ROOTS AND VECTORS OF A  B 0650-05.2.024
                 #ANALYSIS OF LATERALLY LOADED PILES            B 0650-09.2.013
ANCE                    #LATIN SQUARES ANALYSIS OF VARI         B 0704-0776RWAV5
ANCE                    #LATIN SQUARES ANALYSIS OF VARI         B 0704-0491RWAV3
DUCTOR SIZE SELECTION BY KELVINS LAW             #ECONOMIC CON B 1620-09.4.005
. TRA ROUTINE PROG TAPE OPR TAPE LBL&TRAILER CKN           #GEN B 0705-SR-002-0

                        #LD, LOADING ROUTINE                    B 0650-01.2.007
ALCOR *                 #CAM LEADER CO-ORDINATE ROUTINE * C     B 0650-09.5.006
                   #VIPP INSERT LEADING BLANKS.                 B 0704-0895TAVIL
CHED. PHASE ONLY LESS F. BACKER #LEAST COST EST. & SCHEDULING-S B 0650-10.3.005
NLY * LESS * M. C. FRISHBERG    #LEAST COST EST.&SCHED. PHASE O B 0650-10.3.009
DULING *         #1401 LESS 4K * LEAST COST ESTIMATING AND SCHE B 1401-10.3.001
D *        #1401 LESS 8K,12K,16K * LEAST COST ESTIMATING AND SCHE B 1401-10.3.002
NG * TAPE *           #1620 LESS * LEAST COST ESTIMATING&SCHEDULI B 1620-10.3.001
NG * SCHEDULING PORTION *#LESS * LEAST COST ESTIMATING SCHEDULI B 1620-10.3.002
NG * SCHED PORTION#LESS * CARD * LEAST COST ESTIMATING SCHEDULI B 1620-10.3.003
OLYNOMIAL FIT                   #LEAST MAXIMAL ABSOLUTE ERROR P B 0704-0500BSBFP
CT. WITH LINEAR INC. OF VEL.    #LEAST SQ. DETER. FOR A VEL FUN B 0650-09.6.016
UNCTION FOR REFRACT. T/D DATA   #LEAST SQ. DETER. OF VELOCITY F B 0650-09.6.020
T. AND SLOPE OF A  #CALC. OF THE LEAST SQRS. BEST 1/2WAVE POTEN B 0650-09.3.003
ROUTINE         #FN II NTH DEGREE LEAST SQU COEF COMPUTATION SUB B 0704-0848ARPLN
TINE                    #GENERAL LEAST SQUARE CURVE FITTING ROU B 0704-0775RWGLS
TINE.                   #GENERAL LEAST SQUARE CURVE FITTING ROU B 0704-0742RWLS3
AL FIT                  #ARGONNE LEAST SQUARE LEGENDRE POLYNOMI B 0704-0424ANE20
IMATION                #WEIGHTED LEAST SQUARE POLYNOMIAL APPROX B 0650-06.0.009
ORTRAN II/                      #LEAST SQUARE POLYNOMIAL FIT /F B 0704-0772ANE20
        #POLLY-POLYNOMIAL FIT BY LEAST SQUARES                  B 0650-06.0.010
                                #LEAST SQUARES                  B 7090-1243SILSQ
                        #GENERAL LEAST SQUARES ANALYSIS         B 0650-06.0.027
TH ORTHOGONAL POLYNOMIALS       #LEAST SQUARES CURVE FITTING WI B 0650-06.0.023
UTINE USING ORTHOGONAL          #LEAST SQUARES CURVE-FITTING RO B 0704-0636RWCF2
UTINE                           #LEAST SQUARES CURVE-FITTING RO B 0709-0860RWCF
E                     #A GENERAL LEAST SQUARES FITTING PROCEDUR B 0704-1076ANE20
AM.                     #GENERAL LEAST SQUARES FORTRAN SUBPROGR B 0704-0635RWGLS
                              #A LEAST SQUARES ITERATION        B 0709-0934NOLSQ
     #POLYNOMIAL OF BEST FIT BY LEAST SQUARES METHOD            B 0650-06.0.006
                                #LEAST SQUARES POLYNOMIAL FIT   B 0704-0116CLLSQ
XIMATION.                       #LEAST SQUARES POLYNOMIAL APPRO B 0704-0617CA021
 FITTING ROUTINE                #LEAST SQUARES POLYNOMIAL CURVE B 0705-A0-003-0
              #THREE DIMENSIONAL LEAST SQUARES PROCEDURE.       B 0704-0533CF009
N CURVE FITTING                 #LEAST SQUARES RATIONAL FUNCTIO B 0704-0859GSL16
EOUS EQUATIONS                  #LEAST SQUARES SOL. OF SIMULTAN B 0704-0116CLLSQ
                     #NON-LINEAR LEAST SQUARES.                 B 0704-0837ORNLL
                    # ASSOCIATED LEGENDRE FUNCTIONS             B 0704-1040JPASL
        #ARGONNE LEAST SQUARE LEGENDRE POLYNOMIAL FIT           B 0704-0424ANE20
                            #NTH LEGENDRE POLYNOMIAL            B 0704-0654AMPLG
                            #NTH LEGENDRE POLYNOMIAL            B 0704-0654AMPLG
                            #NTH LEGENDRE POLYNOMIAL            B 0704-0654AMPLG
N             #NUMERICAL SOLUTION OF LEGENDRES DIFFERENTIAL EQUATIO B 1401-11.0.002
  #SORT, ALGEBRAIC. KEY AND ITEM LENGTH - 1 WORD. CLOSED.       B 0704-0570ORSRT
  #SORT, ALGEBRAIC. KEY AND ITEM LENGTH - 1 WORD. OPEN.         B 0704-0570ORSRT
   #709/7090 GENERALIZED VARIABLE LENGTH RECORD SORT            B 0709-1159MDSOR
ATING SCHEDULING * SCHED PORTION#LESS * CARD * LEAST COST ESTIM B 1620-10.3.003
CHEDULING * TAPE *          #1620 LESS * LEAST COST ESTIMATING&S B 1620-10.3.001
CHEDULING * SCHEDULING PORTION *#LESS * LEAST COST ESTIMATING S B 1620-10.3.002
ST COST EST.&SCHED. PHASE ONLY * LESS * M. C. FRISHBERG    #LEA B 0650-10.3.009
. & SCHEDULING-SCHED. PHASE ONLY LESS F. BACKER #LEAST COST EST B 0650-10.3.005
                                #LESS 11 * TAPE *               B 1620-10.3.004
G AND SCHEDULING *          #1401 LESS 4K * LEAST COST ESTIMATIN B 1401-10.3.001
STIMATING AND SCHED *   #1401 LESS 8K,12K,16K * LEAST COST E    B 1401-10.3.002
                                #LESS-PHASE 1A-NODE NUMBERING   B 0650-10.3.007
                   #STUDENTS T AT .05 LEVEL                     B 0704-0837ORT05
       #COMPUTATION OF A MIN 2 LEVEL &/OR SWITCHING CIRCUIT     B 0704-1104PKMIN
ES AND CURVES     #MINIMUM ARC LGTH. INTERPOLATION FOR SURFAC   B 0704-0483NA029
RE ROOT, FLOATING-POINT, FORTRAN LIB. VERSION           #SQUA   B 0704-0399MISRT
IFIED NUBES1 PROGRAM FOR FORTRAN LIBRARY                #MOD    B 0704-0547PFBES
01 PROGRAM TO MAINTAIN THE SHARE LIBRARY ABSTRACTS      #A 14   B 0704-1165PNSLI
                          #TAPE LIBRARY CONTROL SYSTEM          B 1401-02.0.001
 PROGRAM                  #CROWN LIFE INSURANCE COMPANY SORTING B 0650-01.5.006
CIMAL OUTPUT PROGRAM UNDER SENSE LIGHT CONTROL           #DE    B 0704-0206NYOUT
        #INPUT PROGRAM UNDER SENSE LIGHT CONTROL                B 0704-0206NYINP
        #INPUT PROGRAM UNDER SENSE LIGHT CONTROL                B 0709-1025WPK06
CIMAL OUTPUT PROGRAM UNDER SENSE LIGHT CONTROL           #DE    B 0709-1026WPK07
MIC PROPS AND PHASE BEHAVIOR OF LIGHT HYDROCARBON M#THERMODYNA B 0650-09.3.002
                         #SET SENSE LIGHTS                      B 0704-0654AMCHK
NSIONAL PROGRAM NUCLEAR-CODE    # LIL ABNER A FEW-GROUP ONE DIME B 0650-08.2.007
EM - 709,7090                   #LINCOLN IPLV INTERPRETIVE SYST B 7090-1196LLIPL
                     #PRODUCTION LINE BALANCING                 B 0650-10.3.002
                     #PRODUCTION LINE BALANCING                 A 1620--LM-018
                       #STRAIGHT LINE BRIDGE GRID SYSTEM        B 0650-09.2.058
OMENT DISTRIBUTION AND INFLUENCE LINE CALCULATION          #M   B 0650-09.2.033
LOCATABLE OCTAL-COLUMN BINARY ON LINE FORTRAN LOADER       #RE  B 0704-0912ASAS8
                             #ON LINE OCTAL DUMP                B 0704-0499CMOCD
IRD. BRIDGE  #MOMENT REACT INFLU LINE ORDINATE FROM CONTINUOS G B 0650-09.2.057
                             #ON LINE PLOT ROUTINE              B 0704-0392OLPLO
                     #PERIFPHERAL LINE PRINTER VERIFIER         B 0704-0262NYPLV
                       #EARTHWORK LINE SHIFT                    B 0650-09.2.022
CTION AND EMPLOYMENT SCHEDULE  #LINEAR DECISION RULE FOR PRODU B 0650-10.3.001
ION AND SOLUTION OF SIMULTANEOUS LINEAR EQUAT    #MATRIX INVERS B 0650-05.2.011
       #SOLUTION OF SIMULTANEOUS LINEAR EQUATION                B 7070-10.4.001
UTINE        #FN II SIMULTANEOUS LINEAR EQUATION SOLUTION SUBRO B 0704-0848ARNXN
                                #LINEAR EQUATION SOLVER         B 0704-0742RWLE3
 MATRICES                       #LINEAR EQUATION SOLVER OF BAND B 0709-0990RWLE4
       #SOLUTION OF SIMULTANEOUS LINEAR EQUATIONS               B 0650-05.1.002
        #SYMMETRIC SIMULTANEOUS LINEAR EQUATIONS                B 0650-05.2.010
UTION OF SYSTEMS OF SIMULTANEOUS LINEAR EQUATIONS         #SOL B 0650-05.2.021
            #MATRIX INVERSION AND LINEAR EQUATIONS              B 0704-1030ANF40
ATRIX INVERSION WITH SOLUTION OF LINEAR EQUATIONS          #M B 0704-0664ANF40
A PROGRAM FOR SOLVING SYSTEMS OF LINEAR EQUATIONS           # B 1401-11.0.003
       #SOLUTION OF SIMULTANEOUS LINEAR EQUATIONS               B 1620-05.0.007
 CODED 7090                     #LINEAR EQUATIONS SOLUTION FAP  B 7090-1206NULEQ
       #SLEP, SOLVES SIMULTANEOUS LINEAR EQUATIONS WITH PIVOTING B 7070-10.4.002
SQ. DETER. FOR A VEL FUNCT. WITH LINEAR INC. OF VEL.     #LEAST B 0650-09.6.016
EPTH   #NORMAL MOVEOUT COMP. FOR LINEAR INC. OF VELOCITY WITH D B 0650-09.6.019
                                #LINEAR MATRIX EQUATION SOLVER  B 0704-0635RWMAT
ECTOR PART. CODE FOR AUGMENT 650#LINEAR PRG. FORCED INVERSION V B 0650-10.1.010
                           #1401 LINEAR PROGRAM                 B 1401-10.1.001
ION          #MXV PROGRAM FOR LINEAR PROGRAM MATRIX PREPARAT    B 1620-10.1.004
                                #LINEAR PROGRAM S1&S2           B 7070-06.1.001
                                #LINEAR PROGRAMING SYSTEM       B 0704-0108RSLPS
                                #LINEAR PROGRAMMING             B 0650-10.1.001
                                #LINEAR PROGRAMMING             B 0650-10.1.002
                                #LINEAR PROGRAMMING             B 0650-10.1.004
                                #LINEAR PROGRAMMING             B 0650-10.1.005
          #THE SYMMETRIC METHOD OF LINEAR PROGRAMMING           B 0650-10.1.008
    #MACHINE LOADING PROBLEM OF LINEAR PROGRAMMING              B 0704-0789IBMLI
                                #LINEAR PROGRAMMING             B 0705-E1-001-0
           #PRODUCT INVERSE LINEAR PROGRAMMING                  B 0705-E2-005-0
E AUGMENTED IBM 650             #LINEAR PROGRAMMING CODE FOR TH B 0650-10.1.006
                   #FORTRAN LINEAR PROGRAMMING CODE.            B 0704-0480CEFLP
20 WITH CARD INPUT&OUTPUT       #LINEAR PROGRAMMING CODE FOR 16 B 1620-10.1.002
RD 1620                         #LINEAR PROGRAMMING CODE FOR CA B 1620-10.1.006
RSION CODE FOR AUGMENTED 650    #LINEAR PROGRAMMING FORCED INVE B 0650-10.1.009
0 * TAPE *                      #LINEAR PROGRAMMING FOR THE 162 B 1620-10.1.001
704.            #COMPREHENSIVE LINEAR PROGRAMMING ON THE IBM    B 0704-0818CESCR
 THE IBM RAMAC 305              #LINEAR PROGRAMMING ROUTINE FOR A 0305--MI-002
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                           #LINEAR PROGRAMMING SUBROUTINE  B 0704-0523SCMUS
CESSOR TO SCROL          # 7090 LINEAR PROGRAMMING SYSTEM - SU B 7090-1195IKLP9
BOUNDS ON VARIABLES        #LINEAR PROGRAMMING WITH UPPER  B 0704-0973RSBP1
            #STEPWISE MULTIPLE LINEAR REGRESSION * TAPE *   B 1620-06.0.006
            #STEPWISE MULTIPLE LINEAR REGRESSION * CARD *   B 1620-06.0.007
THE IBM 7070  #STEPWISE MULTIPLE LINEAR REGRESSION ANALYSIS ON  B 7070-11.3.006
ISE METHOD          #MULTIPLE LINEAR REGRESSION BY THE STEPW B 7070-11.3.002
              #TWO VARIABLE LINEAR REGRESSIONCCORRELATION   B 0650-06.0.054
                   #COMPLEX LINEAR SYSTEM SOLUTION PROGRAM B 0704-0522PFEL3
LE-PRECISION USING         #LINEAR SYSTEM SOLUTION IN DOUB B 0704-0543PFSLD
ON OF SHUNT CAPACITORS ON RADIAL LINES            #LOCATI B 1620-09.4.002
IP,VMCTR          #GSEL,FMCTR,LINK,MOVE,OPHLT,SEQCK,SIGN,STR B 0705-BW-002-0
       #TEMPERATURE OF SATURATED LIQUID                    B 7090-1095WHTSL
  #SPECIFIC VOLUME OF COMPRESSED LIQUID                    B 7090-1095WHVCL
    #SPECIFIC VOLUME OF SATURATED LIQUID                   B 7090-1095WHVSL
THALPY AND ENTROPY OF COMPRESSED LIQUID                #EN B 7090-1095WHHCL
          #ENTHALPY OF SATURATED LIQUID                    B 7090-1095WHHSL
          #PRESSURE OF SATURATED LIQUID                    B 7090-1095WHPSL
           #ENTROPY OF SATURATED LIQUID                    B 7090-1095WHSSL
       #TEMPERATURE OF SATURATED LIQUID FROM ENTHALPY      B 7090-1095WHTSH
S       #ENTHALPY OR ENTROPY IN LIQUID SUPERHEAT OR WET REGION B 7090-1095WHSSI
IZONTAL CYLINDRICAL TANKS      #LIQUID VOLUMES IN FLAT END HOR B 0650-09.7.005
                #VISCOSITY OF LIQUID WATER                 B 7090-1095WHVIS
                           #LIST 75                        A 0705--MI-058
                           #LIST 77                        A 0705--MI-059
CONTROL PANEL FOR SOAP II 8-WORD LIST, AND 650 LOAD CARD  #402 B 0650-12.0.005
        #SHARE CATALOG UPDATER, LISTER. 1401 PROGRAM.      B 0704-1224UCSCU
                #705 ADDRESS LISTING                       B 0705-A0-005-0
                #705 ADDRESS LISTING                       B 0705-NW-001-0
70 LORELI 2 * LOCATION REFERENCE LISTING *             #70 B 7070-04.4.003
INT RECORD TAPE 40K  #FLOW CHART LISTING FROM ASSEMBLY PROG  PR B 0705-IB 0003
01      #CARD REPRODUCING AND/OR LISTING PROGRAM FOR THE IBM 14 B 1401-01.4.003
             #KEYS SEARCH BCD  LISTING TAPE ROUTINE         B 0709-0921VGKEY
      #FLOATING POINT LOG AND LN A                         B 0650-03.1.019
                #LOG 10 A, LN E A                          B 0650-03.1.013
GIVEN X, THIS PROGRAM CALCULATES LN X TO 20D OR 20S.     # B 0704-0498CA004
           #PROBABILITY OF LOSS OF LOAD                    B 0650-09.4.006
               #ONE CARD LOWER LOAD                        B 0705-EK 0001
               #ONE CARD UPPER LOAD                        B 0705-EK 0002
                   #CHANGE CARD LOAD                       B 0705-AF-001-1
                   #CHANGE CARD LOAD                       B 0705-AF-001-1
                   #CARD TO TAPE LOAD                      B 0705-AF-012-0
                           #LOAD AND UNLOAD DISK FILE 1    A 0650--UT-103
APE TO CORE AND DRUMS      #LOAD BINARY CARD IMAGES FROM T B 0704-0395LL010
FOR SOAP II 8-WORD LIST, AND 650 LOAD CARD  #402 CONTROL PANEL  B 0650-12.0.005
                           #LOAD DECK AUDITOR              B 0650-01.2.010
                           #LOAD DECK GENERATOR            B 0650-01.6.026
             #SELF-CHECKING LOAD DECK GENERATOR            B 0650-01.6.033
                   #50 BUS LOAD FLOW PROGRAM               B 0650-09.4.003
                   #99-BUS LOAD FLOW PROGRAM               B 0650-09.4.005
            #30 SERIES BUS LOAD FLOW PROGRAM               B 0650-09.4.012
                 #ELECTRIC LOAD FLOW PROGRAM * TAPE *      B 1620-09.4.001
                 #ELECTRIC LOAD FLOW PROGRAM * CARD *      B 1620-09.4.003
F *                #DUMP AND LOAD ROUTINE FOR IBM 650 * SOS B 0650-01.2.012
#DOUBLE PRECISION FLOATING POINT LOAD SUBROUTINE           B 0704-0385DSCON
                           #LOAD SUBROUTINE                B 7070-02.4.005
                           #LOAD 2 UNLOAD DISK FILE 2      A 0650--UT-104
           #709 FORTRAN LOAD/UNLOAD PACKAGE                B 0709-1133EL9LU
       #ANALYSIS OF LATERALLY LOADED PILES                 B 0650-09.2.013
               #FOUR-PER-CARD LOADER                       B 0650-01.2.001
              #SEVEN-PER-CARD LOADER                       B 0650-01.2.002
            #INDEPENDANT TABLE LOADER                      B 0650-01.2.011
      #MULTIPLE PROGRAM DUMP AND LOADER                    B 0650-01.5.004
                 #ABSOLUTE BINARY LOADER                   B 0704-0405PFCCB
       #TWO CARD BINARY AND OCTAL LOADER                   B 0704-0381ASAS5
        #24 WORD PER CARD BINARY LOADER                    B 0704-0263MULBL
           #DECIMAL, OCTAL, BCD LOADER                     B 0704-0073UADBC
                 #MNEMONIC OCTAL LOADER                    B 0704-0274RS014
                   #BINARY OCTAL LOADER                    B 0704-0215NYBOL
                #SIX CARD UPPER LOADER                     B 0704-1183GDCOR
             #704 SURGE OBJECT LOADER                      B 0704-0877ECOLO
        #EXTENDED FORTRAN 2 BSS LOADER                     B 0704-0902NULUC
       #RELOCATABLE FORTRAN BSS LOADER                     B 0704-0909MPBSS
               #GENERAL PROGRAM LOADER                     B 0704-0844MEGPL
BINARY CARD AND CORRECTION CARD LOADER          #ABSOLUTE B 0704-0525PKCSB
            #DECIMAL, OCTAL, BCD LOADER                    B 0704-0756RWINP
             #RELOCATABLE BINARY LOADER                    B 0704-0467BECSB
            #DECIMAL, OCTAL, BCD LOADER                    B 0704-0756RWINP
       #ARGONNE TAPE LOWER BINARY LOADER                   B 0704-0503ANI11
     #ARGONNE CARD TO BINARY TAPE LOADER                   B 0704-0503ANI11
               #GENERAL PROGRAM LOADER                     B 0704-0508DIGPL
                   #BINARY TAPE LOADER                     B 0704-0425WBTSB
        #BINARY OCTAL CARD OR TAPE LOADER                  B 0704-0690GDBOT
   #ABSOLUTE AND CORRECTION CARD LOADER                    B 0704-0572PFCCB
            #RELOCATABLE BINARY LOADER                     B 0709-0563SE9RB
CARD ROW BINARY-OCTAL UPPER CARD LOADER          #709 FOUR B 0709-0819GDBOC
             #BINARY AND OCTAL LOADER                      B 0709-0951NA092
#SELF-LOADING BINARY-OCTAL LOWER LOADER                    B 0709-0999RL039
                #ROW BINARY CARD LOADER                    B 0709-1034SCCSB
               #CORRECTION CARD LOADER                     B 1401-01.4.001
                       #RELOCATING LOADER                  B 1620-01.2.002
           #DECIMAL, OCTAL, BCD LOADER                     B 7090-1138RWINP
                           #IQ MOD LOADER                  B 7090-1211IQMDL
AL-COLUMN BINARY ON LINE FORTRAN LOADER       #RELOCATABLE OCT B 0704-0912ASAS8
#CALL * CARAT ASSEMBLED LOGICAL LOADER *                   B 1401-01.4.002
              #MURA LOWER BINARY LOADER /ONE CARD/         B 0704-0251MULBL
  #MURA UPPER RELOCATABLE BINARY LOADER /ONE CARD/         B 0704-0432MURBL
     #OCTAL COLUMN BINARY CARD LOADER /THREE CARDS/.       B 0704-0668MUCBL
                           #BINARY LOADER AND CHECKSUM CORRECTOR  B 0709-0563SE9BL
                        #PRINT BSS LOADER DIAGNOSTICS      B 0704-0830MINOL
TSF. CARDS              #ON-LINE LOADER FOR COL. BIN. ABS. AND  B 0704-1012ORCBL
        #ABSOLUTE BINARY UPPER LOADER ONE CARD             B 0709-1102SE9DU
                     # 709-7090 LOADER PACKAGE             B 0709-1045HDLOA
                      #WRITE BSS LOADER STORAGE MAP        B 0704-0830MISTP
                      #WRITE BSS LOADER STORAGE MAP        B 0704-0830MISTP
                 #GENERAL CARD LOADER SUBROUTINE GROUP     B 0704-0446PECSM
       #TAPE CREATING PROGRAM AND LOADER SUBROUTINE.       B 0704-0734PFPRO
FN II BINARY SYMBOLIC SUBROUTINE LOADER WITH FL.PT.OFL.  # B 0704-0848AKBSS
UTE AND CORRECTION TRANSFER CARD LOADER.          #ABSOL B 0704-0673WH005
 #ABSOLUTE AND RELOCATABLE OCTAL LOADER.                   B 0704-0623ELROL
 ONE CARD ABSOLUTE BINARY UPPER LOADER.                  # B 0704-0473CSBUL
BINARY CARD AND CORRECTION CARD LOADER.          #ABSOLUTE B 0704-0525PKCSB
                        #TWO MACHINE LOADER.               B 0709-0709RWTML
TAPE /ROW AND/OR COLUMN BINARY/ LOADER.     #FORTRAN CARD OR B 0709-1163MWRCT
S PROGRAM           #SOS PROGRAM LOADER. CALLS IN A SELECTED SO B 7090-1229IQCSO
                    #FORTRAN LOADER/PACKAGE                A 7070--FO-116
        #RELOCATING BINARY LOADER, UPPER                   B 0704-0525PKCSB
        #RELOCATING BINARY LOADER,LOWER                    B 0704-0525PKCSB
        #RELOCATING BINARY LOADER,LOWER                    B 0709-0563SE9LR
        #RELOCATING BINARY LOADER,UPPER                    B 0709-0563SE9UR
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                       #PROGRAM LOADERS                    B 1620-01.2.001
                         #CHAIN LOADING ADDITIONS & DELETIONS  A 0650--UT-104
RAMMING                #MACHINE LOADING PROBLEM OF LINEAR PROG B 0704-0789IBML1
               #FIVE-PER-CARD LOADING ROUTINE              B 0650-01.2.003
                #SIX-PER-CARD LOADING ROUTINE              B 0650-01.2.004
              #EIGHT-PER-CARD LOADING ROUTINE              B 0650-01.2.006
                         #LD, LOADING ROUTINE              B 0650-01.2.007
             #SORT 55 CHECKING LOADING ROUTINE             B 0705-EQ-001-0
INARY CONVERTER     *#709 SELF LOADING ROW BINARY TO COLUMN B B 0709-0808GDRCC
                         #SELF LOADING TAPE WRITE PROGRAM.  B 0704-0899METOU
                         #SELF LOADING TAPE WRITING ROUTINE  B 0704-0781WH004
                         #SELF LOADING TAPE WRITING ROUTINE  B 0704-0781WH004
                        #LOADOMETER H-6 TABLE              B 0650-09.2.037
ION AND TRANSFER         #LOADS BINARY ABSOLUTE, CORRECT B 0704-0449MI9SI
                      #AB AND LOB                            0650-01.2.008
N RADIAL LINES           #LOCATION OF SHUNT CAPACITORS O B 1620-09.4.002
        #7070 LORELI 2 * LOCATION REFERENCE LISTING *      B 7070-04.4.003
                  #ADDRESS LOCATION SUBROUTINE.            B 0709-1120ATLOC
             #ROOT AND GAIN LOCUS                          B 0650-09.8.001
          #FLOATING POINT LOG AND LN A                     B 0650-03.1.019
                      #LOG BASE 10 OR BASEE                B 7070-08.2.002
               #SUBROUTINE LOG EX FOR THE 7070             B 7070-08.2.004
Y CALCULATION FROM RADIOACTIVITY LOG INTERPRETATION    #POROSIT B 0650-09.6.006
                      #LOG 10 A, LN E A                    B 0650-03.1.013
NARY ARITH.        #NORMALIZED LOG-EXTENDED RANGE FLOATING BI B 0704-0370RS013
                  #NATURAL LOGARITHM                       B 0650-03.1.014
         #COMPLEX NATURAL LOGARITHM                        B 0704-0354NA66.
        #FLOATING NATURAL LOGARITHM                        B 0704-0069LAS82
             #FIXED POINT LOGARITHM                        B 0704-0466RL017
    #FLOATING POINT NATURAL LOGARITHM                      B 0709-0507IBLOG
ING POINT SUBROUTINE FOR NATURAL LOGARITHM FOR      #FLOAT B 0704-0525PKLGA
 #INTERPRETABLE DOUBLE PRECISION LOGARITHM INSTRUCTION     B 0704-0385BSLNX
     #FLOATING POINT NATURAL LOGARITHM OF NORMALIZED       B 0709-0665IBLG3
N FOR COMPLEX ARGUMENTS      #LOGARITHM OF THE GAMMA FUNCTIO B 0704-0493LAS86
   #FLOATING-POINT 709 NATURAL LOGARITHM SUBROUTINE        B 0709-0892RWLN3
                        #LOGARITHM SUBROUTINE              B 7070-08.2.005
                #NATURAL LOGARITHM SUBROUTINE              B 7070-08.2.008
        #MURA FIXED POINT LOGARITHM, BASE E                B 0704-0283MULOG
        #MURA FIXED POINT LOGARITHM, BASE 2                B 0704-0280MULOG
        #MURA FIXED POINT LOGARITHM, BASE 2.               B 0704-0357MULOG
OR 32K704           #GENERAL LOGICAL CORE SORT SUBROUTINE F B 0704-1054BSSEA
  # RESET AND CLEAR CORE AND N LOGICAL DRUMS               B 0704-0443LL024
      #CALL * CARAT ASSEMBLED LOGICAL LOADER *             B 1401-01.4.002
IME                      #   LOGICAL MEMORY SORT, MINIMUM T B 0704-0468CF005
                  #SQUARE TABLE LOOK UP                    B 0705-AF-013-0
         #N DIMENSIONAL TABLE LOOK UP                      B 7090-1204MACUR
              #TRIVARIATE TABLE LOOK-UP                    B 0704-0452SCTRI
EM                     #NEW MACRO LOOK-UP FOR 705 AUTOCODER SYST B 0705-PG-012-0
                #RANDOM TABLE LOOKUP SUBROUTINE            B 0704-0551CSDEV
NE         #TABLE READ IN & TABLE LOOKUP, INTERPOLATION SUBROUTI B 0704-0659GCTLU
                 #MATRIX LOOP TEST                         B 0704-0085CLMLP
                       #LOOPCODER                          B 0705-HB-001-0
LISTING *              #7070 LORELI 2 * LOCATION REFERENCE B 7070-04.4.003
          #PROBABILITY OF LOSS OF LOAD                     B 0650-09.4.006
             #TRANSMISSION LOSSES AND PENALTY FACTORS      B 1620-09.4.008
 PROGRAM NUCLEAR-CODE          # LOST A CROSS SECTION AVERAGING B 0650-08.2.004
      #RELOCATING BINARY LOADER,LOWER                      B 0704-0525PKCSB
      #RELOCATING BINARY LOADER,LOWER                      B 0709-0563SE9LR
              #ARGONNE TAPE LOWER BINARY LOADER            B 0704-0503ANI11
                      #MURA LOWER BINARY LOADER /ONE CARD/ B 0704-0251MULBL
                  #ONE CARD LOWER LOAD                     B 0705-EK 0001
    #SELF-LOADING BINARY-OCTAL LOWER LOADER                B 0709-0999RL039
RTER                     #LP/90 TO SCROL 704 INPUT CONVE B 0704-0937ERCON
650                      #LCC SURFACE FITTING FOR BASIC  B 0650-08.3.001
                         #LS- 3                            B 0650-06.0.024
NERAL PURPOSE SYSTEM FOR THE 650 L2                     #GE B 0650-02.0.008
EST.&SCHED. PHASE ONLY * LESS * M. C. FRISHBERG    #LEAST COST B 0650-10.3.009
ROID CALCULATIONS * CARD *    #M-100 MOMENT OF INERTIA & CENT B 1620-09.3.004
ROID CALCULATIONS * TAPE *    #M-100 MOMENT OF INERTIA & CENT B 1620-09.3.005
E BEHAVIOR OF  LIGHT HYDROCARBON M#THERMODYNAMIC PROPS AND PHAS B 0650-09.3.002
 OF RETURN * PVIA * * INF. CHAIN MACH * #PRESENT VALUE AND RATE B 0650-07.0.017
                         #TWO MACHINE LOADER.              B 0709-0709RWTML
EAR PROGRAMMING          #MACHINE LOADING PROBLEM OF LIN B 0704-0789IBML1
R SYSTEM                 #NEW MACRO LOOK-UP FOR 705 AUTOCODE B 0705-PG-012-0
                         #704 MACRO-SAP ASSEMBLER.         B 0704-0958MIMS
SUBROUTINES              #MAD TRANSLATOR AND ASSOCIATED  B 0704-1101UMMAD
                         #MADSM1 CURVE SMOOTHING ROUTINE B 7090-1241MADSM
ELL 111   #FL DEC INTERP SYS 650 MAG DRUM CALC W/IMMED ACCESS B B 0650-02.0.021
ISTICAL INTERPRETIVE SYS FOR IBM MAG DRUM CALCULATOR     #STAT B 0650-06.0.017
#MOD BELL TRANS PROG FOR 650-653 MAG DRUM CONE STGE COMPU   B 0650-02.1.011
                         #MAIN REGRESSION PROGRAM          B 0704-0822TVREM
TRACTS          #A 1401 PROGRAM TO MAINTAIN THE SHARE LIBRARY ABS B 0704-1165PNSLI
                         #MAKE SAP OCTAL                   B 0704-0513BESAK
            #MANAGEMENT DECISION MAKING EXERCISE           B 7070-12.9.002
SY          #SYSTEM IMMEDIATELY MAKING PROGRAMMING LANGUAGE EA B 0704-1096TVSMP
                         #MAN-SCHEDULING                   B 0650-10.3.006
RCISE                    #MANAGEMENT DECISION MAKING EXE B 7070-12.9.002
               #AN INVENTORY MANAGEMENT SIMULATOR * CARD *  B 1620-10.2.001
                  #INVENTORY MANAGEMENT SIMULATOR * TAPE *  B 1620-10.2.002
                  #INVENTORY MANAGEMENT SIMULATOR * CARD *  B 1620-10.2.003
FORTRAN VERSION   #INVENTORY MANAGEMENT SIMULATOR7070 FULL  B 7070-12.1.001
                         #TAPE MANEUVERING ROUTINE.        B 0704-0688GKTMR
LUDING I/O               #MANIPULATE BCD-CODED DATA, INC B 0704-0879MI4BC
RAM FOR THE 709     #MATRIX MANIPULATING INTERPRETIVE PROG B 0709-0936LLMMI
CHART ANALYSIS BY BOOLEAN MATRIX MANIPULATION          #FLOW B 0709-0824LLFLC
ERAL PURPOSE LANGUAGE FOR SYMBOL MANIPULATION    #COMIT - GEN B 0709-1198MICOM
               #WRITE BSS LOADER STORAGE MAP               B 0704-0830MISTP
                #WRITE BSS LOADER STORAGE MAP              B 0704-0830MISTP
NT-OUT PROGRAM        #FORTRAN MAP AND MISSING SUBROUTINE PRI B 0704-0909MPMAP
                      #FORTRAN MAPPER ROUTINE              B 1620-01.6.016
EMBLY SYSTEM CONVERTED TO TAPE * MASCOT *        #MODIFIED ASS B 1401-01.1.001
Y OF SPS TWO *           #FULL MAST *FULL MINNEAPOLIS ASSEMBL B 1401-01.1.006
PS TWO *                 #MAST *MINNEAPOLI ASSEMBLY OF S B 1401-01.1.005
                  #CREATE MASTER PROGRAM TAPE              B 0705-A0-010-0
                  #SEARCH MASTER PROGRAM TAPE              B 0705-A0-011-0
 *                #MATES * MASTER TAPE EXECUTARY PROGRAMS B 7070-03.4.003
      #MAXIMUM DENSITY FO GRANULAR MATERIALS               B 0650-09.2.012
PROGRAMS *              #MATES * MASTER TAPE EXECUTARY    B 7070-03.4.003
                        #MATH FIN                          B 0650-07.0.007
M ONE           #FORTRAN MATHEMATICAL PROGRAMMING SYSTE B 0704-0863RSM1
M I-ALL SOLUTIONS         #MATHEMATICAL PROGRAMMING SYSTE B 0704-1092RSM1A
M TWO                     #MATHEMATICAL PROGRAMMING SYSTE B 0709-1037SCM2
UNCTIONS SUBROUTINE       #MATHIEU AND MODIFIED MATHIEU F B 0650-03.2.006
             #MATHIEU AND MODIFIED MATHIEU FUNCTIONS SUBROUTINE  B 0650-03.2.006
 #MOLECULAR SPECTROSCOPY MULT OF MATRICES                  B 0650-05.2.023
         #REAL EIGENVALUES OF REAL MATRICES                B 0704-0635RWEIG
 #LINEAR EQUATION SOLVER OF BAND MATRICES                  B 0709-0990RWLE4
EVALUATOR FOR NEARLY TRIANGULAR MATRICES          #DETERMINANT B 0704-0635RWDET
D EIGENVECTORS OF REAL SYMMETRIC MATRICES        #EIGENVALUES AN B 0704-1029ANF20
  #EIGENVALUES OF REAL SYMMETRIC MATRICES BY THE JACOBI METHOD  B 0650-05.1.006
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#EIGENVALUE FOR SYMMETRIC MATRICES IN FLOATING POINT B 0704-0260NA189
#STORE ROW MATRICES INTO A LARGE MATRIX B 0704-0223CLMST
#EIGENVALUES OF REAL SYMMETRIC MATRICES ON THE 1620 D/P SYS B 1620-05.0.004
#EIGENVALUES OF REAL SYMMETRIC MATRICES ON 1620 D/P SYSTEM B 1620-05.0.003
L1 #GENERATE MATRICES TO BE SOLVED BY NU TP B 0704-1110NUGEN
N QUARTIMAX ROTATION OF A FACTOR MATRIX #PATER B 0650-05.1.007
#LATENT ROOTS AND VECTORS OF A MATRIX B 0650-05.2.016
EIGENVALUES & EIGENVECTORS OF A MATRIX #TO OBTAIN B 0650-05.2.025
STMULTIPLY REAL BY SYMETRIC REAL MATRIX #PO B 0704-0273CLMMP
RMINANT AND EIGENVECTOR FOR REAL MATRIX #DETE B 0704-0116CLDET
#STORE ROW MATRICES INTO A LARGE MATRIX B 0704-0223CLMST
#K TIMES UNIT MATRIX B 0704-0085CLMKO
#704-FORTRAN II SUBPROGRAM FOR MATRIX B 0704-0705MIHDI
EIGENVECTORS OF A REAL SYMMETRIC MATRIX #EIGENVALUES AND B 0704-0664ANF20
PY LATENT ROOTS AND VECTORS OF A MATRIX #MOLECULAR SPECTROSCO B 0650-05.2.024
VECTORS OF NON-SYMMETRIC SQUARE MATRIX #EIGENVALUES AND EIGEN B 0650-05.2.018
ALUES AND EIGENVECTORS SYMMETRIC MATRIX - FI #EIGENV B 0704-0474NUMXE
#INTERPRETATION MATRIX ABSTRACTION B 0704-0085CLMTX
#GENERAL MATRIX ABSTRACTION FROM TAPES B 0704-0367MBMTX
POINT #MURA MATRIX ADD OR SUBTRACT, FIXED B 0704-0432MUMAS
#MATRIX ADDITION B 0704-0085CLMAD
N. #DOUBLE PRECISION MATRIX ADDITION AND SUBTRACTIO B 0704-0744AMDPA
#NORMALIZE MATRIX BY COLUMNS. B 0704-0236CLMNR
#NORMALIZE MATRIX BY ROWS B 0704-0236CLMNR
DOUBLE-PRECISION FLOATING BINARY MATRIX CONVERSION PROG # B 0704-0329NYDFM
INE #704-SAP-CODED MATRIX DIAGONALIZATION SUBROUT B 0704-0697MIHDI
#704-SAP FLOATING-PT. TRAP MATRIX DIAGONALIZATION B 0704-0705MIHDI
IPLY OR DIVIDE, REAL #MATRIX ELEMENT BY ELEMENT MULT B 0704-0273CLMMD
#SOLUTION OF GENERAL MATRIX EQUATION AX - B. B 0704-0141LAS88
ERVAL ARITH. #SOLUTION OF MATRIX EQUATION AX-B USING INT B 0704-0880IBSME
ERVAL ARITH. #SOLUTION OF MATRIX EQUATION AX-B USING INT B 0704-0880IBSME
#LINEAR MATRIX EQUATION SOLVER B 0704-0635RWMAT
#MATRIX EXPAND B 0704-0085CLMEX
#MATRIX HEADING REMOVAL B 0704-0085CLMBH
COLUMNS #MATRIX INTERCHANGE OF ROWS AND B 0704-0085CLMIN
#MATRIX INVERSE B 0704-0085CLMIV
#MATRIX INVERSION B 0650-05.1.001
#COMPLEX ARITHMETIC MATRIX INVERSION B 0650-05.1.003
#MATRIX INVERSION B 0650-05.2.001
#LARGE SCALE MATRIX INVERSION B 0650-05.2.007
#MATRIX INVERSION B 0650-05.2.008
#DOUBLE PRECISION MATRIX INVERSION B 0650-05.2.009
#SYMMETRICAL MATRIX INVERSION B 0650-05.2.013
#MATRIX INVERSION B 0650-05.2.015
#MATRIX INVERSION B 0704-0058UAINV
#MATRIX INVERSION B 0704-0232NYDMI
#DOUBLE PRECISION MATRIX INVERSION B 0704-0405PFIDP
#A GENERAL PROGRAM FOR COMPLEX MATRIX INVERSION B 0704-1075ANF10
#MATRIX INVERSION B 0705-E2-004-0
#MATRIX INVERSION B 1620-05.0.006
#SINGLE PRECISION MATRIX INVERSION B 7070-10.1.003
#GENERALIZED MATRIX INVERSION * PRINT 1 * B 0705-IB 0010
OF SIMULTANEOUS LINEAR EQUAT #MATRIX INVERSION AND SOLUTION B 0650-05.2.011
UATIONS #MATRIX INVERSION AND LINEAR EQ B 0704-1030ANF40
OUS EQUATIONS #7070 MATRIX INVERSION AND SIMULTANE B 7070-10.1.002
LIMINATION #MATRIX INVERSION BY GAUSSIAN E B 0650-05.2.002
NG #MATRIX INVERSION BY PARTITIONI B 0704-0324NYDMI
IR 1 * #MATRIX INVERSION ROUTINE 1 * M B 0650-05.2.012
E IMPROVEMENT OF ACCURACY #MATRIX INVERSION WITH ITERATIV B 0650-05.2.022
OF LINEAR EQUATIONS #MATRIX INVERSION WITH SOLUTION B 0704-0664ANF40
#SYMMETRIC MATRIX INVERSION. B 0704-0573CF009
#MATRIX INVERSION. B 0704-0405PFEL1
#MATRIX LOOP TEST B 0704-0085CLMLP
VE PROGRAM FOR THE 709 #MATRIX MANIPULATING INTERPRETI B 0709-0936LLMMI
#FLOW CHART ANALYSIS BY BOOLEAN MATRIX MANIPULATION B 0709-0824LLFLC
#VECTOR BY SYMMETRICAL MATRIX MULTIPLICATION B 0650-05.2.014
#MATRIX MULTIPLICATION B 0704-0085CLMMP
#DOUBLE PRECISION MATRIX MULTIPLICATION. B 0704-0699AMDPM
#MATRIX MULTIPLICATION. B 0704-0435MAMAT
#DOUBLE PRECISION MATRIX MULTIPLICATION B 7070-10.1.001
T/ #MURA MATRIX MULTIPLY /FLOATING POIN B 0704-0432MUMAM
#MATRIX PACKAGE B 0650-01.6.036
#MXV PROGRAM FOR LINEAR PROGRAM MATRIX PREPARATION B 1620-10.1.004
#MATRIX PRINT B 0704-0085CLMPR
#BUMP, BOSTON UNIVERSITY MATRIX PROGRAM B 0650-02.1.006
#MATRIX PUNCH B 0704-0085CLMCP
#QUASI-TRIDIAGONAL MATRIX ROUTINE B 0704-1109NUTPL
#MODIFIED QUASI-TRIDIAGONAL MATRIX ROUTINE. B 0704-0901NUHLU
#DOUBLE PRECISION MATRIX SCALAR MULTIPLICATION B 0704-0759AMDPS
#NEARLY TRIANGULARIZATION OF A MATRIX SUBROUTINE B 0704-0635RWNTR
#MATRIX SUBTRACTION B 0704-0085CLMSB
M. #EXPAND TRIANGULAR MATRIX TO SQUARE SYMMETRIC FOR B 0704-0460MIEXA
#CONTRACT SQUARE SYMMETRIC MATRIX TO TRIANGULAR FORM. B 0704-0460MICNT
#MATRIX TRANSFER B 0704-0223CLMTA
SITION #MATRIX TRANSLATION A/O TRANSPO B 0650-01.6.031
#MATRIX TRANSPOSE B 0704-0085CLMTR
#SQUARE MATRIX TRANSPOSE ON ITSELF B 0704-0432MUMTR
DISPLACED IN CORE #SQUARE MATRIX TRANSPOSED ON ITSELF OR B 0704-0661GDF02
#MATRIX TRANSPOSED ON ITSELF B 0704-0290GEMTO
#SQUARE MATRIX TRANSPOSED ON ITSELF B 0704-0290GESTO
NANT AND EIGENVECTOR FOR COMPLEX MATRIX. #DETERMI B 0704-0116CLDET
#OPERATE ON A REAL, SYMMETRIC MATRIX. B 0704-0460MIOPM
AND EIGENVECTORS OF A HERMITIAN MATRIX. #EIGENVALUES B 0704-0884PKHME
AND VECTORS OF A REAL, SYMMETRIC MATRIX. #EIGENVALUES B 0704-0460MIHDI
LUE PROB. OF A COMPLEX HERMITIAN MATRIX. #PRELIM. EIGENVA B 0704-0460MIMAU
#MATRIX-VECTOR MULTIPLICATION B 0650-05.1.004
#MATRIX-VECTOR PRODUCT B 0650-05.1.009
#7070 INTERCORRELATION MATRIX, CORR1 B 7070-11.3.003
#7070 INTERCORRELATION MATRIX, CORR2 - FOR CARD INPUT B 7070-11.3.004
#MAXF B 0650-05.1.010
IAL FIT #LEAST MAXIMAL ABSOLUTE ERROR POLYNOM B 0704-0500BSBFP
TERIALS #MAXIMUM DENSITY FO GRANULAR MA B 0650-09.2.012
T. #RANDOM NO. GENERATOR, MAXWELL-BOLTZMANN DIST. FT. P B 0704-0743ORMAX
#RESTART PROGRAM FOR MD SORT B 0709-1160MDSRS
ARIANCE OR COVARIANCE AND ADJUST MEANS PROGRAM #ANALYSIS OF V B 0650-06.0.034
#CORRECTION OF COAL MOISTURE MEASUREMENTS B 0650-09.4.011
TIC SYNTHESIS OF PATH GENERATING MECHANISMS #KINEMA B 0650-09.5.003
#MEM PRINT ANALYSER B 0705-SB-006-0
RY SUBROUTINE IDENTIFICATION AND MEMORY ALLOCATION # BINA B 0704-0739ARPEK
#MEMORY COMPARISON DUMP B 0704-0931PKCOM
TINE #UNIVERSAL MEMORY DUMP AND CONDENSING ROU B 0650-01.6.028
#MEMORY DUMP AND RELOAD ROUTINE B 0650-01.3.008
#705 MEMORY INTERPRETER B 0705-AO-009-0
NTERRUPT FORTRAN-LOADING TO COPY MEMORY ON TO TAPE. #I B 0709-1164MWFOT
#ALTERED MEMORY PRINT B 0705-EQ-005-0
#TRAP OCTAL MEMORY PRINT - /TRAP SCOOP/ B 0704-0278UASPO
#OCTAL MEMORY PRINT OUT PROGRAM B 0704-0286NYDS1
#TRACE AND RECORD ALTERATIONS IN MEMORY PROGRAM B 0704-0395LL003
#DYNAMIC ACCESS TO MEMORY PROGRAM B 0704-0395LL002
#MEMORY PUNCH OUT B 0705-AF-002-0
#SAVE MEMORY SORT 57-PH3 B 0705-CU-002-0
LOGICAL MEMORY SORT, MINIMUM TIME B 0704-0468CF005
#3 WAY MERGE PROGRAM B 0704-0427NSMRG
#FORTRAN OUTPUT MERGE PROGRAM B 0704-0853ME020
CORDS #GENERALIZED MERGE PROGRAM FOR UNBLOCKED RE B 1401-01.2.002
#TAPE MERGE 2 A 0650--SM-401
#MERGE 2 A 1401--SM-044
#MERGE 709 A 0709--SM-067
#MERGE 80 A 0705--SM-055
#MERGE 91 A 7070--SM-078
#VIPP MERGER. B 0709-1136BWVIP
RAL PURPOSE #VIPP MERGER. SECOND PHASE OF A GENE B 0704-0926TAVIP
NS. #TWO-DIMENSIONAL MESH FOR RELAXATION CALCULATIO B 0704-0725PKMER
#MESH GENERATOR B 0704-0233ATMG1
D FLOW DISTRIBUTION. HARDY CROSS METHOD #FLUI B 0650-09.7.007
#FACTOR ANALYSIS BY THE CENTROID METHOD B 0650-05.1.008
IAL OF BEST FIT BY LEAST SQUARES METHOD #POLYNOM B 0650-06.0.006
ION SUBROUTINE, INTERVAL-HALVING METHOD #ITERAT B 0704-0327GMITR
#CRITICAL PATH PROGRAMMING METHOD B 0704-1188GMCP
FITTING- SIMULATED PLANT RECORD METHOD #CURVE B 1620-09.4.009
#SQUARE ROOT, TOPLER METHOD B 7070-08.3.002
INEAR REGRESSION BY THE STEPWISE METHOD #MULTIPLE L B 7070-11.3.002
R THE GAUSS-SOUTHWELL RELAXATION METHOD #A PROGRAM FO B 0650-09.6.014
AN EQUATION WITH NEWTON-RAPHSONS METHOD #SOLUTION OF B 1401-11.0.001
TION PROBLEM, FLOW- OR HUNGARIAN METHOD #THE TRANSPORTA B 0704-0464IBTFL
ROUTINE, 10 PT. GAUSS QUADRATURE METHOD #INTEGRATION SUB B 0704-0237GLGAU
SYMMETRIC MATRICES BY THE JACOBI METHOD #EIGENVALUES OF REAL B 0650-05.1.006
&REGRESSION ANALYSIS BY STEPWISE METHOD #MULTIPLE CORRELATION B 7070-11.3.007
LYNOMIALS #NEWTONS METHOD FOR FINDING ROOTS OF PO B 0704-0110GLROP
TION #FLOATING POINT GILL METHOD FOR RUNGE-KUTTA INTEGRA B 0704-0491RWDE4
#THE WHERRY-WINER METHOD OF FACTOR ANALYSIS B 0650-06.0.028
#THE SYMMETRIC METHOD OF LINEAR PROGRAMMING B 0650-10.1.008
#AN AUTOMATIC METHOD OF OPTIMUM PROGRAMMING B 0650-01.1.003
#VARIABLE METRIC MINIMIZATION B 0704-0980ANZ01
#NUMERICAL INTEGRATION BY MIDPOINT PROCEDURE B 0704-1017AND10
#RAY TRAJECTORY MIGRATION B 0650-09.6.017
E #9X9 TEN MILLISECOND MULTIPLY SUBROUTIN B 1401-03.0.001
F 2ND ORD. EQ. #FLOAT. PT. MILNE, RUNGE-KUTTA INTEGRAT. O B 0704-0450RWDE3
- #DBL. PREC. FLOATING PT. MILNE, RUNGE-KUTTA INTEGRATION B 0704-0610RWDE3
CUIT #COMPUTATION OF A MIN 2 LEVEL &/OR SWITCHING CIR B 0704-1104PKMIN
OVER A ROAD NETWORK #TRACING A MIN. PATH BET. ZONE CENTROIDS B 0650-09.2.080
ON ON A FINITE POINT SET #MINIMAX POLYNOMIAL APPROXIMATI B 0650-06.0.043
#VARIABLE METRIC MINIMIZATION B 0704-0980ANZ01
CTION OF N VARIABLES #MINIMIZATION ROUTINE FOR A FUN B 0704-0804RWMIN
#BINARY DECK MINIMIZER B 0704-0333CWBDO
#BOOLEAN ALGEBRA MINIMIZER B 7090-1197LLBAM
N FOR SURFACES AND CURVES #MINIMUM ARC LGTH. INTERPOLATIO B 0704-0483NA029
M TABLE DISTRIBUTION #MINIMUM ERROR ROUTINE FOR STEA B 7090-1095WH058
ZERO, MINIMUM SOLVER B 0704-1041JPZOM
LOGICAL MEMORY SORT, MINIMUM TIME B 0704-0468CF005
HING #COMPUTATION OF A MINIMUM TWO-LEVEL AND-OR SWITC B 0704-0787PKMIN
FRAMES #AUTOMATIC MINIMUM WEIGHT DESIGN OF STEEL B 0650-09.2.052
O * #FULL MAST *FULL MINNEAPOLIS ASSEMBLY OF SPS TW B 1401-01.1.006
#MATRIX INVERSION ROUTINE 1 * MIR 1 * B 0650-05.2.012
#COFIT NUCLEAR-CODE MISCELLANEOUS B 0704-NUCLEAR
#EXFIT NUCLEAR-CODE MISCELLANEOUS B 0704-NUCLEAR
#F0031 NUCLEAR-CODE MISCELLANEOUS B 0704-NUCLEAR
#MISCELLANEOUS UTILITY ROUTINES B 0650-01.6.023
ICIENTS #MISSING DATA CORRELATION COEFF B 0650-06.0.055
ROGRAM #FORTRAN MAP AND MISSING SUBROUTINE PRINT-OUT P B 0704-0909MPMAP
#MITILAC B 0650-02.0.002
UMP #OCTAL MNEMONIC FLOATING POINT CORE D B 0709-0633WDOMF
#MNEMONIC OCTAL LOADER B 0704-0274RS014
3 MAG DRUM CONE STGE COMPU #MOD BELL TRANS PROG FOR 650-65 B 0650-02.1.011
#IQ MOD LOADER B 7090-1211IQMDL
#IBM 7070 PROGRAM MOD ROUTINE B 7070-03.1.001
#MODA B 0705-SR-006-0
#ARDC MODEL ATMOSPHERE OF 1959 B 0709-0924RWMA5
. PROG. DA-2 1 #DIGITAL TERRAIN MODEL SYS 4 POINT POLY. INTERP B 0650-09.2.062
ENT PROGRAMS #DIGITAL TERRAIN MODEL SYSTEM HORIZONTAL ALIGNM B 0650-09.2.040
WORK PROGRAM #DIGITAL TERRAIN MODEL SYSTEM PRELIMINARY EARTH B 0650-09.2.042
PROGRAM DA-3 #DIGITAL TERRAIN MODEL SYSTEM PROFILE SMOOTHING B 0650-09.2.063
PROGRAM TC-1 #DIGITAL TERRAIN MODEL SYSTEM TERRAIN DATA EDIT B 0650-09.2.039
T PROGRAMS #DIGITAL TERRAIN MODEL SYSTEM VERTICAL ALIGNMEN B 0650-09.2.041
#MODEL 4 GEODIMETER B 0650-09.2.085
#ADDRESS MODIFICATION B 0705-BW-001-1
#SORT 54 TECHNIQUE OF MODIFICATION OF PHASE II B 0705-XE-001-0
#SORT 54 MODIFICATION TO USE FILE SIZE B 0705-XE-002-0
AN II ON-LINE TO OFF-LINE OUTPUT MODIFYING SUBR. #FORTR B 0704-0637ANZ01
AN II OFF-LINE TO ON-LINE OUTPUT MODIFYING SUBR. #FORTR B 0704-0637ANZ01
RAN II ON-LINE TO OFF-LINE INPUT MODIFYING SUBR. #FORT B 0704-0637ANZ01
PILER FOR USE OF SPECIAL CHAR #MODS OF INTER TRANS * IT * COM B 0650-02.1.002
NE #MODULO 2PI CONVERSION SUBROUTI B 7070-08.1.014
CALCULATOR #MODULUS 11 SELF-CHECKING DIGIT B 7070-02.9.001
#CORRECTION OF COAL MOISTURE MEASUREMENTS B 0650-09.4.011
#DIATOMIC MOLECULAR INTEGRAL PROGRAM B 0704-0849MIDIA
MATRICES #MOLECULAR SPECTROSCOPY MULT OF B 0650-05.2.023
ROOTS AND VECTORS OF A MATRIX #MOLECULAR SPECTROSCOPY LATENT B 0650-05.2.024
MOMENTS OF INERTIA OF POLYATOMIC MOLECULES # B 0650-09.3.005
NCE LINE CALCULATION #MOMENT DISTRIBUTION AND INFLUE B 0650-09.2.033
#MOMENT DISTRIBUTION B 0650-09.2.005
#MOMENT DISTRIBUTION B 0650-09.2.009
ALCULATIONS * CARD * #M-100 MOMENT OF INERTIA & CENTROID C B 1620-09.3.004
ALCULATIONS * TAPE * #M-100 MOMENT OF INERTIA & CENTROID C B 1620-09.3.005
TE FROM CONTINUOS GIRD. BRIDGE #MOMENT REACT INFLU LINE ORDINA B 0650-09.2.057
IC MOLECULES #MOMENTS OF INERTIA OF POLYATOM B 0650-09.3.005
#IBSYS MONITOR A 7090--SV-918
#MONITOR SUBROUTINE B 0704-0302NYMON
PROGRAM #MONITOR SUBROUTINE AND OUTPUT B 0704-0302NYMON
#ONE PHASE MONITOR SYSTEM. B 7090-1094BESYS
#704 SELECTIVE MONITOR TRACE SYSTEM. B 0704-0708WHSMT
#704 SELECTIVE MONITOR TRACE. B 0704-0601WHSMT
#OFFLINE EDIT FOR FORTRAN MONITOR WITH SOURCE LANG DEBUG B 7090-1115GPFMS
#EURIPUS-3 NUCLEAR-CODE MONTE CARLO B 0704-NUCLEAR
#DAEDALUS NUCLEAR-CODE MONTE CARLO B 0704-NUCLEAR
#POLYPHEMUS NUCLEAR-CODE MONTE CARLO B 0704-NUCLEAR
#SPAN-2 NUCLEAR-CODE MONTE CARLO B 0704-NUCLEAR
#SPIC-1 NUCLEAR-CODE MONTE CARLO B 0704-NUCLEAR
#TUT-T5 NUCLEAR-CODE MONTE CARLO B 0704-NUCLEAR
TINE/ #CONSTANTS FOR OR MONTE CARLO PKG. /NOT A SUBROU B 0704-0743ORMOC
MOONSHINE NUCLEAR-CODE B 0650-08.2.001
#MORDEM II B 0650-06.0.026
#A MORE ACCURATE RUNGE-KUTTA B 0704-0414GLMAR
#POST MORTEM DUMP B 1620-01.5.004
#MOVE VARIABLE, GROUPED FIELDS B 0705-PG-010-0
CTR #GSEL,FMCTR,LINK,MOVE,OPHLT,SEQCK,SIGN,STRIP,VM B 0705-BW-002-0
OF VELOCITY WITH DEPTH #NORMAL MOVEOUT COMP. FOR LINEAR INC. B 0650-09.6.019
#MOVEX B 0705-SR-007-0
DATA #MOVING AVERAGES OF TIME-SERIES B 0704-0335NYMA1
SUBROUTINE SAVES THE CONSOLE /AC,MQ,IRA,IRB,IRC, #THIS B 0704-0345ELSAV

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SUBROUTINE SAVES THE CONSOLE /AC,MQ,IRA,IRB,IRC,        #THIS  B 0704-0345ELSAV
SE MULTIPLE REGRESSION ANALYSIS, MR1             #7070 STEPWI B 7070-11.3.001
   #THE TRANSCENDENTAL FUNCTIONS MU AND NU                     B 0704-0311GMMUF
                          #SWAP MU AND NU NUCLEAR-CODE PHYSICS B 0704-NUCLEAR
                               #MUFT 3 NUCLEAR-CODE            B 0650-08.2.006
                               #MUFT 4 NUCLEAR-CODE TRANSPORT  B 0704-NUCLEAR
        #MOLECULAR SPECTROSCOPY MULT OF MATRICES               B 0650-05.2.023
 BINARY ARITH.       #NORMALIZED MULT.  EXTENDED RANGE FLOATING B 0704-0370RS013
 TRANSFORMATIONS        #STEPWISE MULT. REGRESSION WITH VARIABLE B 7090-1194ERMPR
AN II INPUT SUBROUTINE         #MULTI-DIMENSION SYMBOLIC FORTR B 0704-0848ARSYM
 HEAT EQUATION SOLVER          #MULTI-MATERIAL ONE DIMENSIONAL B 0704-0652RWHF2
ELIABILITY STUDIES             #MULTI-PURPOSE ESTIMATION FOR R B 0704-1058WLREL
                          #1620 MULTI-TRACE                    B 1620-01.4.003
                               #MULTI-VARIABLE CORRELATION     B 0650-06.0.022
OGRAM.                         #MULTICOMPONENT DISTILLATION PR B 0704-1186IBDST
WER DESIGN CALCULATIONS        #MULTICOMPONENT DISTILLATION TO B 1620-09.3.002
        # ONE-SPACE-DIMENSIONAL MULTIGROUP NUCLEAR-CODE        B 0650-08.2.003
NSPORT EQUATION NUCLEAR-CODE # A MULTIGROUP P3, THE NEUTRON TRA B 0650-08.2.028
RIABLES                        #MULTIPLE CORRELATION FOR 50 VA B 0650-06.0.007
ESSIONS ANALYSIS               #MULTIPLE CORRELATIONS AND REGR B 0704-0417PFCR1
PROGRAM                 #FORTRAN MULTIPLE CORRELATION ANALYSIS  B 0709-1121NRNRM
N ANALYSIS BY STEPWISE METHOD  #MULTIPLE CORRELATION&REGRESSIO B 7070-11.3.007
 POINT.             #SIMULTANEOUS MULTIPLE INTEGRATION, FLOATING B 0704-0240NOSIG
APE *                   #STEPWISE MULTIPLE LINEAR REGRESSION * T B 1620-06.0.006
ARD *                   #STEPWISE MULTIPLE LINEAR REGRESSION * C B 1620-06.0.007
THE STEPWISE METHOD            #MULTIPLE LINEAR REGRESSION BY  B 7070-11.3.002
LYSIS ON THE IBM 7070   #STEPWISE MULTIPLE LINEAR REGRESSION ANA B 7070-11.3.006
                               #MULTIPLE NUMERICAL INTEGRATION B 0650-04.0.002
ER                             #MULTIPLE PROGRAM DUMP AND LOAD B 0650-01.5.004
                               #MULTIPLE REGRESSION ANALYSIS   B 0650-06.0.001
ROGRAMS RAP RAPA TRAP          #MULTIPLE REGRESSION ANALYSIS P B 0650-06.0.030
                               #MULTIPLE REGRESSION ANALYSIS   B 0650-06.0.031
                               #MULTIPLE REGRESSION ANALYSIS   B 0650-06.0.046
ION PROGRAM.                   #MULTIPLE REGRESSION BACK SOLUT B 0704-0749SCBOP
.             #INPUT EDITOR FOR MULTIPLE REGRESSION CODE SCRAP B 0704-0749SCIEM
ION ANALYSIS PROGRAM.          #MULTIPLE REGRESSION & CORRELAT B 0704-0749SCRAP
                        #STEPWISE MULTIPLE REGRESSION PROCEDURE B 0704-0477ERMPR
MR1              #7070 STEPWISE MULTIPLE REGRESSION ANALYSIS,  B 7070-11.3.001
SIVE ANALYSIS                  #MULTIPLE REGRESSION, COMPREHEN B 0704-0915TVMRC
     #BCD TAPE-CARD READING FOR MULTIPLE SCAN.                 B 0704-0904SISCA
                               #MULTIPLE TAPE TEST ROUTINE     B 7090-1113APMTT
APE SYSTEMS                    #MULTIPLE UTILITY PROGRAM FOR T A 1401--UT-039
                 #MATRIX-VECTOR MULTIPLICATION                 B 0650-05.1.004
   #VECTOR BY SYMMETRICAL MATRIX MULTIPLICATION                B 0650-05.2.014
                        #MATRIX MULTIPLICATION                 B 0704-0085CLMMF
 #DOUBLE PRECISION MATRIX SCALAR MULTIPLICATION                B 0704-0759AMDPS
                        #MATRIX MULTIPLICATION                 B 0704-0435MAMAT
#DOUBLE PRECISION FLOATING POINT MULTIPLICATION                B 0704-0650RWMUL
       #DOUBLE PRECISION MATRIX MULTIPLICATION                 B 7070-10.1.001
       #DOUBLE PRECISION MATRIX MULTIPLICATION.                B 0704-0699AMDPM
                               #MULTIPLIES TWO FOURIER SERIES. B 0704-0788IBMFS
     #DOUBLE PRECISION FLOATING MULTIPLY                       B 7070-08.4.002
                   #MURA MATRIX MULTIPLY /FLOATING POINT/      B 0704-0432MUMAM
     #MATRIX ELEMENT BY ELEMENT MULTIPLY OR DIVIDE, REAL       B 0704-0273CLMMD
          #9X9 TEN MILLISECOND MULTIPLY SUBROUTINE             B 1401-03.0.001
                              # MULTIREGROUP  NUCLEAR-CODE     B 0650-08.2.027
                               #MULTITRACE * TAPE *            B 1620-01.4.006
YS ONLY/      #SORT, ALGEBRAIC. MULTIWORD KEYS. /WHOLE WORD KE B 0704-0570ORSRT
                               #MURA BINARY PUNCH ROUTINE      B 0704-0256MUBPU
                               #MURA BINARY PUNCH ROUTINE      B 0704-0256MUBPU
                               #MURA BINARY PUNCH ROUTINE      B 0704-0263MUBPU
                               #MURA BINARY PUNCH ROUTINE 4    B 0704-0283MUBPU
OTTER                          #MURA CATHODE RAY TUBE POINT PL B 0704-0321MUSCP
LS                             #MURA COMPLETE ELLIPTIC INTEGRA B 0704-0668MUCEI
 /FIXED POINT/                 #MURA DOUBLE PRECISION ADDITION B 0704-0256MUDPA
ROUTINE                        #MURA EFFECTIVE ADDRESS SEARCH  B 0704-0253MUEAS
                               #MURA EXPONENTIAL, BASE E       B 0704-0256MUEXP
                               #MURA EXPONENTIAL, BASE 2       B 0704-0256MUEXP
UTINE                          #MURA FIXED POINT ARCTANGENT RO B 0704-0263MUATN
                               #MURA FIXED POINT CUBE ROOT     B 0704-0314MUCRT
SE E                           #MURA FIXED POINT LOGARITHM, BA B 0704-0283MULOG
SE 2.                          #MURA FIXED POINT LOGARITHM, BA B 0704-0357MULOG
SE 2                           #MURA FIXED POINT LOGARITHM, BA B 0704-0280MULOG
                               #MURA FIXED POINT RUNGE-KUTTA   B 0704-0280MURKY
                               #MURA FIXED POINT RUNGE-KUTTA   B 0704-0891MURKY
                               #MURA FIXED POINT SINE          B 0704-0280MUSIN
                               #MURA FIXED POINT SINE          B 0704-0280MUSIN
OUTINE                         #MURA FIXED POINT SQUARE ROOT R B 0704-0263MUSQR
OUTINE                         #MURA FIXED POINT SQUARE ROOT R B 0704-0283MUSQR
                               #MURA FLOATING DECIMAL DUMP     B 0704-0321MUFDD
                               #MURA FLOATING POINT CUBE ROOT. B 0704-0280MUCRT
A                              #MURA FLOATING POINT RUNGE-KUTT B 0704-0314MURKY
CISION ADDITION                #MURA FLOATING POINT DOUBLE PRE B 0704-0280MUDPA
                               #MURA FRACTION DUMP             B 0704-0253MUFRD
                               #MURA INTEGER DUMP              B 0704-0251MUIND
CARD/                          #MURA LOWER BINARY LOADER /ONE  B 0704-0251MULBL
IXED POINT                     #MURA MATRIX ADD OR SUBTRACT, F B 0704-0432MUMAS
 POINT/                        #MURA MATRIX MULTIPLY /FLOATING B 0704-0432MUMAM
                               #MURA OCTAL DUMP                B 0704-0251MUOCD
                          #RDF3 MURA READ DECIMAL FRACTION     B 0704-0283MURDF
TINE                           #MURA READ DECIMAL FRACTION ROU B 0704-0283MURDF
INE                            #MURA READ DECIMAL INTEGER ROUT B 0704-0256MURDI
TINE                           #MURA READ DECIMAL INTEGERS ROU B 0704-0263MURDI
TINE                           #MURA READ FLOATING DECIMAL ROU B 0704-0283MURFD
                               #MURA READ OCTAL NUMBER ROUTINE B 0704-0263MURON
                               #MURA REFLECTED 704             B 0704-0432MUR70
                               #MURA REFLECTIVE 704            B 0704-0253MU704
DE RAY TUBE DISPLAY            #MURA SIX COLUMN FRACTION CATHO B 0704-0310MUSCP
                               #MURA SIX COLUMN FRACTION PRINT B 0704-0314MUPRF
LOADER /ONE CARD/              #MURA UPPER RELOCATABLE BINARY  B 0704-0432MURBL
PRINT                          #MURA VARIABLE COLUMN FRACTION  B 0704-0357MUPRF
PRINT                          #MURA VARIABLE COLUMN FRACTION  B 0704-0357MUPRF
                        #SIFON4 MURA 650 ON 704 SIMULATOR      B 0704-0548MUSFN
ROUTINES                       #MUSH DATA ASSEMBLER AND PRINT  B 0704-0523SCMAP
          #COMPUTER AUTOMATED MUSIC                            B 0650-11.0.007
                               #MUSIC                          B 0705-IB 0011
 MATRIX PREPARATION            #MXV PROGRAM FOR LINEAR PROGRAM B 1620-10.1.004
                      #ARCSINE N                               B 7070-08.1.003
 DIFFERENTIAL EQUATIONS OF ORDER N       #NUMERICAL SOLUTION OF B 0650-04.0.013
        #BESSEL FUNCTION Y SUB N /X/.                          B 0704-0704RWBF4
                               #N DIMENSIONAL TABLE LOOK UP    B 7090-1204MACUR
     #AITKENS INTERPOLATION FOR N EQUAL INTERVALS              B 0704-0122PKANI
                #FLOATING POINT N FACTORIAL SUBROUTINE         B 0704-0525PKFAK
     # RESET AND CLEAR CORE AND N LOGICAL DRUMS                B 0704-0443LL024
                               #N ROOT ROUTINE                 B 0704-0690GDNRT
UATIONS              #SOLUTION OF N SIMULTANEOUS DIFFERENTIAL EQ B 0650-04.0.011
ZATION ROUTINE FOR A FUNCTION OF N VARIABLES             #MINIMI B 0704-0804RWMIN
RATION/EQUAL INTERVALS/        #N-STRIP TRAPEZOIDAL RULE INTEG B 0704-0931PKMTZ
        #BINARY SEARCH ROUTINE NA 839                          B 0709-0951NA083
                               #NATURAL LOGARITHM              B 0650-03.1.014
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                    #FLOATING NATURAL LOGARITHM                B 0704-0069LAS82
                     #COMPLEX NATURAL LOGARITHM                B 0704-0354NA66.
              #FLOATING POINT NATURAL LOGARITHM                B 0709-0507IBLOG
   #FLOATING POINT SUBROUTINE FOR NATURAL LOGARITHM FOR        B 0704-0525PKLGA
D             #FLOATING POINT NATURAL LOGARITHM OF NORMALIZE B 0709-0665IBLG3
          #FLOATING-POINT 709 NATURAL LOGARITHM SUBROUTINE     B 0709-0892RWLN3
                             #NATURAL LOGARITHM SUBROUTINE     B 7070-08.2.008
SORTS THE BIBLIOGRAPHY TAPE FROM NC 138                      # B 0704-1144NC014
READS THE FINAL SORTED TAPE FROM NC 139                      # B 0704-1144NC014
#READS THE SORTED KEY WORDS FROM NC 139                        B 0704-1144NC014
HE SORTED BIBLIOGRAPHY TAPE FROM NC 142                #READS T B 0704-1144NC014
QUADRATURE                   #NCI2 FIXED POINT NEWTON-COTES  B 0704-0357MUNCI
OGRAM TO SORT THE KEY WORDS FROM NC138                     #PR B 0704-1144NC013
     #DETERMINANT EVALUATOR FOR NEARLY TRIANGULAR MATRICES     B 0704-0635RWDET
MATRIX SUBROUTINE            #NEARLY TRIANGULARIZATION OF A  B 0704-0635RWNTR
                             #NED NUCLEAR-CODE                 B 0650-08.2.017
 PROGRAM FOR CHECKING OPERATIONS NEEDING TRANSLATING      #709 B 0709-0482GASPO
M. FT.PT      #RANDOM NO. GEN., NERENSON-ROSEN FISSION SPECTRU B 0704-0743ORFIS
                             #NETWOORK REDUCTION               B 0650-09.4.002
RDY-CROSS SOLUTION OF WATER FLOW NETWORK                   #HA B 0650-09.7.003
RIBUTION OF WATER FLOW IN A PIPE NETWORK                 #DIST B 1620-09.7.001
 BET. ZONE CENTROIDS OVER A ROAD NETWORK   #TRACING A MIN. PATH B 0650-09.2.080
RT CIRCUIT SOLUTION OF POWER SYS NETWORK  #IMPROVED DIGITAL SHO B 0650-09.4.004
                     #HYDRAULIC NETWORK ANALYSIS               B 0650-09.7.002
                          #GAS NETWORK ANALYSIS * CARD *       B 1620-09.3.003
                          #GAS NETWORK ANALYSIS * TAPE *       B 1620-09.3.001
                          #GAS NETWORK ANALYSIS PROGRAM        B 0650-09.7.001
O RECYCLING * IBM 650 *    #A GAS NETWORK ANALYSIS PROG WITH AUT B 0650-09.7.008
                  #CAPACITATED NETWORK FLOW PROGRAM            B 0704-0511MICNF
              #OUT OF KILTER NETWORK FLOW ROUTINE ONE          B 0709-1084RSOKF
UMENTS                       #NEUMANN FUNCTIONS OF LARGE ARG B 0704-0416CSNMB
IELD NUCLEAR-CODE    # CALCULATE NEUTRON ATTENUATION-REACTOR SH B 0650-08.2.025
R NUCLEAR-CODE                 # NEUTRON ENERGY SPECTRA IN WATE B 0650-08.2.021
LEAR-CODE # A MULTIGROUP P3, THE NEUTRON TRANSPORT EQUATION NUC B 0650-08.2.028
SELEC ECON. COND. SIZE-SPEC CASE NEW ENG ELEC SYS PROG 18    # B 1620-09.4.004
CODER SYSTEM                 #NEW MACRO LOOK-UP FOR 705 AUTO B 0705-PG-012-0
              #NCI2 FIXED POINT NEWTON-COTES QUADRATURE        B 0704-0357MUNCI
-FINDER          #A MODIFIED NEWTON-RAPHSON POLYNOMIAL ROOT B 0704-0568ELQRC
   #SOLUTION OF AN EQUATION WITH NEWTON-RAPHSONS METHOD        B 1401-11.0.001
TS OF POLYNOMIALS            #NEWTONS METHOD FOR FINDING ROO B 0704-0110GLROP
ON ROUTINE NOSIR             #NINE OPERATION SPLIT INSTRUCTI B 0650-02.0.006
  #SINE AND COSINE FUNCTIONS FOR NLLS.                         B 0704-0837ORSCN
      #EXPONENTIAL/3/ROUTINE FOR NLLS.                         B 0704-0837ORX3N
 FUNCTIONS OF THE FIRST KIND FOR NLLS.                 #BESSEL B 0704-0837ORBFN
T OVERFLOW/UNDERFLOW ROUTINE FOR NLLS.         #FLOATING-POIN B 0704-0837OROUN
ON-IBM/                      #NON-LINEAR ESTIMATION /PRINCET B 0704-0687IBNL1
                             #NON-LINEAR LEAST SQUARES.        B 0704-0837ORNLL
E WITH DIFFERENTIAL EQNS.    #NON-LINEAR REGRESSION PROCEDUR B 0704-1119ERNLR
ONS, REAL                    #NON-LINEAR SIMULTANEOUS EQUATI B 0704-0273CLSME
ONS, REAL                    #NON-LINEAR SIMULTANEOUS EQUATI B 0704-0273CLSME
LY OF VARIANCE OR COVARIANCE FOR NON-ORTH/D & STAT. DESIGN #ANA B 0650-06.0.059
IBUTIONS.                    #NON-PARAMETRICAL TEST OF DISTR B 0704-0815PFTNP
EIGENVALUES AND EIGENVECTORS OF  NON-SYMMETRIC SQUARE MATRIX  # B 0650-05.2.018
       #BINARY TAPE CORRECTOR. NON-SYSTEM VERSION              B 0709-1055DIBTC
                       #RANDOM NORMAL DEVIATE SUBROUTINE.      B 0704-0550CSDEV
                       #RANDOM NORMAL DEVIATES                 B 0650-06.0.035
    #RANDOM NUMBERS AND RANDOM NORMAL DEVIATES GENERATOR       B 7070-11.7.001
          #FRACTION REDUCTION TO NORMAL FORM                   B 0704-0900NUFRE
R INC. OF VELOCITY WITH DEPTH   #NORMAL MOVEOUT COMP. FOR LINEA B 0650-09.6.019
AND AREA                     #NORMAL PROBABILITY - ORDINATE  B 0709-1001NA860
                      #INVERSE NORMAL PROBABILITY FUNCTIONS    B 0709-1002NA861
                             #NORMALIZE MATRIX BY COLUMNS.     B 0704-0236CLMNR
                             #NORMALIZE MATRIX BY ROWS         B 0704-0236CLMNR
ATING POINT NATURAL LOGARITHM OF NORMALIZED                #FLO B 0709-0665IBLG3
     #FLOATING POINT SUBROUTINES NORMALIZED                    B 1401-03.0.004
 FLOATING BINARY ARITH.      #NORMALIZED ADD  EXTENDED RANGE B 0704-0370RS013
GE FLOATING BINARY ARITH.    #NORMALIZED ARCTAN-EXTENDED RAN B 0704-0370RS013
GE FLOATING BINARY ARITH.    #NORMALIZED DIVIDE-EXTENDED RAN B 0704-0370RS013
GE FLOATING BINARY ARITH.    #NORMALIZED E TO X-EXTENDED RAN B 0704-0370RS013
NCTION WITH POISSON TERM     #NORMALIZED INCOMPLETE GAMMA FU B 7090-1177URGAM
FLOATING BINARY ARITH.       #NORMALIZED LOG-EXTENDED RANGE  B 0704-0370RS013
GE FLOATING BINARY ARITH.    #NORMALIZED MULT.  EXTENDED RAN B 0704-0370RS013
NGE FLOATING BINARY ARITH    #NORMALIZED SQ.ROOT-EXTENDED RA B 0704-0370RS013
TION                         #NORMALIZED VARIMAX FACTOR ROTA B 7070-11.3.008
NDOM NUMBERS.                #NORMALLY DISTRIBUTED PSEUDO-RA B 0704-0578RWND2
NDOM NUMBERS.                #NORMALLY DISTRIBUTED PSEUDO-RA B 0704-0578RWND2
RATION SPLIT INSTRUCTION ROUTINE NOSIR              #NINE OPE B 0650-02.0.006
                             #NOST P                           A 7080--SV-087
      #BANG 4 * BASIC ARITHMETIC NOTATION GENERATOR *          B 1401-10.2.002
                       #ROCKET NOZZLE PROGRAM                  B 0704-1156LRRON
UTATION SUBROUTINE        #FN II NTH DEGREE LEAST SQU COEF COMP B 0704-0848ARPLN
                             #NTH LEGENDRE POLYNOMIAL          B 0704-0654AMPLG
                             #NTH LEGENDRE POLYNOMIAL          B 0704-0654AMPLG
                             #NTH LEGENDRE POLYNOMIAL          B 0704-0654AMPLG
                      #COMPLEX NTH ROOT                        B 0704-0354NA63.
E                            #NTH ROOT FIXED POINT SUBROUTIN A 0650--LM-007
TINE                         #NTH ROOT FLOATING POINT SUBROU A 0650--LM-009
                             #NTH ROOT OF X                    B 7070-08.3.003
              #FLOATING POINT NTH ROOT SUBROUTINE              B 0704-0525PKN00
 TRANSCENDENTAL FUNCTIONS MU AND NU                        #THE B 0704-0311GMMUF
                #SWAP MU AND NU NUCLEAR-CODE PHYSICS           B 0704-NUCLEAR
ENERATE MATRICES TO BE SOLVED BY NU TPL1                     #G B 0704-1110NUGEN
            #TO READ AND CHECK NU WTB-WRITTEN RECORDS          B 0704-0911NURTB
RARY                 #MODIFIED NUBES1 PROGRAM FOR FORTRAN LIB B 0704-0547PFBES
                    #WHIRLAWAY NUCLEAR CODE                    B 7090-NUCLEAR
                      #UNCLE 4 NUCLEAR-CODE                    B 0650-08.2.018
                          #NED NUCLEAR-CODE                    B 0650-08.2.017
                   # MOONSHINE NUCLEAR-CODE                    B 0650-08.2.001
                   # PARACANTOR NUCLEAR-CODE                   B 0650-08.2.002
ONE-SPACE-DIMENSIONAL MULTIGROUP NUCLEAR-CODE                #  B 0650-08.2.003
 CROSS SECTION AVERAGING PROGRAM NUCLEAR-CODE          # LOST A B 0650-08.2.004
                      # DONATE  NUCLEAR-CODE                   B 0650-08.2.005
                       #MUFT 3 NUCLEAR-CODE                    B 0650-08.2.006
                      # K-CODE  NUCLEAR-CODE                   B 0650-08.2.008
                      # VALPROD  NUCLEAR-CODE                  B 0650-08.2.013
       # P-3 FLUX DISTRIBUTION  NUCLEAR-CODE                   B 0650-08.2.014
UR REACTOR KINETICS %ARK-1¤ CODE NUCLEAR-CODE            # ARMO B 0650-08.2.019
                      # ART-1   NUCLEAR-CODE                   B 0650-08.2.020
 NEUTRON ENERGY SPECTRA IN WATER NUCLEAR-CODE                 # B 0650-08.2.021
                 # ENSIGN CODE  NUCLEAR-CODE                   B 0650-08.2.022
                # MULTIREGROUP  NUCLEAR-CODE                   B 0650-08.2.027
                      #HAFEVER NUCLEAR-CODE                    B 0704-NUCLEAR
                          #FLT NUCLEAR-CODE                    B 0704-NUCLEAR
                       #HECTIC NUCLEAR-CODE                    B 0704-NUCLEAR
                        #FLEER NUCLEAR-CODE                    B 0704-NUCLEAR
                        #APCOI NUCLEAR-CODE                    B 0704-NUCLEAR
                         #2DXY NUCLEAR-CODE                    B 0704-NUCLEAR
                 #APWRC-SYNFAR NUCLEAR-CODE                    B 0709-NUCLEAR
                        #FUGUE NUCLEAR-CODE                    B 7090-NUCLEAR
                     #AIREK-II NUCLEAR-CODE                    B 7090-NUCLEAR
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              #EQUIPOISE NUCLEAR-CODE                        B 7090-NUCLEAR
            #TWENTY-GRAND NUCLEAR-CODE                       B 7090-NUCLEAR
4 CYLINDRICAL GEOMETRY CELL CODE NUCLEAR-CODE             #S B 7090-NUCLEAR
                   #2DXY NUCLEAR-CODE                        B 7090-NUCLEAR
RE DISTRIBUTION IN FUEL ELEMENTS NUCLEAR-CODE    # TEMPERATU B 0650-08.2.026
CTOR CODE FOR SPHERICAL GEOMETRY NUCLEAR-CODE     # BALL A REA B 0650-08.2.016
FUSION EQUATION IN ONE DIMENSION NUCLEAR-CODE     #UNCLE 3 DIF B 0650-08.2.012
ORNET REACTOR CODE SPHERICAL GEO NUCLEAR-CODE    # BEEHIVE & H B 0650-08.2.009
FFUSION EQUATION IN %X, Y¤ SPACE NUCLEAR-CODE    # UNCLE 11 DI B 0650-08.2.011
UTRON ATTENUATION-REACTOR SHIELD NUCLEAR-CODE   # CALCULATE NE B 0650-08.2.025
EW-GROUP ONE DIMENSIONAL PROGRAM NUCLEAR-CODE   # LIL ABNER A F B 0650-08.2.007
SION EQUATION IN CYLINDRICAL GEO NUCLEAR-CODE   # UNCLE 1 DIFFU B 0650-08.2.010
, THE NEUTRON TRANSPORT EQUATION NUCLEAR-CODE # A MULTIGROUP P3 B 0650-08.2.028
                 #CANDLE NUCLEAR-CODE BURNUP                 B 0704-NUCLEAR
                  #TURBO NUCLEAR-CODE BURNUP                 B 0704-NUCLEAR
                  #DRACO NUCLEAR-CODE BURNUP                 B 0704-NUCLEAR
                 #SIZZLE NUCLEAR-CODE BURNUP                 B 7090-NUCLEAR
             #TEMPEST-II NUCLEAR-CODE CROSS-SECTIONS         B 7090-NUCLEAR
                   #FORM NUCLEAR-CODE CROSS-SECTIONS         B 7090-NUCLEAR
                #TEMPEST NUCLEAR-CODE CROSS-SECTIONS         B 7090-NUCLEAR
                  #AETRA NUCLEAR-CODE CROSS-SECTIONS         B 7090-NUCLEAR
                  #GAM-I NUCLEAR-CODE CROSS-SECTIONS         B 7090-NUCLEAR
                 #STDY-3 NUCLEAR-CODE ENGINEERING            B 0704-NUCLEAR
                  #ART I NUCLEAR-CODE ENGINEERING            B 0704-NUCLEAR
               #ABRAC-01 NUCLEAR-CODE ENGINEERING            B 0704-NUCLEAR
                  #ATBAC NUCLEAR-CODE ENGINEERING            B 0704-NUCLEAR
                 #ART 04 NUCLEAR-CODE ENGINEERING            B 0704-NUCLEAR
                  #BINTO NUCLEAR-CODE ENGINEERING            B 0704-NUCLEAR
                  #F0020 NUCLEAR-CODE ENGINEERING            B 0704-NUCLEAR
                   #HEAT NUCLEAR-CODE ENGINEERING            B 0704-NUCLEAR
           #PROP AND JET NUCLEAR-CODE ENGINEERING            B 0704-NUCLEAR
              #SET CODES NUCLEAR-CODE ENGINEERING            B 0704-NUCLEAR
                 #TEMP-2 NUCLEAR-CODE ENGINEERING            B 0704-NUCLEAR
                 #TURF-6 NUCLEAR-CODE ENGINEERING            B 0704-NUCLEAR
               #WB TSG-1 NUCLEAR-CODE ENGINEERING            B 0704-NUCLEAR
                  #PECAN NUCLEAR-CODE ENGINEERING            B 0704-NUCLEAR
                #AIMFIRE NUCLEAR-CODE ENGINEERING            B 7090-NUCLEAR
NE-DIMENSIONAL  #WANDA-4 NUCLEAR-CODE GROUP DIFFUSION O B 0704-NUCLEAR
NE-DIMENSIONAL     #ZOOM NUCLEAR-CODE GROUP DIFFUSION O B 0704-NUCLEAR
NE-DIMENSIONAL   #COGENT NUCLEAR-CODE GROUP DIFFUSION O B 0704-NUCLEAR
WO-DIMENSIONAL     #CURE NUCLEAR-CODE GROUP DIFFUSION T B 0704-NUCLEAR
WO-DIMENSIONAL    #PDQ-2 NUCLEAR-CODE GROUP DIFFUSION T B 0704-NUCLEAR
WO-DIMENSIONAL    #PDQ-3 NUCLEAR-CODE GROUP DIFFUSION T B 0704-NUCLEAR
WO-DIMENSIONAL      #REM NUCLEAR-CODE GROUP DIFFUSION T B 0704-NUCLEAR
NE-DIMENSIONAL     #FIRE NUCLEAR-CODE GROUP DIFFUSION O B 0704-NUCLEAR
NE-DIMENSIONAL #WANDA 2,3 NUCLEAR-CODE GROUP DIFFUSION O B 0704-NUCLEAR
HREE-DIMENSIONAL    #TKO NUCLEAR-CODE GROUP DIFFUSION T B 0704-NUCLEAR
HREE-DIMENSIONAL    #UFO NUCLEAR-CODE GROUP DIFFUSION T B 0704-NUCLEAR
WO-DIMENSIONAL  #PDQ2-90 NUCLEAR-CODE GROUP DIFFUSION T B 7090-NUCLEAR
NE-DIMENSIONAL      #FOG NUCLEAR-CODE GROUP DIFFUSION O B 7090-NUCLEAR
NE-DIMENSIONAL    #AIM-6 NUCLEAR-CODE GROUP DIFFUSION O B 7090-NUCLEAR
                  #COFIT NUCLEAR-CODE MISCELLANEOUS          B 0704-NUCLEAR
                  #EXFIT NUCLEAR-CODE MISCELLANEOUS          B 0704-NUCLEAR
                  #F0031 NUCLEAR-CODE MISCELLANEOUS          B 0704-NUCLEAR
              #EURIPUS-3 NUCLEAR-CODE MONTE CARLO            B 0704-NUCLEAR
               #DAEDALUS NUCLEAR-CODE MONTE CARLO            B 0704-NUCLEAR
             #POLYPHEMUS NUCLEAR-CODE MONTE CARLO            B 0704-NUCLEAR
                 #SPAN-2 NUCLEAR-CODE MONTE CARLO            B 0704-NUCLEAR
                 #SPIC-1 NUCLEAR-CODE MONTE CARLO            B 0704-NUCLEAR
                 #TUT-T5 NUCLEAR-CODE MONTE CARLO            B 0704-NUCLEAR
                   #PERT NUCLEAR-CODE PERTURBATION           B 7090-NUCLEAR
                   #PREP NUCLEAR-CODE PHYSICS                B NORC-NUCLEAR
               #SOFOCATE NUCLEAR-CODE PHYSICS                B 0704-NUCLEAR
         #SWAP MU AND NU NUCLEAR-CODE PHYSICS                B 0704-NUCLEAR
                     #PS NUCLEAR-CODE PHYSICS                B 0704-NUCLEAR
                  #QUERY NUCLEAR-CODE PHYSICS                B 0704-NUCLEAR
                #GRACE-I NUCLEAR-CODE PHYSICS                B 7090-NUCLEAR
                  #CLOUD NUCLEAR-CODE PHYSICS                B 7090-NUCLEAR
               #GRACE-11 NUCLEAR-CODE PHYSICS                B 7090-NUCLEAR
                  #CEPTR NUCLEAR-CODE TRANSPORT              B 0704-NUCLEAR
                   #FLIP NUCLEAR-CODE TRANSPORT              B 0704-NUCLEAR
        #HERD-1,2, AND 3 NUCLEAR-CODE TRANSPORT              B 0704-NUCLEAR
                   #PIMG NUCLEAR-CODE TRANSPORT              B 0704-NUCLEAR
                #SIMPL-1 NUCLEAR-CODE TRANSPORT              B 0704-NUCLEAR
                #SIMPL-2 NUCLEAR-CODE TRANSPORT              B 0704-NUCLEAR
                    #SNG NUCLEAR-CODE TRANSPORT              B 0704-NUCLEAR
                 #TRIP-1 NUCLEAR-CODE TRANSPORT              B 0704-NUCLEAR
                 #MUFT 4 NUCLEAR-CODE TRANSPORT              B 0704-NUCLEAR
                  #RANCH NUCLEAR-CODE TRANSPORT              B 0704-NUCLEAR
                   #SAIL NUCLEAR-CODE TRANSPORT              B 7090-NUCLEAR
            #FORTRAN SN6 NUCLEAR-CODE TRANSPORT              B 7090-NUCLEAR
IAL W/AUTO ERROR ANALYSIS      #NUM SOLU OF ORDINARY DIFFERENT B 0650-04.0.012
          #LESS-PHASE 1A-NODE NUMBERING                      B 0650-10.3.007
 OF COVARIANCE DISPROP. SUBCLASS NUMBERS           #ANALYSIS B 0650-06.0.057
IS OF VARIANCE,DISPROP. SUBCLASS NUMBERS             #ANALYS B 0650-06.0.058
RFORMING OPERATIONS WITH COMPLEX NUMBERS   #INTERP. SYS. FOR PE B 1620-02.0.003
ATES GENERATOR          #RANDOM NUMBERS AND RANDOM NORMAL DEVI B 7070-11.7.001
RMALLY DISTRIBUTED PSEUDO-RANDOM NUMBERS.                #NO B 0704-0578RWND2
RMALLY DISTRIBUTED PSEUDO-RANDOM NUMBERS.                #NO B 0704-0578RWND2
MBOLIC PROGRAM TAPE USING SERIAL NUMBERS.        # UPDATE SY B 0709-1009WDSER
      #BINARY INTEGER TO ROMAN NUMERAL CONVERSION.           B 0704-08700RROM
RRECTOR                    #NUMERIC TAPE DUPLICATOR AND CO A 1620--MI-016
 PROCEDURE FOR USING SOAP WITH A NUMERIC 650              #A B 0650-01.6.012
               #MULTIPLE NUMERICAL INTEGRATION               B 0650-04.0.002
OUBLE INTEGRAL             #NUMERICAL INTEGRATION OF THE D B 0650-07.0.010
INT PROCEDURE              #NUMERICAL INTEGRATION BY MIDPO B 0704-1017AND10
ALLY SPACED POINTS         #NUMERICAL INTEGRATION OF UNEQU B 0704-1157TU900
NE           #FLOATING POINT NUMERICAL INTEGRATION SUBROUTI B 0704-0525PKLAQ
NE           #FLOATING POINT NUMERICAL INTEGRATION SUBROUTI B 0704-0525PKLEQ
POISSON AND HEAT FLOW EQUATION  #NUMERICAL SOLUTION OF LAPLACE  B 0650-04.0.010
TIAL EQUATIONS OF ORDER N       #NUMERICAL SOLUTION OF DIFFEREN B 0650-04.0.013
S DIFFERENTIAL EQUATION         #NUMERICAL SOLUTION OF LEGENDRE B 1401-11.0.002
                           #NY BOL1 TRANSITION               B 0704-0216NYPLD
G ROUT *     #FACTOR * FOURTEEN O ONE AUTO CONT TEST OPTIMIZIN B 1401-01.4.007
ING *          #FAST * FOURTEEN O ONE AUTOMATED SYSTEM OF TEST B 1401-01.4.004
L SYSTEM *     #FITS * FOURTEEN O ONE INPUT-OUTPUT TAPE CONTRO B 1401-01.4.011
                 #704 SURGE OBJECT LOADER                    B 0704-0877ECOLO
ORS OF A MATRIX            #TO OBTAIN EIGENVALUES & EIGENVECT B 0650-05.2.025
               #MAKE SAP OCTAL                               B 0704-0513BESAK
                #BINARY OCTAL CARD OR TAPE LOADER            B 0704-0690GDBOT
R /THREE CARDS/.           #OCTAL COLUMN BINARY CARD LOADE B 0704-0668MUCBL
                           #OCTAL CORRECTION CARD READER     B 0704-0830MIOCT
                           #OCTAL CORRECTION CARD READER     B 0704-0830MIOCT
                #ON LINE OCTAL DUMP                          B 0704-0499CMOCD
                   #MURA OCTAL DUMP                          B 0704-0251MUOCD
               #MNEMONIC OCTAL LOADER                        B 0704-0274RS014
                 #BINARY OCTAL LOADER                        B 0704-0215NYBOL
       #TWO CARD BINARY AND OCTAL LOADER                     B 0704-0381ASAS5
             #BINARY AND OCTAL LOADER                        B 0709-0951NA092
     #ABSOLUTE AND RELOCATABLE OCTAL LOADER.                 B 0704-0623ELROL
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OP/                          #TRAP OCTAL MEMORY PRINT - /TRAP SCO B 0704-0278UASPO
                                #OCTAL MEMORY PRINT OUT PROGRAM B 0704-0286NYDSI
CORE DUMP                       #OCTAL MNEMONIC FLOATING POINT  B 0709-0633WDOMF
                      #MURA READ OCTAL NUMBER ROUTINE           B 0704-0263MURON
                             # OCTAL TAPE PRINT                 B 0704-0301RL013
RTRAN LOADER     #RELOCATABLE OCTAL-COLUMN BINARY ON LINE FO B 0704-0912ASAS8
                       #    704 OCTAL-DECIMAL DUMP              B 0704-0932E00DD
                        #DECIMAL, OCTAL, BCD LOADER             B 0704-0756RWINP
                        #DECIMAL, OCTAL, BCD LOADER             B 0704-0756RWINP
                        #DECIMAL, OCTAL, BCD LOADER             B 0704-0073UADBC
                        #DECIMAL, OCTAL, BCD LOADER             B 7090-1138RWINP
        #FORTRAN II ON-LINE TO OFF-LINE INPUT MODIFYING SUBR. B 0704-0637ANZ01
NE          #GENERALIZED,PACKAGED,OFF-LINE INPUT-OUTPUT SUBROUTI B 0704-0620CF009
.           #FORTRAN II ON-LINE TO OFF-LINE OUTPUT MODIFYING SUBR B 0704-0637ANZ01
IFYING SUBR.        #FORTRAN II OFF-LINE TO ON-LINE OUTPUT MOD B 0704-0637ANZ01
OR WITH SOURCE LANG DEBUG       #OFFLINE EDIT FOR FORTRAN MONIT B 7090-1115GPFMS
TION.                           #OFFSET CIRCLE PROBABILITY FUNC B 0704-0869RCOCI
LIC SUBROUTINE LOADER WITH FL.PT.OFL.       #FN II BINARY SYMBO B 0704-0848ARBSS
                                #OHIO CUT AND FILL              B 0650-09.2.030
O-COLUMN BINARY CARD CONVERSION, ON-LINE             #STANDARD-T B 0704-0374NA277
                                #ON-LINE BCD CARD READ ROUTINE  B 0709-0948MLRBC
              #READ BCD TAPE OR ON-LINE CARD READER             B 0704-0073UACSH
E           #GENERALIZED,PACKAGED,ON-LINE INPUT-OUTPUT SUBROUTIN B 0704-0573CF001
BS. AND TSF. CARDS              #ON-LINE LOADER FOR COL. BIN. A B 0704-10120RCBL
        #FORTRAN II OFF-LINE TO ON-LINE OUTPUT MODIFYING SUBR. B 0704-0637ANZ01
                                #ON-LINE STORAGE DUMP           B 0650-01.6.030
IFYING SUBR.         #FORTRAN II ON-LINE TO OFF-LINE OUTPUT MOD B 0704-0637ANZ01
FYING SUBR.          #FORTRAN II ON-LINE TO OFF-LINE INPUT MODI B 0704-0637ANZ01
 MATHEMATICAL PROGRAMMING SYSTEM ONE                    #FORTRAN B 0704-0863RSM1
T OF KILTER NETWORK FLOW ROUTINE ONE                         #OU B 0709-1084RSOKF
ROUT *      #FACTOR * FOURTEEN O ONE AUTO CONT TEST OPTIMIZING  B 1401-01.4.007
G *           #FAST * FOURTEEN O ONE AUTOMATED SYSTEM OF TESTIN B 1401-01.4.004
     #WRITES A FOURIER SERIES AS ONE BINARY RECORD ON TAPE.     B 0704-0788IBWFS
   #ABSOLUTE BINARY UPPER LOADER ONE CARD                       B 0709-1102SE9DU
 LOADER.                       #  ONE CARD ABSOLUTE BINARY UPPER B 0704-0473CSBUL
                                #ONE CARD LOWER LOAD            B 0705-EK 0001
                                #ONE CARD TAPE COPY ROUTINE     B 0704-0540SC
                                #ONE CARD UPPER LOAD            B 0705-EK 0002
  #UNCLE 3 DIFFUSION EQUATION IN ONE DIMENSION NUCLEAR-CODE     B 0650-08.2.012
SOLVER            #MULTI-MATERIAL ONE DIMENSIONAL HEAT EQUATION  B 0704-0652RWHF2
R-CODE   # LIL ABNER A FEW-GROUP ONE DIMENSIONAL PROGRAM NUCLEA B 0650-08.2.007
 PUNCHES                  #SKIPS ONE FILE ON A DECIMAL TAPE AND B 0704-1144NC014
SYSTEM *      #FITS * FOURTEEN O ONE INPUT-OUTPUT TAPE CONTROL  B 1401-01.4.011
RATE OF RET-PV2A-FINITE CHAIN OF ONE INVESTMENT      #PRES VAL- B 0650-07.0.018
                    #ITERATION, ONE OR TWO VARIABLES            B 0704-0433MCITR
                           #SPS ONE PASS FOR PAPER TAPE         A 1620--SP-007
                                #ONE PHASE MONITOR SYSTEM.      B 7090-1094BESYS
XTREMUM OF UNIMODAL FUNCTIONS OF ONE VARIABLE                #E B 0704-0878BEMIM
      #BESSEL FUNCTIONS OF ORDER ONE.                           B 0704-0636RWBF3
                 #SIMULATION OF ONE-ARMED BANDIT * CARD *       B 1620-11.0.011
          #1620 SIMULATION OF A ONE-ARMED BANDIT * TAPE *       B 1620-11.0.002
IRE NUCLEAR-CODE GROUP DIFFUSION ONE-DIMENSIONAL             #F B 0704-NUCLEAR
2,3 NUCLEAR-CODE GROUP DIFFUSION ONE-DIMENSIONAL         #WANDA  B 0704-NUCLEAR
A-4 NUCLEAR-CODE GROUP DIFFUSION ONE-DIMENSIONAL          #WAND B 0704-NUCLEAR
OOM NUCLEAR-CODE GROUP DIFFUSION ONE-DIMENSIONAL             #Z B 0704-NUCLEAR
ENT NUCLEAR-CODE GROUP DIFFUSION ONE-DIMENSIONAL           #COG B 0704-NUCLEAR
FOG NUCLEAR-CODE GROUP DIFFUSION ONE-DIMENSIONAL              # B 7090-NUCLEAR
M-6 NUCLEAR-CODE GROUP DIFFUSION ONE-DIMENSIONAL            #AI B 7090-NUCLEAR
UP NUCLEAR-CODE                # ONE-SPACE-DIMENSIONAL MULTIGRO B 0650-08.2.003
                                #ONE-TO-SEVEN CONVERTER         B 0650-01.6.009
MULTIWORD KEYS. /WHOLE WORD KEYS ONLY/       #SORT, ALGEBRAIC.  B 0704-05700RSRT
      #PUNCHES A FOURIER SERIES ONTO BINARY RELOCATABLE CARDS. B 0704-0788IBPUF
PRE TO FLT PT REPRE          #INT OP 4 CONV OF NO FROM FIX PT RE B 0650-01.6.017
ORTRAN EDIT DECK                #OPEN SUBROUTINE ADDITIONS TO F B 0704-1081LROSR
C. KEY AND ITEM LENGTH - 1 WORD.-OPEN.        #SORT, ALGEBRAI B 0704-05700RSRT
           #STRESS ANALYSIS OF OPEN-WEB STRUCTURES              B 0650-09.2.038
ATRIX.                          #OPERATE ON A REAL, SYMMETRIC M B 0704-0460MIOPM
                     #PROCESSOR OPERATING SYSTEM                A 1410--PR-108
ICOR FLOATING INTERP. COMPATIBLE OPERATION ROUTINE          #FL B 0650-02.0.020
UTINE NOSIR                 #NINE OPERATION SPLIT INSTRUCTION RO B 0650-02.0.006
RETIVE SYSTEM      #COMPLEX ARITH OPERATIONS IN BELL LAB. INTERP B 0650-02.0.012
      #709 PROGRAM FOR CHECKING OPERATIONS NEEDING TRANSLATING B 0709-0482GASPO
                          #UNIT OPERATIONS SIMULATOR            B 0650-09.6.022
S    #INTERP. SYS. FOR PERFORMING OPERATIONS WITH COMPLEX NUMBER B 1620-02.0.003
                          #TAPE OPERATOR PROGRAM /TOP/          B 0704-0382GSTOP
           # CORBIE, AUTOMATIC OPERATOR SYSTEM                  B 0704-0372BSCRB
         #GSEL,FMCTR,LINK,MOVE,OPHLT,SEQCK,SIGN,STRIP,VMCTR     B 0705-BW-002-0
     #GEN. TRA ROUTINE PROG TAPE OPR TAPE LBL&TRAILER CKN       B 0705-SR-002-0
                                #OPTICAL RAY TRACING            B 0650-08.1.001
                     #SOAP-TYPE OPTIMAL ASSEMBLY PROGRAM STRAP B 0650-01.1.007
 4000                #SOAP TYPE OPTIMAL ASSEMBLY PROGRAM STRAP B 0650-01.1.012
      #7070 GENERATIONS OF 1401 OPTIMIZED PROGRAMS * GOOP *     B 7070-01.9.003
                #FLOATING POINT OPTIMIZED RUNGE KUTTA           B 0704-1147ECRKO
ION.            #FLOATING POINT OPTIMIZED RUNGE-KUTTA INTEGRAT B 0709-1170ATRKS
 12F6.0                         #OPTIMIZED TAPE READ FOR FORMAT B 0704-0791TVMEO
                                #OPTIMIZING PROGRAM             B 0650-01.1.002
 * FOURTEEN O ONE AUTO CONT TEST OPTIMIZING ROUT *      #FACTOR B 1401-01.4.007
        #AN AUTOMATIC METHOD OF OPTIMUM PROGRAMMING             B 0650-01.1.003
                                #OPTIMUM SEPARATOR PRESSURE     B 0650-09.6.005
  #STROBIC-SKELLY TR. ROUT. WITH OPTION BR&TRANS&IND. ADD. CONV B 1620-01.4.004
NE, RUNGE-KUTTA INTEGRAT. OF 2ND ORD. EQ.      #FLOAT. PT. MIL B 0704-0450RWDE3
 FUNCTIONS FOR REAL ARGUMENT AND ORDER                #  BESSEL B 0704-0469NUBES
BROUTINE                 #SECOND ORDER DIFFERENTIAL EQUATION SU B 0704-1073BCDIF
TEGRATION OF SPECIAL FORM OF 2ND ORDER EQU.                #IN B 0704-0141LAS88
ION OF DIFFERENTIAL EQUATIONS OF ORDER N     #NUMERICAL SOLUT B 0650-04.0.013
          #BESSEL FUNCTIONS OF ORDER ONE.                       B 0704-0636RWBF3
      #SECOND,THIRD,AND FOURTH ORDER RUNGE-KUTTA INTEGRATION    B 0704-1233AAINT
          #BESSEL FUNCTIONS OF ORDER ZERO.                      B 0704-0636RWBF2
FUNCTION OF COMPLEX ARGUMENT AND ORDER.                #  BESSEL B 0704-0979NUBES
B K TIMES Z OR I              #ALL ORDERS OF BESSEL FUNCTION J SU B 0709-0984RWBF7
 Y SUB K TIMES Z              #ALL ORDERS OF THE BESSEL FUNCTIONS B 0709-0985RWBF8
/RUNGE-KUTTA/                   #ORDINARY DIFF. EQUNS.SOLUTION  B 7090-1205NUDEQ
     #INTER SUBROU FOR SOLU OF ORDINARY DIFFERENTIAL EQUATION B 0650-04.0.005
RROR ANALYSIS          #NUM SOLU OF ORDINARY DIFFERENTIAL W/AUTO E B 0650-04.0.012
S SYSTEM            #FLOATING POINT ORDINARY DIFFERENTIAL EQUATION B 0704-0525PKNID
S SYSTEM            #FLOATING POINT ORDINARY DIFFERENTIAL EQUATION B 0704-0525PKNID
          #NORMAL PROBABILITY - ORDINATE AND AREA               B 0709-1001NA860
                      #SMOOTHED ORDINATE AND DERIVATIVE         B 7090-1248MDSOD
BRIDGE  #MOMENT REACT INFLU LINE ORDINATE FROM CONTINUOS GIRD.  B 0650-09.2.057
OGRAM            #BPR REVISION OF OREGON HORIZONTAL ALIGNMENT PR B 0650-09.2.053
                          #FILE ORGANIZATION ROUTINES           A 1401--UT-057
IMULATING THE CARD 650 ON A TAPE ORIENTED 7070               #S B 7070-05.1.004
ARES CURVE-FITTING ROUTINE USING ORTHOGONAL           #LEAST SQU B 0704-0636RWCF2
LEAST SQUARES CURVE FITTING WITH ORTHOGONAL POLYNOMIALS       # B 0650-06.0.023
TTER                            #ORTHOGONAL POLYNOMIAL CURVE FI B 0650-06.0.039
                       #GENERAL ORTHONORMALIZING SUBROUTINE.    B 0704-0850BSORT
           #TRANSLATOR AND OTHER FORMATS TO SOAP RELOKS         B 0650-01.6.048
      #TO ASSIGN TAPE UNIT USAGE OTHER THAN THAT WHICH IS       B 7090-1199PEIBL
       #TWELVE UTILITY PROGRAMS OUTLINED IN 305 BULLETIN NO. 1 A 0305--UT-008
RELATION ANALYSIS WITH ANNOTATED OUTPUT                    #COR B 0650-06.0.014
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#TRIPLE PRECISION OUTPUT                                  B 0704-0378CA002
T BCD TEXT GENERATOR FOR FORTRAN OUTPUT            #PRINTER PLO B 0709-1118URPLO
#FN II BCD TAPE OUTPUT FOR FORMAT 12F6.0,4I2              B 0704-1057TVMEF
#DOUBLE PRECISION OUTPUT FOR FORTRAN                      B 0709-1202NRDOC
#PAGE HEADING OUTPUT FORTRAN II SUBROUTINE                B 0704-0848ARHED
#FORTRAN OUTPUT MERGE PROGRAM                             B 0704-0853ME020
#FORTRAN II ON-LINE TO OFF-LINE OUTPUT MODIFYING SUBR.    B 0704-0637ANZ01
#FORTRAN II OFF-LINE TO ON-LINE OUTPUT MODIFYING SUBR.    B 0704-0637ANZ01
#BCD OUTPUT PROGRAM                                       B 0704-0654AMWOT
#BCD OUTPUT PROGRAM                                       B 0704-0528BSWOT
#GENERAL PURPOSE OUTPUT PROGRAM                           B 0704-0497ASAS6
#MONITOR SUBROUTINE AND OUTPUT PROGRAM                    B 0704-0302NYMON
#A GENERAL OUTPUT PROGRAM                                 B 0709-0569SE90U
HT CONTROL     #DECIMAL OUTPUT PROGRAM UNDER SENSE LIG B 0704-0206NYOUT
HT CONTROL     #DECIMAL OUTPUT PROGRAM UNDER SENSE LIG B 0709-1026WPK07
#GENERAL PURPOSE OUTPUT PROGRAM.                          B 0709-0947MLAS6
#GENERAL OUTPUT ROUTINE                                   B 0704-0652RWPRT
#GENERAL PUNCHED OUTPUT ROUTINE                           B 0704-0512DMPUN
#DATA PROCESSING OUTPUT ROUTINE                           B 0704-0512DMDPO
#GENERAL OUTPUT ROUTINE FOR THE 709.                      B 0709-1039RWPRT
#DOUBLE PRECISION OUTPUT SCALING                          B 0704-0334NA022
#  GENERALIZED OUTPUT SUBROUTINE                          B 0704-0988NUOUT
#BCD OUTPUT SUBROUTINE                                    B 0704-0500BSEWO
AM TO GENERATE 1401 T/P PROG. ON OUTPUT TAPES.     #704 PROGR B 0704-1231TVTPP
#TREE OUTPUT TO FREEWAY INPUT                             B 0650-09.2.082
#DOUBLE PRECISION OUTPUT.                                 B 0704-0577RWDPT
RELATION ANALYSIS WITH ANNOTATED OUTPUT-PART II          #COR B 0650-06.0.032
RELATION ANALYSIS WITH ANNOTATED OUTPUT-PART 3           #COR B 0650-06.0.037
#GS REVISION OF GL OUT2                                   B 0704-0204GSOUT
A MIN. PATH BET. ZONE CENTROIDS OVER A ROAD NETWORK   #TRACING B 0650-09.2.080
NLLS.      #FLOATING-POINT OVERFLOW/UNDERFLOW ROUTINE FOR B 0704-0837OROUN
E CHECK TEST         #OVERFLOW, UNDERFLOW, AND DIVID B 0704-0248CLOUD
#OVERHAUL PROGRAM                                         B 0650-09.2.069
ON SYSTEMS ANALYSIS  #OVERHEAD ELECTRICAL DISTRIBUTI B 0650-09.4.008
#FORTRAN OVERLOADER SUBPROGRAM                            B 0704-0830MISLA
#NOST P                                                   A 7080--SV-087
#P-V-T DATA CALCULATIONS                                  B 0650-09.6.002
-CODE                # P-3 FLUX DISTRIBUTION  NUCLEAR B 0650-08.2.014
#709 9 PAC                                                A 0709--PR-060
SUBROUTINE     #GENERALIZED,PACKAGED,OFF-LINE INPUT-OUTPUT B 0704-0620CF009
SUBROUTINE     #GENERALIZED,PACKAGED,ON-LINE INPUT-OUTPUT  B 0704-0573CF001
#BINARY TO PACKED BCD CONVERTER                           B 0704-0359ELSMO
#PACT 1A SAMPLE PROGRAM                                   B 0704-0316NA259
SUBROUTINE           #PAGE HEADING OUTPUT FORTRAN II B 0704-0848ARHED
ED INCOMPLETE BLOCKS #PAIRED COMPARISONS FROM BALANC B 0650-06.0.038
PARCOPLET-2-21 *     #COMPLETE PAIRED COMPARISONS SCHEDULE * B 0650-06.0.045
#GENERAL PURPOSE 407 CONTROL PANEL                        B 0650-01.6.056
AND 650 LOAD CARD  #402 CONTROL PANEL FOR SOAP II 8-WORD LIST, B 0650-12.0.005
#7070 650 PANEL SIMULATOR                                 B 7070-05.1.001
#650 SOAP CONTROL PANEL WIRING SUGGESTION                 B 0650-12.0.006
ROGRAMS, STORED PROGRAM, PROCESS PANEL, POST TRAC#THREE TRACE P A 0305--AT-007
#GOTRAN FOR PAPER TAPE                                    A 1620--PR-010
#FORTRAN WITH FORMAT FOR PAPER TAPE                       A 1620--FO-003
#FORTRAN PRE-COMPILER FOR PAPER TAPE                      A 1620--FO-005
#SPS ONE PASS FOR PAPER TAPE                              A 1620--SP-007
#SPS TWO PASS FOR PAPER TAPE                              A 1620--SP-008
#FORTRAN FOR PAPER TAPE                                   A 1620--FO-001
FALL DATA   #FITTING DATA TO TWO PARA. GAMMA DIST-SPEC REF RAIN B 0650-06.0.051
#PARABOLIC INTERPOLATION                                  B 0650-03.1.030
#BIVARIATE PARABOLIC INTERPOLATION                        B 0704-0248CLPIN
# PARACANTOR NUCLEAR-CODE                                 B 0650-08.2.002
#BPR PARALLAX REDUCTION PROGRAM                           B 0650-09.8.002
#WATER SURFACE PROFILE PARAMETERS                         B 0650-09.2.051
TE PAIRED COMPARISONS SCHEDULE * PARCOPLET-2-21 *     #COMPLE B 0650-06.0.045
#KWIC SORT PROGRAM FIRST PART                             B 0704-0914NCKSP
#KWIC SORT PROGRAM SECOND PART                            B 0704-0914NCKSP
EAR PRG. FORCED INVERSION VECTOR PART. CODE FOR AUGMENT 650#LIN B 0650-10.1.010
#ANALYSIS OF VARIANCE FOR PART. OR SING. REPLICATED KBY   B 0650-06.0.063
R SERIES.        #COMPUTES THE PARTIAL DERIVATIVE OF A FOURIE B 0704-0788IBPDF
NCT.     #DIFFERENTIATION AND PARTIAL DIFFER. OF RATIONAL FU B 0704-0445PEPAR
#ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS                  B 0704-0674RWSPA
SOLVER        #SIMULTANEOUS PARTIAL DIFFERENTIAL EQUATIONS B 0704-1043JPSRC
ING POINT ADDITION   #PARTIAL DOUBLE PRECISION FLOAT B 0704-0650RWADD
#PARTICLE SCATTERING                                      B 0704-0743ORTUR
#MATRIX INVERSION BY PARTITIONING                         B 0704-0324NYDMI
APED AREA     #A PROGRAM FOR PARTITIONING OF ARBITRARILY SH B 0650-09.6.013
#SPS TWO PASS FOR CARDS                                   A 1620--SP-009
#SPS ONE PASS FOR PAPER TAPE                              A 1620--SP-007
#SPS TWO PASS FOR PAPER TAPE                              A 1620--SP-008
#PAT COMPILER                                             B 7070-04.4.001
#1401 PAT COMPILER FOR 7070                               B 7070-04.4.004
#7070 PAT COMPILER SYSTEM                                 B 7070-04.4.002
#PAT UTILITY SYSTEM * 40K *                               A 1410--AT-105
#PAT UTILITY SYSTEM * 10/20K *                            A 1410--AT-104
FACTOR MATRIX        #PATERN QUARTIMAX ROTATION OF A B 0650-05.1.007
#CRITICAL PATH ANALYSIS                                   B 1620-10.3.005
ULATION        #CRITICAL PATH AND RESOURCE SUMMARY CALC B 7090-1158ORCPS
A ROAD NETWORK   #TRACING A MIN. PATH BET. ZONE CENTROIDS OVER B 0650-09.2.080
#KINEMATIC SYNTHESIS OF PATH GENERATING MECHANISMS        B 0650-09.5.003
#CRITICAL PATH PROGRAMMING METHOD                         B 0704-1188GMCP
SION TWO-DIMENSIONAL   #PDQ-2 NUCLEAR-CODE GROUP DIFFU B 0704-NUCLEAR
SION TWO-DIMENSIONAL   #PDQ-3 NUCLEAR-CODE GROUP DIFFU B 0704-NUCLEAR
FUSION TWO-DIMENSIONAL #PDQ2-90 NUCLEAR-CODE GROUP DIF B 7090-NUCLEAR
#PECAN NUCLEAR-CODE ENGINEERING                           B 0704-NUCLEAR
#TRANSMISSION LOSSES AND PENALTY FACTORS                  B 1620-09.4.008
#24 WORD PER CARD BINARY LOADER                           B 0704-0263MULBL
G COMP. WITH ELEC. COMP.  #CALC. PERF. CHARACT. OF RECIPROCATIN B 0650-09.6.015
#EVALUATING COMPRESSOR PERFORMANCE                        B 0650-09.5.005
PLEX NUMBERS   #INTERP. SYS. FOR PERFORMING OPERATIONS WITH COM B 1620-02.0.003
IER                  #PERIFPHERAL LINE PRINTER VERIF B 0704-0262NYPLV
#PERIPHERAL CARD VERIFIER                                 B 0704-0262NYPCV
#SIMULATE PERIPHERAL EQUIPMENT                            A 0709--SI-071
TRANSLATOR           #PERIPHERAL EQUIPMENT SYMBOLIC B 0709-0961PPPES
#1401 SCRAMBLE PERIPHERAL EQUIPMENT SIMULATOR             B 1401-13.3.001
# A VARIABLE FIELD PERIPHERAL INPUT                       B 0704-0209NOVNP
#BELL LABS PERMUTATION INDEX PROGRAM                      B 7090-1239BEPIP
AUTO-PIC *        #AUTOMATIC PERSONAL IDENTIFICATION CODE * B 0650-01.6.041
#AUTOPIC 1401 *AUTOMATIC PERSONAL IDENTIFICATION CODE *   B 1401-01.4.014
#PERT NUCLEAR-CODE PERTURBATION                           B 7090-NUCLEAR
#PERT NUCLEAR-CODE PERTURBATION                           B 7090-NUCLEAR
CARBON M#THERMODYNAMIC PROPS AND PHASE BEHAVIOR OF  LIGHT HYDRO B 0650-09.3.002
54 TECHNIQUE OF MODIFICATION OF PHASE II             #SORT B 0705-XE-001-0
#ONE PHASE MONITOR SYSTEM.                                B 7090-1094BESYS
#VIPP SORTER. FIRST PHASE OF A GENERAL PURPOSE            B 0704-0926TAVIP
#VIPP MERGER. SECOND PHASE OF A GENERAL PURPOSE           B 0704-0926TAVIP
HBERG    #LEAST COST EST.&SCHED. PHASE ONLY * LESS * M. C. FRIS B 0650-10.3.009
ST COST EST. & SCHEDULING-SCHED. PHASE ONLY LESS F. BACKER #LEA B 0650-10.3.005
#CHI SQUARE AND PHI FOR 2X2 CONTINGENCY TABLE             B 0650-06.0.016
#PREP NUCLEAR-CODE PHYSICS                                B NORC-NUCLEAR
#SOFOCATE NUCLEAR-CODE PHYSICS                            B 0704-NUCLEAR
#SWAP MU AND NU NUCLEAR-CODE PHYSICS                      B 0704-NUCLEAR
#PS NUCLEAR-CODE PHYSICS                                  B 0704-NUCLEAR
#QUERY NUCLEAR-CODE PHYSICS                               B 0704-NUCLEAR
#GRACE-I NUCLEAR-CODE PHYSICS                             B 7090-NUCLEAR
#CLOUD NUCLEAR-CODE PHYSICS                               B 7090-NUCLEAR
#GRACE-11 NUCLEAR-CODE PHYSICS                            B 7090-NUCLEAR
#PI-STAR PROGRAM                                          B 0704-1061PKPST
#PI-STAR SUBROUTINE                                       B 0704-1062PKPST
#ANALYSIS OF LATERALLY LOADED PILES                       B 0650-09.2.013
#PIMG NUCLEAR-CODE TRANSPORT                              B 0704-NUCLEAR
#DISTRIBUTION OF WATER FLOW IN A PIPE NETWORK             B 1620-09.7.001
#PIPE STREES ANALYSIS                                     B 0650-09.5.002
ES             #CALCULATION OF PIPING SYSTEM EXPANSION STRESS B 0650-09.5.001
MULTANEOUS LINEAR EQUATIONS WITH PIVOTING     #SLEP, SOLVES SI B 7070-10.4.002
CISION CLEAR AND ADD           #PK CLAD & PK STOD - DOUBLE PRE B 0704-0525PKCLA
#MODIFIED PK KWIC PROGRAM /SDA 884/                       B 0704-1144NC013
AR AND ADD          #PK CLAD & PK STOD - DOUBLE PRECISION CLE B 0704-0525PKCLA
#CONSTANTS FOR CR MONTE CARLO PKG. /NOT A SUBROUTINE/     B 0704-0743ORMOC
#COMPLEX 1 * INTERPRETIVE PKGE FOR COMPLEX ARITHMETIC     B 0650-07.0.014
#COMPLEX 11 * INTERPRETIVE PKGE FOR COMPLEX ARITHMETIC    B 0650-07.0.015
#SIMULATED PLANT RECORD AUXILIARY.                        B 0704-0604TVSP?
#CURVE FITTING- SIMULATED PLANT RECORD METHOD             B 1620-09.4.009
#PLATE-TO-PLATE CALCULATIONS                              B 0650-09.3.004
#CRT NUMBER PLOT                                          B 0704-0458GDNUM
RTRAN OUTPUT        #PRINTER PLOT BCD TEXT GENERATOR FOR FO B 0709-1118URPLO
#1401 PLOT I                                              B 1401-14.0.001
#CONTOUR PLOT PROGRAM                                     B 0704-0506MICR1
#CONTOUR PLOT PROGRAM                                     B 0704-0506MICR2
#ON LINE PLOT ROUTINE                                     B 0704-0392OLPLO
#GENERALIZED PLOT ROUTINE                                 B 7090-1146AMPLO
#POLAR POINT PLOT SUBROUTINE                              B 0704-0556ERPLO
#SCOPE GRID PLOTTER                                       B 0704-0432MUSCO
#MURA CATHODE RAY TUBE POINT PLOTTER                      B 0704-0321MUSCP
#SCOPE GRID PLOTTER                                       B 0704-0357MUSCP
#GENERALIZED PLOTTER                                      B 1620-09.7.003
#GENERALIZED PLOTTER II                                   B 1620-09.7.002
#ARBITRARY CURVE PLOTTER SUBROUTINE                       B 0704-0284WHWH2
#GENERAL PURPOSE PLOTTING SUBROUTINE                      B 0704-1085UMPLO
#CURVE PLOTTING SUBROUTINE                                B 0705-AO-004-0
BCD           #SIMULATES INPUT PLUGBOARD OF BASIC 650.  READS B 0704-0480CE650
#SIR PLUS                                                 B 0650-02.0.018
#ARCSINE, ARCOSINE FLOATING POINT--QUADRANT ALLOCATION    B 0704-0825JPASN
#ARCTANGENT, FLOATING POINT--QUADRANT ALLOCATION          B 0704-0825JPATN
#MURA MATRIX MULTIPLY /FLOATING POINT/                    B 0704-0432MUMAM
DOUBLE PRECISION ADDITION /FIXED POINT/             #MURA  B 0704-0256MUDPA
ER INTERPRETIVE SYSTEM /FLOATING POINT/      #COMPLEX NUMB B 0704-0832BECPK
INTEGRATION OF UNEQUALLY SPACED POINTS        #NUMERICAL B 0704-1157TU900
#SMOOTH AND DIFFERENTIATE DATA POINTS                     B 0704-0223CLSMD
FERENTIATE UNEQUALLY SPACED DATA POINTS    #SMOOTH AND DIF B 0704-0331CLSMD
#POISON                                                   B 0709-0956LCPSN
#NUMERICAL SOLUTION OF LAPLACE POISSON AND HEAT FLOW EQUATION B 0650-04.0.010
D INCOMPLETE GAMMA FUNCTION WITH POISSON TERM       #NORMALIZE B 7090-1177URGAM
COORDINATES     #RELAXATION PROG POISSONS EQUAT IN RECTANGULAR B 0650-04.0.009
#RANDOM NUMBER GENERATOR,  POLAR ANGLE. FLOATING POINT.   B 0704-0743ORPOL
#RECTANGULAR TO POLAR CONVERSION                          B 0704-0354NA87.
#POLAR POINT PLOT SUBROUTINE                              B 0704-0556ERPLO
#POLAR TO CARTESIAN COORDINATES                           B 0650-03.1.015
SQUARES              #POLLY-POLYNOMIAL FIT BY LEAST B 0650-06.0.010
IGITAL TERRAIN MODEL SYS 4 POINT POLY. INTERP. PROG. DA-2 1  #D B 0650-09.2.062
#MOMENTS OF INERTIA OF POLYATOMIC MOLECULES               B 0650-09.3.005
#ZEROS OF A COMPLEX POLYNOMIAL                            B 0704-0405PFZPC
#ZEROS OF A COMPLEX POLYNOMIAL                            B 0704-0225GMZER
#NTH LEGENDRE POLYNOMIAL                                  B 0704-0654AMPLG
#NTH LEGENDRE POLYNOMIAL                                  B 0704-0654AMPLG
#NTH LEGENDRE POLYNOMIAL                                  B 0704-0654AMPLG
G TO SELECTED TERMS OF A GENERAL POLYNOMIAL         #FITTIN B 0704-1077GC000
#WEIGHTED LEAST SQUARE POLYNOMIAL APPROXIMATION           B 0650-06.0.009
FINITE POINT SET      #MINIMAX POLYNOMIAL APPROXIMATION ON A B 0650-06.0.043
#LEAST SQUARES POLYNOMIAL APPROXIMATION.                  B 0704-0617CA021
ON                   #POLYNOMIAL COEFFICIENT REDUCTI B 0704-0224ASAS1
#ORTHOGONAL POLYNOMIAL CURVE FITTER                       B 0650-06.0.039
NE            #LEAST SQUARES POLYNOMIAL CURVE FITTING ROUTI B 0705-AO-003-0
E *                  #POLYNOMIAL CURVE FITTING * TAP B 1620-07.0.001
D *                  #POLYNOMIAL CURVE FITTING * CAR B 1620-07.0.002
#POLYNOMIAL CURVE FIT                                     B 1620-07.0.004
#UNIVARIATE POLYNOMIAL EVALUATION                         B 0704-0375UAUPE
RAN I PROGRAMS     #UNIVARIATE POLYNOMIAL EVALUATION FOR FORT B 0704-0375UAUPE
FOR 709         #FLOATING POINT POLYNOMIAL EVALUATION ROUTINE B 0709-0841RCPEV
E.                   #POLYNOMIAL EXPANSION SUBROUTIN B 0704-0611AVPOL
#POLYNOMIAL EXPANSION                                     B 0704-0435MAPOL
#ARGONNE LEAST SQUARE LEGENDRE POLYNOMIAL FIT             B 0704-0424ANE20
#LEAST MAXIMAL ABSOLUTE ERROR POLYNOMIAL FIT              B 0704-0500BSBFP
#LEAST SQUARES POLYNOMIAL FIT                             B 0704-0116CLLSQ
#POLYNOMIAL FIT                                           B 7090-1242SIPYF
#LEAST SQUARE POLYNOMIAL FIT /FORTRAN II/                 B 0704-0772ANE20
#ZEROS OF A POLYNOMIAL IN DOUBLE PRECISION                B 0704-0766ANC20
AM DA-5        #GENERAL PURPOSE POLYNOMIAL INTERPOLATION PROGR B 0650-09.2.073
T SQUARES METHOD      #POLYNOMIAL OF BEST FIT BY LEAS B 0650-06.0.006
#GENERAL POLYNOMIAL PROGRAM                               B 0704-0417PFZPQ
GRAM       #DOUBLE PRECISION POLYNOMIAL ROOT EXTRACTION PRO B 0709-1215AQE73
IREX *               #POLYNOMIAL ROOT EXTRACTION * T B 7070-09.1.001
S                    #POLYNOMIAL ROOT FINDER ROUTINE B 7090-1124MLHPR
#A MODIFIED NEWTON-RAPHSON POLYNOMIAL ROOT-FINDER         B 0704-0568ELQRC
H.       #REAL ROOTS OF A REAL POLYNOMIAL USING INTERVAL ARIT B 0704-0880IBRRP
H.       #REAL ROOTS OF A REAL POLYNOMIAL USING INTERVAL ARIT B 0704-0880IBRRP
NTS              #ROOTS OF POLYNOMIAL WITH REAL COEFFICIE B 0709-0927MAPOL
#ZEROS OF A REAL POLYNOMIAL.                              B 0704-0405PFZPR
#ZEROS, EXTENDED RANGE POLYNOMIAL/ZERP/.                  B 0704-0565CA004
#ZEROS OF COMPLEX POLYNOMIALS                             B 0650-07.0.006
TONS METHOD FOR FINDING ROOTS OF POLYNOMIALS           #NEW B 0704-0110GLROP
# ZEROS OF COMPLEX POLYNOMIALS                            B 0704-0692JPZPO
ES CURVE FITTING WITH ORTHOGONAL POLYNOMIALS     #LEAST SQUAR B 0650-06.0.023
CARLO                #POLYPHEMUS NUCLEAR-CODE MONTE B 0704-NUCLEAR
T AND PUNCH SUBROUTINE    #POPOUT  A GENERAL PURPOSE PRIN B 0704-0422NOPOU
OACTIVITY LOG INTERPRETATION   #POROSITY CALCULATION FROM RADI B 0650-09.6.006
TIMATING SCHEDULING * SCHEDULING PORTION *#LESS * LEAST COST ES B 1620-10.3.002
ST ESTIMATING SCHEDULING * SCHED PORTION#LESS * CARD * LEAST CO B 1620-10.3.003
#POST MORTEM DUMP                                         B 1620-01.5.004
#G & L POST PROCESSOR                                     B 0650-10.3.008
, STORED PROGRAM, PROCESS PANEL, POST TRAC#THREE TRACE PROGRAMS A 0305--AT-007
#POST-MORTEM ROUTINE                                      B 0704-0390MIPMR
REAL MATRIX          #POSTMULTIPLY REAL BY SYMETRIC B 0704-0273CLMMP
OF THE LEAST SQRS. BEST 1/2WAVE POTENT. AND SLOPE OF A  #CALC. B 0650-09.3.003
#POWER DENSITY SPECTRUM                                   B 0704-0897AAPDS
N, FLOATING          #POWER SPECTRAL DENSITY FUNCTIO B 0704-0577RWPS2
#AUTOCORRELATION AND POWER SPECTRUM                       B 0650-06.0.013
#AUTO-CORRELATION AND POWER SPECTRUM ANALYSIS             B 0704-0296NYCP2
IGITAL SHORT CIRCUIT SOLUTION OF POWER SYS NETWORK  #IMPROVED D B 0650-09.4.004
RENTS   #CALCULATION OF ELECTRIC POWER SYSTEM SHORT-CIRCUIT CUR B 0650-09.4.007
TY CALCULATIONS .    #ELECTRICAL POWER SYSTEM TRANSIENT STABILI B 0650-09.4.001
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R III                              #PRE-ASSEMBLY EDIT FOR AUTOCODE B 0705-SR-003-0
                                   #PRE-ASSEMBLY PROGRAM           B 0704-0176NAPRE
                           #FORTRAN PRE-COMPILER FOR CARD          A 1620--FO-006
                           #FORTRAN PRE-COMPILER FOR PAPER TAPE    A 1620--FO-005
SUBROUTINE                 #DOUBLE PREC. FLOATING PT EXPONENTIAL   B 0709-0839IBEXD
E-KUTTA INTEGRATION-         #DBL. PREC. FLOATING PT. MILNE, RUNG B 0704-0610RWDE3
 INTEGRATION OF              #DBL. PREC. FLOATING PT. RUNGE-KUTTA B 0704-0610RWDE2
 SUBROUTINE.               #DOUBLE PREC. FLOATING PT. SQUARE-ROOT B 0704-0727IBSQD
#ZEROS OF A POLYNOMIAL IN DOUBLE PRECISION                         B 0704-0766ANC20
       #FLOATING POINT DOUBLE PRECISION ABSTRACTION                B 0704-0110GLDPA
   #MURA FLOATING POINT DOUBLE PRECISION ADDITION                  B 0704-0280MUDPA
T/                    #MURA DOUBLE PRECISION ADDITION /FIXED POIN B 0704-0256MUDPA
ION                        #DOUBLE PRECISION ARC TANGENT INSTRUCT B 0704-0423BSATN
TINE.                      #DOUBLE PRECISION ARCSIN/ARCCOS SUBROU B 0704-0538NOASD
                           #TRIPLE PRECISION ARITHMETIC            B 0704-0481CA004
         #FLOATING POINT DOUBLE PRECISION ARITHMETICS.             B 0704-0417PFSDP
                           #TRIPLE PRECISION ARITHMETIC PACKAGE    B 0704-0378CA001
                   #FORTRAN DOUBLE PRECISION ARITHMETIC PACKAGE    B 7090-1122NRNPR
   #PK CLAD & PK STOD - DOUBLE PRECISION CLEAR AND ADD             B 0704-0525PKCLA
ACKAGE                     #TRIPLE PRECISION COMPLEX ARITHMETIC P B 0704-0546CA005
ACKAGE.                    #DOUBLE PRECISION COMPLEX ARITHMETIC P B 0704-0647NPDFC
                           #DOUBLE PRECISION COMPLEX FAD AND FMP  B 0704-0223CLDPC
D FDP                      #DOUBLE PRECISION COMPLEX FAD, FMP, AN B 0704-0223CLDPC
                           #TRIPLE PRECISION COMPLEX SQUARE ROOT  B 0704-0565CA005
ON                       #  DOUBLE PRECISION DETERMINANT EVALUATI B 0704-0356CA002
ION          #INTERPRETABLE DOUBLE PRECISION EXPONENTIAL INSTRUCT B 0704-0385BSEXP
                           #TRIPLE PRECISION EXPONENTIAL ROUTINE  B 0704-0565CA004
                           #DOUBLE PRECISION FLOATING ADD         B 0704-0223CLDPA
                           #DOUBLE PRECISION FLOATING ADD         B 7070-08.4.003
                           #DOUBLE PRECISION FLOATING DIVIDE      B 0704-0223CLDPD
                           #DOUBLE PRECISION FLOATING DIVIDE      B 7070-08.4.001
                           #DOUBLE PRECISION FLOATING MULTIPLY    B 7070-08.4.002
INTERPRETIVE ROU  #DOPSIR DOUBLE PRECISION FLOATING POINT SOAP    B 0650-02.0.010
PRETIVE SUBROUTINE         #DOUBLE PRECISION FLOATING POINT INTER B 0704-0385BSINT
SUBROUTINE                 #DOUBLE PRECISION FLOATING POINT LOAD  B 0704-0385BSCON
 SUBROUTINE                #DOUBLE PRECISION FLOATING POINT PRINT B 0704-0385BSOUT
 SUBROUTINE                #DOUBLE PRECISION FLOATING POINT PRINT B 0704-0529BSOUT
ION               #PARTIAL DOUBLE PRECISION FLOATING POINT ADDIT B 0704-0650RWADD
ION                        #DOUBLE PRECISION FLOATING POINT ADDIT B 0704-0650RWDPF
ION                        #DOUBLE PRECISION FLOATING POINT DIVIS B 0704-0650RWFDV
PLICATION                  #DOUBLE PRECISION FLOATING POINT MULTI B 0704-0650RWMUL
INPUT                      #DOUBLE PRECISION FLOATING POINT CARD  B 0704-0650RWREA
ENTIAL SUBROUTINE          #DOUBLE PRECISION FLOATING POINT EXPON B 0704-0806IBEXD
ENTIAL ROUTINE.            #DOUBLE PRECISION FLOATING POINT EXPON B 0704-0931PKEXP
NGENT SUBROUTINE           #DOUBLE PRECISION FLOATING POINT ARCTA B 0709-1148NODPA
    #SINGLE PRECISION TO DOUBLE PRECISION FORTRAN INPUT            B 0709-1201NRDIC
                           #DOUBLE PRECISION INPUT CONVERSION.    B 0704-0585CA006
                           #DOUBLE PRECISION INPUT SCALING        B 0704-0334NA022
                           #DOUBLE PRECISION INPUT.               B 0704-0577RWDPN
N              #INTERPRETABLE DOUBLE PRECISION LOGARITHM INSTRUCTIO B 0704-0385BSLNX
SUBTRACTION.               #DOUBLE PRECISION MATRIX ADDITION AND  B 0704-0744AMDPA
                           #DOUBLE PRECISION MATRIX INVERSION     B 0650-05.2.009
                           #DOUBLE PRECISION MATRIX INVERSION     B 0704-0405PFIDP
                           #SINGLE PRECISION MATRIX INVERSION     B 7070-10.1.003
N.                         #DOUBLE PRECISION MATRIX MULTIPLICATIO B 0704-0699AMDPM
N                          #DOUBLE PRECISION MATRIX MULTIPLICATIO B 7070-10.1.001
LICATION                   #DOUBLE PRECISION MATRIX SCALAR MULTIP B 0704-0759AMDPS
                           #TRIPLE PRECISION OUTPUT               B 0704-0378CA002
                           #DOUBLE PRECISION OUTPUT FOR FORTRAN   B 0709-1202NRDOC
                           #DOUBLE PRECISION OUTPUT SCALING       B 0704-0334NA022
                           #DOUBLE PRECISION OUTPUT.              B 0704-0577RWDPT
ACTION PROGRAM             #DOUBLE PRECISION POLYNOMIAL ROOT EXTR B 0709-1215AQE73
    #INTERPRETER FOR 650 DOUBLE PRECISION PROGRAMS.                B 0704-0583BEL1D
                           #DOUBLE PRECISION SIGN COMPATIBILITY   B 0704-0417PFCSF
UATIONS,                 #  DOUBLE PRECISION SIMULTANEOUS REAL EQ B 0704-0356CA001
N SOLVER             #LARGE DOUBLE PRECISION SIMULTANEOUS EQUATIO B 7090-1149AS012
                           #DOUBLE PRECISION SIN-COS ROUTINE      B 0704-0929OLDPS
          #INTERPRETABLE DOUBLE PRECISION SINE AND COSINE          B 0704-0385BSS&C
ION          #INTERPRETABLE DOUBLE PRECISION SQUARE ROOT INSTRUCT B 0704-0385BSSQR
                           #TRIPLE PRECISION SQUARE ROOT          B 0704-0481CA003
                           #DOUBLE PRECISION SQUARE ROOT ROUTINE  B 7070-08.3.006
FORTRAN INPUT              #SINGLE PRECISION TO DOUBLE PRECISION  B 0709-1201NRDIC
        #TREND ANALYSIS AND PREDICTION                             B 0650-09.2.050
      #PRINCIPAL COMPONENTS PREDICTION EQUATION.                   B 0704-1168TVPCP
COMPLEX HERMITIAN MATRIX.        #PRELIM. EIGENVALUE PROB. OF A   B 0704-0460MIMAU
    #DIGITAL TERRAIN MODEL SYSTEM PRELIMINARY EARTHWORK PROGRAM    B 0650-09.2.042
                           #PREP NUCLEAR-CODE PHYSICS             B NORC-NUCLEAR
ROGRAM FOR LINEAR PROGRAM MATRIX PREPARATION              #MXV P B 1620-10.1.004
       #REGRESSION ANALYSIS DATA PREPARATION                       B 1620-01.6.001
TE CHAIN OF ONE INVESTMENT      #PRES VAL-RATE OF RET-PV2A-FINI B 0650-07.0.018
RN * PVIA *-* INF. CHAIN MACH * #PRESENT VALUE AND RATE OF RETU B 0650-07.0.017
           #OPTIMUM SEPARATOR PRESSURE                             B 0650-09.6.005
                 #ISENTROPIC PRESSURE CHANGE SUBROUTINE            B 7090-1095WHISD
                           #PRESSURE OF SATURATED LIQUID          B 7090-1095WHPSL
ART. CODE FOR AUGMENT 650#LINEAR PRG. FORCED INVERSION VECTOR P B 0650-10.1.010
                           #PRIME NUMBER GENERATOR                B 0650-03.1.033
                        #7070 - PRINCIPAL AXIS FACTOR ANALYSIS B 7070-11.3.005
N EQUATION.                #PRINCIPAL COMPONENTS PREDICTIO B 0704-1168TVPCP
  #MURA VARIABLE COLUMN FRACTION PRINT                             B 0704-0357MUPRF
  #MURA VARIABLE COLUMN FRACTION PRINT                             B 0704-0357MUPRF
                      # OCTAL TAPE PRINT                           B 0704-0301RL013
        #MURA SIX COLUMN FRACTION PRINT                            B 0704-0314MUPRF
                           #MATRIX PRINT                           B 0704-0085CLMPR
                   #ALTERED MEMORY PRINT                           B 0705-EQ-005-0
                   #SELECTIVE TAPE PRINT                           B 0705-EQ-006-0
    #TRAP * TAPE RECORD ANALYZER PRINT *                           B 1401-01.4.019
     #REPRODUCE, GANG PUNCH AND PRINT * RGCP *                     B 1401-13.1.009
            #TRAP OCTAL MEMORY PRINT - /TRAP SCOOP/                B 0704-0278UASPO
                          #MEM PRINT ANALYSER                      B 0705-SB-006-0
    #POPOUT  A GENERAL PURPOSE PRINT AND PUNCH SUBROUTINE          B 0704-0422NOPOU
                           #PRINT BSS LOADER DIAGNOSTICS          B 0704-0830MINOL
ATIGN                      #PRINT CONTROL FOR REPORT GENER B 0709-1038RWPCR
                          #TAPE PRINT OUT                          B 0705-AF-011-0
              #OCTAL MEMORY PRINT OUT PROGRAM                      B 0704-0286NYDS1
HART LISTING FROM ASSEMBLY PROG  PRINT RECORD TAPE 40K  #FLOW C B 0705-IB 0003
         #MUSH DATA ASSEMBLER AND PRINT ROUTINES                   B 0704-0523SCMAP
#DOUBLE PRECISION FLOATING POINT PRINT SUBROUTINE                  B 0704-0529BSOUT
#DOUBLE PRECISION FLOATING POINT PRINT SUBROUTINE                  B 0704-0385BSOUT
                           #PRINT TABLE OF ERRORS--PRETB          B 0704-0391NOPRT
#GENERALIZED MATRIX INVERSION *  PRINT 1 *                         B 0705-IB 0010
                           #PRINT 1 TRACING ROUTINE               B 0705-AO-001-0
             #ABBREVIATED PRINT 1 TRACING ROUTINE                  B 0705-AO-002-0
BINARY ARITH.          #DECIMAL PRINT-EXTENDED RANGE FLOATING  B 0704-0370RS013
RTRAN MAP AND MISSING SUBROUTINE PRINT-OUT PROGRAM          #FO B 0704-0909MPMAP
   #TAPE DUMP FOR THE 709/OCTAL PRINT/                             B 0709-0502RLTD9
EOUS CARD TO TAPE AND/OR TAPE TO PRINTER              #SIMULTAN B 1401-13.1.010
                  #TAPE TO PRINTER OR PUNCH * UC TPOP *            B 1401-01.4.016
R FOR FORTRAN OUTPUT          #PRINTER PLOT BCD TEXT GENERATO B 0709-1118URPLO
                   #TAPE TO PRINTER PROGRAM                        A 1401--UT-026
         #PERIPHERAL LINE PRINTER VERIFIER                         B 0704-0262NYPLV
                  #TAPE TO PRINTER/PUNCH ROUTINE                   A 0650--UT-003
                  #TAPE TO PRINTER/PUNCH SIMULATOR                 B 0709-0651WDTPS
             #ZIP * INSTANT PRINTING *                             B 1401-01.4.009
 TESTING RANDOMNESS OF DECIMALS #PRINTING CONSTANT DECIMALS AND B 1401-11.0.004
CAPE * EFFORTLESS SYS CALCUL AND PRINTING EVERYTHING *      #ES B 1401-01.4.010
                 #KWIC REPORT FOR PRINTING OR PUNCHING             B 0704-0913NCKRF
#CONSTRUCT A TABLE OF ERRORS FOR PRINTING--ERTBL                   B 0704-0391NOERT
                           #CORE PRINTOUT ROUTINE-VARIABLE         B 1401-01.4.017
                     #SIMPLIFIED PRIORITY CARD/TAPE ROUTINE        B 7070-02.4.004
ISK * SEE 1410-PR-108 *  #REPORT PRO. GENERAT. CARD/TAPE/1405 D A 1410--RG-910
ATRIX.         #PRELIM. EIGENVALUE PROB. OF A COMPLEX HERMITIAN M B 0704-0460MIMAU
MMA DISTRIBUTION     #DETERMINING PROBABILITIES FROM A FITTED GA B 0650-06.0.040
A                          #NORMAL PROBABILITY - ORDINATE AND ARE B 0709-1001NA860
                   #OFFSET CIRCLE PROBABILITY FUNCTION.            B 0704-0869RCOCI
                  #INVERSE NORMAL PROBABILITY FUNCTIONS            B 0709-1002NA861
      #FLOATING POINT /N/ VARIATE PROBABILITY INTEGRAL             B 0704-0794RWNP3
                           #PROBABILITY OF LOSS OF LOAD            B 0650-09.4.006
                 #TRANSPORTATION PROBLEM-INDIRECT ADDRESSING       A 1620--LM-017
     #UNIV OF HOUSTON ASSEMBLR FOR PROC.ENG. INTER CODING SYS      B 0650-02.0.017
       #STEPWISE MULTIPLE REGRESSION PROCEDURE                     B 0704-0477ERMPR
UMERICAL INTEGRATION BY MIDPOINT PROCEDURE                      #N B 0704-1017AND10
#A GENERAL LEAST SQUARES FITTING PROCEDURE                         B 0704-1076ANE20
AT*                        #PROCEDURE FOR AUTOMATIC TEST*P A 7070--AT-082
                     #ERROR PROCEDURE FOR FORTRAN II               B 0704-0785GEGER
A NUMERIC 650                 #A PROCEDURE FOR USING SOAP WITH  B 0650-01.6.012
NS.          #NON-LINEAR REGRESSION PROCEDURE WITH DIFFERENTIAL EQ B 0704-1119ERNLR
#THREE DIMENSIONAL LEAST SQUARES PROCEDURE.                        B 0704-0533CF009
BLY FOR IBM  704              #PROCESS CONTROL COMPUTER ASSEM B 0704-1184ININI
 TRACE PROGRAMS, STORED PROGRAM, PROCESS PANEL, POST TRAC#THREE A 0305--AT-007
TIVE SYSTEM          #INFORMATION PROCESSING LANGUAGE V INTERPRE B 0704-1006RSIPL
                           #DATA PROCESSING OUTPUT ROUTINE         B 0704-0512DMDPO
           #VARIABLE INFORMATION PROCESSING PACKAGE                B 0704-0856CVVIP
       #709 VARIABLE INFORMATION PROCESSING PACKAGE                B 0709-1135BWVIP
                       #709 DATA PROCESSING PACKAGE                A 0709--UT-069
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ELAXATION PROG POISSONS EQUAT IN RECTANGULAR COORDINATES #R B 0650-04.0.009
N #RECTANGULAR TO POLAR CONVERSIO B 0704-0354NA87.
NETWORK ANALYSIS PROG WITH AUTO RECYCLING * IBM 650 * #A GAS B 0650-09.7.008
#NETWOORK REDUCTION B 0650-09.4.002
#STRAIN ROSETTE DATA REDUCTION B 0650-09.5.004
#POLYNOMIAL COEFFICIENT REDUCTION B 0704-0224ASAS1
#STRAIN GAGE DATA REDUCTION * CARD * B 1620-09.6.001
#STRAIN GAGE DATA REDUCTION * TAPE * B 1620-09.6.002
#BPR PARALLAX REDUCTION PROGRAM B 0650-09.8.002
#FRACTION REDUCTION TO NORMAL FORM B 0704-0900NUFRE
INATE TRUSS ANAL #CONNECTOR AND REDUNDANCY PROGS FOR INDERTERM B 0650-09.2.007
ATA TO TWO PARA. GAMMA DIST-SPEC REF RAINFALL DATA #FITTING D B 0650-06.0.051
#7070 LORELI 2 * LOCATION REFERENCE LISTING * B 7070-04.4.003
#MURA REFLECTED 704 B 0704-0432MUR70

#MURA REFLECTIVE 704 B 0704-0253MU704
DETER. OF VELOCITY FUNCTION FOR REFRACT. T/D DATA #LEAST SQ. B 0650-09.6.020
#RELOCATABLE TO REGIONAL SOAP II B 0650-01.6.034
TROPY IN LIQUID SUPERHEAT OR WET REGIONS #ENTHALPY OR EN B 7090-1095WHSSI
#SIMULATION OF AN INDEXING REGISTER IN SIR B 0650-02.0.016
* FIRS#FLOATING PT. AND INDEXING REGISTER SIMULATOR WITH TRACE B 0650-01.6.050
ROUTINE FOR 650 SYSTEM INDEXING REGISTERS #SYM TRACING B 0650-01.4.007
#STEPWISE REGRESSION B 0705-E2-003-0
SIS PROGRAM. #MULTIPLE REGRESSION & CORRELATION ANALY B 0704-0749SCRAP
#STEPWISE MULTIPLE LINEAR REGRESSION * CARD * B 1620-06.0.007
#STEPWISE MULTIPLE LINEAR REGRESSION * TAPE * B 1620-06.0.006
#MULTIPLE REGRESSION ANALYSIS B 0650-06.0.046
#MULTIPLE REGRESSION ANALYSIS B 0650-06.0.001
#RAP-A REGRESSION ANALYSIS PROGRAM B 0650-06.0.018
AP RAPA TRAP #MULTIPLE REGRESSION ANALYSIS PROGRAMS R B 0650-06.0.030
#MULTIPLE REGRESSION ANALYSIS B 0650-06.0.031
TAPE * #REGRESSION ANALYSIS PROGRAM * B 1620-06.0.001
CARD * #REGRESSION ANALYSIS PROGRAM * B 1620-06.0.002
#SCRAP * SIXTEEN-TWENTY CARD REGRESSION ANALYSIS PROGRAM * B 1620-06.0.003
#STRAP * STEPWISE REGRESSION ANALYSIS PROGRAM * B 1620-06.0.004
RATION #REGRESSION ANALYSIS DATA PREPA B 1620-01.6.001
7070 #STEPWISE MULTIPLE LINEAR REGRESSION ANALYSIS ON THE IBM B 7070-11.3.006
#CORRELATION AND REGRESSION ANALYSIS, B 0704-0782PFCR3
#7070 STEPWISE MULTIPLE REGRESSION ANALYSIS, MR1 B 7070-11.3.001
AM. #MULTIPLE REGRESSION BACK SOLUTION PROGR B 0704-0749SCBOP
HOD #MULTIPLE LINEAR REGRESSION BY THE STEPWISE MET B 7070-11.3.002
#INPUT EDITOR FOR MULTIPLE REGRESSION CODE SCRAP. B 0704-0749SCIEM
#STEPWISE MULTIPLE REGRESSION PROCEDURE B 0704-0477ERMPR
ERENTIAL EQNS. #NON-LINEAR REGRESSION PROCEDURE WITH DIFF B 0704-1119ERNLR
#ESSO STEPWISE REGRESSION PROGRAM B 0650-06.0.056
#CARP-A CONELATION & REGRESSION PROGRAM B 0650-06.0.064
#MAIN REGRESSION PROGRAM B 0704-0822TVREM
FORMATIONS #STEPWISE MULT. REGRESSION WITH VARIABLE TRANS B 7090-1194ERMPR
#TWO VARIABLE LINEAR REGRESSION&CORRELATION B 0650-06.0.054
YSIS #MULTIPLE REGRESSION, COMPREHENSIVE ANAL B 0704-0915TVMRC
#MULTIPLE CORRELATIONS AND REGRESSIONS ANALYSIS B 0704-0417PFCR1
IRCULAR AND HYPERBOLIC FUNCTIONS REGULAR BESSEL FUNCTIONS #C B 0650-03.2.001
#DE RELATIVIZE PROGRAM B 0704-0230RS012
#RELATIVIZE SYMBOLIC DECK B 0704-0116CLREL
#TWO-DIMENSIONAL MESH FOR RELAXATION CALCULATIONS. B 0704-0725PKMER
PROGRAM FOR THE GAUSS-SOUTHWELL RELAXATION METHOD #A B 0650-09.6.014
IN RECTANGULAR COORDINATES #RELAXATION PROG LAPLACES EQUAT B 0650-04.0.007
IN CYLINDRICAL COORDINATE SYS #RELAXATION PROG LAPLACES EQUA B 0650-04.0.008
IN RECTANGULAR COORDINATES #RELAXATION PROG POISSONS EQUAT B 0650-04.0.009
#MULTI-PURPOSE ESTIMATION FOR RELIABILITY STUDIES B 0704-1058WLREL
#MEMORY DUMP AND RELOAD ROUTINE B 0650-01.3.008
#RELOCATABLE BINARY LOADER B 0704-0467BECSB
CARD/ #MURA UPPER RELOCATABLE BINARY LOADER /ONE B 0704-0432MURBL
#RELOCATABLE BINARY LOADER B 0709-0563SE9RB
HES A FOURIER SERIES ONTO BINARY RELOCATABLE CARDS. #PUNC B 0704-0788IBPUF
#RELOCATABLE FORTRAN BSS LOADER B 0704-0909MPBSS
#ABSOLUTE AND RELOCATABLE OCTAL LOADER. B 0704-0623ELROL
Y ON LINE FORTRAN LOADER #RELOCATABLE OCTAL-COLUMN BINAR B 0704-0912ASAS8
I #RELOCATABLE TO REGIONAL SOAP I B 0650-01.6.034
#RELOCATING BINARY LOADER,LOWER B 0704-0525PKCSB
R #RELOCATING BINARY LOADER, UPPE B 0704-0525PKCSB
#RELOCATING BINARY LOADER,LOWER B 0709-0563SE9LR
#RELOCATING BINARY LOADER,UPPER B 0709-0563SE9UR
#RELOCATING LOADER B 1620-01.2.002
#RELOCON B 0650-01.6.025
SLATOR AND OTHER FORMATS TO SOAP RELOKS #TRAN B 0650-01.6.048
ON TWO-DIMENSIONAL #REM NUCLEAR-CODE GROUP DIFFUSI B 0704-NUCLEAR
RIDE * SUBROUTINE FOR TRANS FROM REMING TO IBM DATA EQU * #ST B 1401-01.4.013
#MATRIX HEADING REMOVAL B 0704-0085CLMBH
#RENT OR BUY ANALYSIS B 0650-10.1.007
S OF VARIANCE FOR PART. OR SING. REPLICATED KBY #ANALYSI B 0650-06.0.063
G #KWIC REPORT FOR PRINTING OR PUNCHIN B 0704-0913NCKRF
#PRINT CONTROL FOR REPORT GENERATION B 0709-1038RWPCR
/1405 DISK * SEE 1410-PR-108 * #REPORT PRO. GENERAT. CARD/TAPE A 1410--RG-910
#FARGO REPORT PROGRAM A 1401--RG-045
#REPORT PROGRAM GENERATOR RPG A 1401--RG-048
UTOCODER ASSEMBLY #CARD REPORT PROGRAM GENERATOR AND A B 1401-01.3.001
UTOCODER ASSEMBLY #TAPE REPORT PROGRAM GENERATOR AND A B 1401-01.3.002
#REPORT PROGRAM GENERATOR A 1410--RG-103
7070-PR-075* #REPORT PROGRAM GENERATOR *SEE A 7070--RG-902
F NO FROM FIX PT REPRE TO FLT PT REPRE #INT OP 4 CONV O B 0650-01.6.017
#INT OP 4 CONV OF NO FROM FIX PT REPRE TO FLT PT REPRE B 0650-01.6.017
FOURIER HALF-SERIES IN CANONICAL REPRESENTATION #GIVEN A B 0704-0788IBGFL
ES A FOURIER SERIES IN CANONICAL REPRESENTATION #INTEGRAT B 0704-0788IBIFS
RIES. #EXPANDS THE REPRESENTATION OF A FOURIER SE B 0704-0788IBERF
CH A FOURIER SERIES IN CANONICAL REPRESENTATION. #SEAR B 0704-0788IBSFS
TS A FOURIER SERIES IN CANONICAL REPRESENTATION. #CONVER B 0704-0788IBWFS
T * RGCP * #REPRODUCE, GANG PUNCH AND PRIN B 1401-13.1.009
GRAM FOR THE IBM 1401 #CARD REPRODUCING AND/OR LISTING PRO B 1401-01.4.003
ORTRAN WRITE-UP OF RW REQX.SPACE REQUIRED-122 CELLS #F B 0709-0946RWFEQ
#FORTRAN WRITE-UP OF RW REQX.SPACE REQUIRED-122 CELLS B 0709-0946RWFEQ
#THE CORNELL RESEARCH SIMULATOR B 0650-10.2.001
ICAL DRUMS # RESET AND CLEAR CORE AND N LOG B 0704-0443LL024
#SELF-LOADING DRUM RESET PROGRAM B 0704-0376UAZDR
RAVITY #RESIDUALS AND DERIVATIVES OF G B 0650-09.6.008
#CORRELATIONAL RESIDUE COMPUTATION. B 0704-0405PFCR2
#CRITICAL PATH AND RESOURCE SUMMARY CALCULATION B 7090-1158ORCPS
#RESTART PROGRAM FOR MD SORT B 0709-1160MDSRS
EDITOR /RL 0400/ #RESTART PROGRAM FOR THE BINARY B 0709-1032RL041
NVESTMENT #PRES VAL-RATE OF RET-PV2A-FINITE CHAIN OF ONE I B 0650-07.0.018
#AUTOMATIC INFORMATION RETRIEVAL PROGRAM B 0650-12.0.007
ACH * #PRESENT VALUE AND RATE OF RETURN * PVIA * * INF. CHAIN M B 0650-07.0.017
TER #CALCULATIONS OF RATE OF RETURN USING THE IBM 650 COMPU B 0650-09.6.011
SYS REVISED BELL LAB TAPE SYS #REVISED BELL LAB INTERPRETIVE B 0650-02.0.015
EVISED BELL LAB INTERPRETIVE SYS REVISED BELL LAB TAPE SYS #R B 0650-02.0.015
ADJUSTMENT COMPUTATION #REVISED TRAVERSE AND TRAVERSE B 0650-09.2.015
L ALIGNMENT #REVISED TRAVERSE AND HORIZONTA B 0650-09.2.084
RAL FREEWAY ASSIGNMENT, STOCKTON REVISION #GENE B 0650-09.2.079
SPS TO FORTRAN SUBROUTINE EDIT * REVISION * # B 1620-01.6.009
#GS REVISION OF GL OUT2 B 0704-0204GSOUT
ALIGNMENT PROGRAM #BPR REVISION OF OREGON HORIZONTAL B 0650-09.2.053
#REWIND TAPES B 0704-0223CLMRT
EPRODUCE, GANG PUNCH AND PRINT * RGCP * #R B 1401-13.1.009
#CHINESE BAR AND RING PUZZLE * TAPE * B 1620-11.0.003
#ROAD DESIGN PROGRAM B 0650-09.2.029
PATH BET. ZONE CENTROIDS OVER A ROAD NETWORK #TRACING A MIN. B 0650-09.2.080
#ROADWAY TEMPLATE GENERATOR B 0650-09.2.078
#ROCKET NOZZLE PROGRAM B 0704-1156LRRON
#SUCKER ROD PUMP DESIGN B 0650-09.6.007
#ROD READING CONVERSION PROGRAM B 0650-09.2.028
#BINARY INTEGER TO ROMAN NUMERAL CONVERSION. B 0704-0870ORROM
#SQUARE ROOT A 0650--LM-006
#CUBE ROOT B 0650-03.1.003
#COMPLEX NTH ROOT B 0704-0354NA63.
#MURA FIXED POINT CUBE ROOT B 0704-0314MUCRT
TING-POINT DOUBLE-PRECISION CUBE ROOT #FLOA B 0704-0525PKCBR
NG-POINT DOUBLE-PRECISION SQUARE ROOT #FLOATI B 0704-0525PKSQR
#TRIPLE PRECISION SQUARE ROOT B 0704-0481CA003
#TRIPLE PRECISION COMPLEX SQUARE ROOT B 0704-0565CA005
#1620 FIX POINT SQUARE ROOT B 1620-07.0.003
#FIXED POINT SQUARE ROOT * CLOSED * SUBROUTINE B 1620-03.0.002
#ROOT AND GAIN LOCUS B 0650-09.8.001
#DETERMINANT EVALUATION AND ROOT EXTRACTION B 0704-0514NA029
#POLYNOMIAL ROOT EXTRACTION * TIREX * B 7070-09.1.001
#DOUBLE PRECISION POLYNOMIAL ROOT EXTRACTION PROGRAM B 0709-1215AQE73
#GENERAL ROOT FINDER FORTRAN SUBROUTINE B 0704-0635RWGRT
#POLYNOMIAL ROOT FINDER ROUTINES B 7090-1124MLHPR
#ROOT FINDING SUBROUTINE B 0650-07.0.004
#NTH ROOT FIXED POINT SUBROUTINE A 0650--LM-007
#NTH ROOT FLOATING POINT SUBROUTINE A 0650--LM-009
PRETABLE DOUBLE PRECISION SQUARE ROOT INSTRUCTION #INTER B 0704-0385BSSQR
#NTH ROOT OF X B 7070-08.3.003
#MURA FIXED POINT SQUARE ROOT ROUTINE B 0704-0283MUSQR
#MURA FIXED POINT SQUARE ROOT ROUTINE B 0704-0263MUSQR
#N ROOT ROUTINE B 0704-0690GDNRT
#DOUBLE PRECISION SQUARE ROOT ROUTINE B 7070-08.3.006
#FLOATING POINT SQUARE ROOT SUBROUTINE B 0650-07.0.011
#SQUARE ROOT SUBROUTINE B 0650-03.1.001
#SQUARE ROOT SUBROUTINE B 0650-03.1.002
#FLOATING POINT SQUARE ROOT SUBROUTINE A 0650--LM-010
#FLOATING POINT NTH ROOT SUBROUTINE B 0704-0525PKN00
#CUBE ROOT SUBROUTINE B 0704-0931PKCBR
#FLOATING POINT SQUARE ROOT SUBROUTINE B 0709-0619IBSQR
#SQUARE ROOT SUBROUTINE B 1401-03.0.003
#VARIABLE FIELD SQUARE ROOT SUBROUTINE B 1620-03.0.001
#SQUARE ROOT SUBROUTINE B 7070-08.3.007
#SQUARE ROOT SUBROUTINE B 7070-08.3.008
#SQUARE ROOT SUBROUTINE B 7070-08.3.009
#SQUARE ROOT SUBROUTINE B 7070-08.3.010
#ROOT TRACING B 7090-1169RCRTR
#ARCSIN X, ARCCOS X, SQUARE ROOT X B 0650-03.1.028
#CUBE ROOT X B 0650-03.1.029
#SQUARE ROOT X B 7070-08.3.001
#MURA FLOATING POINT CUBE ROOT. B 0704-0280MUCRT
INARY ARITH #NORMALIZED SQ.ROOT-EXTENDED RANGE FLOATING B B 0704-0370RS013
DIFIED NEWTON-RAPHSON POLYNOMIAL ROOT-FINDER #A MO B 0704-0568ELQRC
#SQUARE ROOT, FLOATING POINT B 0704-0641CSSQT
#SQUARE ROOT, FLOATING POINT. B 0704-0653CSSQT
#SQUARE ROOT, FLOATING POINT 709 ONLY B 0709-0485MISRT
#SQUARE ROOT, FLOATING-POINT B 0704-0399MISRT
LIB. VERSION #SQUARE ROOT, FLOATING-POINT, FORTRAN B 0704-0399MISRT
#SQUARE ROOT, TOPLER METHOD B 7070-08.3.002
#CHARACTERISTIC ROOTS AND VECTORS B 0704-0148NYCRV
#LATENT ROOTS AND VECTORS OF A MATRIX B 0650-05.2.016
#MOLECULAR SPECTROSCOPY LATENT ROOTS AND VECTORS OF A MATRIX B 0650-05.2.024
VARIABLE #ROOTS OF A FUNCTION OF A REAL B 0650-07.0.002
NG INTERVAL ARITH. #REAL ROOTS OF A REAL POLYNOMIAL USI B 0704-0880IBRRP
NG INTERVAL ARITH. #REAL ROOTS OF A REAL POLYNOMIAL USI B 0704-0880IBRRP
COEFFICIENTS #ROOTS OF POLYNOMIAL WITH REAL B 0709-0927MAPOL
#NEWTONS METHOD FOR FINDING ROOTS OF POLYNOMIALS B 0704-0110GLROP
#STRAIN ROSETTE DATA REDUCTION B 0650-09.5.004
HE EQUINOX OF #TO ROTATE A GIVEN VECTOR X FROM T B 0709-0945RWREQ
#EQUATOR-ECLIPTIC ROTATION B 0709-0954RWFOB
#NORMALIZED VARIMAX FACTOR ROTATION B 7070-11.3.008
#PATERN QUARTIMAX ROTATION OF A FACTOR MATRIX B 0650-05.1.007
#EQUATOR-ECLIPTIC ROTATION-ROTATE A GIVEN VECTOR B 0709-0953RWROB
FLOATING POINT SOAP INTERPRETIVE ROU #DOPSIR DOUBLE PRECISION B 0650-02.0.010
O ONE AUTO CONT TEST OPTIMIZING ROUT * #FACTOR * FOURTEEN B 1401-01.4.007
. ADD. CONV #STROBIC-SKELLY TR. ROUT. WITH OPTION BR&TRANS&IND B 1620-01.4.004
#CORE PRINTOUT ROUTINE-VARIABLE B 1401-01.4.017
#TIME SERIES ROUTING B 0705-E2-002-0
#ROW BINARY CARD LOADER B 0709-1034SCCSB
#ROW BINARY DISASSEMBLY PROGRAM B 0704-0784GERDS
NVERTER #709 SELF LOADING ROW BINARY TO COLUMN BINARY CO B 0709-0808GDRCC
NVERSION. #704 ROW BINARY TO COLUMN BINARY CO B 0709-0951NA901
Y CONVERSION. #704 ROW BINARY TO 709 COLUMN BINAR B 0709-0951NA901
ADER #709 FOUR CARD ROW BINARY-OCTAL UPPER CARD LO B 0709-0819GDBOC
IX #STORE ROW MATRICES INTO A LARGE MATR B 0704-0223CLMST
H #ABSOLUTE ROW OR COLUMN BINARY CARD PUNC B 0704-0455BESCB
#CARD TO TAPE SIMULATOR AND ROW TO COLUMN CONVERTER. B 0704-1013ORCTT
#NORMALIZE MATRIX BY ROWS B 0704-0236CLMNR
#MATRIX INTERCHANGE OF ROWS AND COLUMNS B 0704-0085CLMIN
#REPORT PROGRAM GENERATOR RPG A 1401--RG-048
BASIC FORTRAN * #RSTR * FUNCTION SUBROUTINE FOR B 7070-01.9.001
#INTEGRAL EVAL., SIMPSONS RULE /EQU. INTERV./ B 0704-0116CLINT
#INTEGRAL EVAL., TRAPEZ. RULE /EQU. INTERVALS/ B 0704-0116CLINT
N #SIMPSONS RULE FLOATING-POINT INTEGRATIO B 0709-0982RWSI2
MENT SCHEDULE #LINEAR DECISION RULE FOR PRODUCTION AND EMPLOY B 0650-10.3.001
LS/ #N-STRIP TRAPEZOIDAL RULE INTEGRATION/EQUAL INTERVA B 0704-0931PKMTZ
#FLOATING POINT OPTIMIZED RUNGE KUTTA B 0704-1147ECRKO
#MURA FIXED POINT RUNGE-KUTTA B 0704-0891MURKY
#A MORE ACCURATE RUNGE-KUTTA B 0704-0414GLMAR
#MURA FIXED POINT RUNGE-KUTTA B 0704-0280MURKY
#MURA FLOATING POINT RUNGE-KUTTA B 0704-0314MURKY
#SECOND,THIRD,AND FOURTH ORDER RUNGE-KUTTA INTEGRATION B 0704-1233AAINT
#FLOATING PT. COWELL /2ND SUM/, RUNGE-KUTTA INTEGRATION B 0704-0775RWDE6
#FLOATING POINT ADAMS-MOULTON, RUNGE-KUTTA INTEGRATION B 0704-0450RWDE2
RD. EQ. #FLOAT. PT. MILNE, RUNGE-KUTTA INTEGRAT. OF 2ND O B 0704-0450RWDE3
#FLOATING POINT GILL METHOD FOR RUNGE-KUTTA INTEGRATION B 0704-0491RWDE4
#DBL. PREC. FLOATING PT. MILNE, RUNGE-KUTTA INTEGRATION- B 0704-0610RWDE3
#DBL. PREC. FLOATING PT. RUNGE-KUTTA INTEGRATION OF B 0704-0610RWDE2
#FLOATING POINT OPTIMIZED RUNGE-KUTTA INTEGRATION. B 0709-1170ATRKS
#FORTRAN FLOATING POINT RUNGE-KUTTA INTEGRATION. B 0709-1171ATRKS
G DIFFERENTIAL EQUATION ON 650 #RUNGE-KUTTA ROUTINE FOR SOLVIN B 0650-07.0.005
LS #FORTRAN WRITE-UP OF RW REQX.SPACE REQUIRED-122 CEL B 0709-0946RWFEQ
#7090 S-PROGRAM A 7090--10-094
E WITH A TAPERED HUB * CARD * #S-100 STRESS ANALYSIS OF FLANG B 1620-09.7.004
NGED TAPERED HUB * CARD * #S-109 STRESS ANALYSIS OF A FLA B 1620-09.7.005
#SAIL NUCLEAR-CODE TRANSPORT B 7090-NUCLEAR
#TAPE PROGRAM FINDER,WRITER,AND SALVAGE B 0650-01.5.011
#PACT 1A SAMPLE PROGRAM B 0704-0316NA259
STIMATION FROM DOUBLY TRUNCATION SAMPLES #E B 0704-0878BEMSD
#SAN DIEGO FREEWAY ASSIGNMENT B 0650-09.2.043
AUTOMATIC CODER, COMPATIBLE WITH SAP # B 0704-1220NSABC
POINT TRAP ROUTINE 704 FORTRAN SAP CODED. #FLOATING B 0704-1071NUEFM
#ARCTAN A/B, FORTRAN II VERSION,SAP CODED. B 0704-0603WH005
#MAKE SAP OCTAL B 0704-0513BESAK.
#AN EDITOR FOR SAP SYMBOLIC DECKS. B 0704-0960MIEDS
#ENTHALPY OF SATURATED LIQUID B 7090-1095WHHSL
#PRESSURE OF SATURATED LIQUID B 7090-1095WHPSL
#ENTROPY OF SATURATED LIQUID B 7090-1095WHSSL
#TEMPERATURE OF SATURATED LIQUID B 7090-1095WHTSL
#SPECIFIC VOLUME OF SATURATED LIQUID B 7090-1095WHVSL
#TEMPERATURE OF SATURATED LIQUID FROM ENTHALPY B 7090-1095WHTSH
HALPY ENTROPY SPECIFIC VOLUME OF SATURATED VAPOR #ENT B 7090-1095WHHSV

#SAVE MEMORY SORT 57-PH3 B 0705-CU-002-0
#ERCO SPACE SAVER B 0650-02.0.007
RB,IRC, #THIS SUBROUTINE SAVES THE CONSOLE /AC,MQ,IRA,I B 0704-0345ELSAV
RB,IRC, #THIS SUBROUTINE SAVES THE CONSOLE /AC,MQ,IRA,I B 0704-0345ELSAV
#DOUBLE PRECISION MATRIX SCALAR MULTIPLICATION B 0704-0759AMDPS
#LARGE SCALE MATRIX INVERSION B 0650-05.2.007
#DOUBLE PRECISION INPUT SCALING B 0704-0334NA022
#DOUBLE PRECISION OUTPUT SCALING B 0704-0334NA022
#7070 SCAN B 7070-04.9.002
D TAPE-CARD READING FOR MULTIPLE SCAN. #BC B 0704-0904SISCA
#FORTRANSIT SCANNING ROUTINE B 0650-01.6.055
#PUNCH A SCAT DECK B 1401-13.1.006
#PARTICLE SCATTERING B 0704-0743QRTUR
,16K * LEAST COST ESTIMATING AND SCHED * #1401 LESS 8K,12K B 1401-10.3.002
AST COST ESTIMATING SCHEDULING * SCHED PORTION#LESS * CARD * LE B 1620-10.3.003
LE FOR PRODUCTION AND EMPLOYMENT SCHEDULE #LINEAR DECISION RU B 0650-10.3.001
#COMPLETE PAIRED COMPARISONS SCHEDULE * PARCOPLET-2-21 * B 0650-06.0.045
#GENERAL AMORTIZATION SCHEDULE PROGRAM B 0709-0955VGGAS
S 4K * LEAST COST ESTIMATING AND SCHEDULING * #1401 LES B 1401-10.3.001
S * CARD * LEAST COST ESTIMATING SCHEDULING * SCHED PORTION#LES B 1620-10.3.003
N *#LESS * LEAST COST ESTIMATING SCHEDULING * SCHEDULING PORTIO B 1620-10.3.002
AST COST ESTIMATING SCHEDULING * SCHEDULING PORTION *#LESS * LE B 1620-10.3.002
IT FUNCTIONS #SCHEDULING WITH ARBITRARY PROF B 0709-1086IBAPF
ESS F. BACKER #LEAST COST EST. & SCHEDULING-SCHED. PHASE ONLY L B 0650-10.3.005
RAM-VARIABLE FORMAT #SCHENECTADY DECIMAL INPUT PROG B 0704-0204GSIN2
#SOLUTION OF RADIAL SCHRODINGER EQUATION B 0704-1072NUSCH
TH FLOATING POINT * #SCION * SCIENTIFIC 1401 PROGRAMMING WI B 1401-03.0.002
MMING WITH FLOATING POINT * #SCION * SCIENTIFIC 1401 PROGRA B 1401-03.0.002
#SCOOP I AND II B 1401-01.4.012
#TRAP OCTAL MEMORY PRINT - /TRAP SCOOP/ B 0704-0278UASPO
#SCOPE GRID PLOTTER B 0704-0357MUSCP
#SCOPE GRID PLOTTER B 0704-0432MUSCO
SIMULATOR #1401 SCRAMBLE PERIPHERAL EQUIPMENT B 1401-13.3.001
GRESSION ANALYSIS PROGRAM * #SCRAP * SIXTEEN-TWENTY CARD RE B 1620-06.0.003
TOR FOR,MULTIPLE REGRESSION CODE SCRAP. #INPUT EDI B 0704-0749SCIEM
#COMPUTATION OF BRIDGE SCREED ELEVATIONS B 0650-09.2.075
PROGRAMMING SYSTEM - SUCESSOR TO SCROL # 7090 LINEAR B 7090-1195IKLP9
#LP/90 TO SCROL 704 INPUT CONVERTER B 0704-0937ERCON
#SORT 80 UNDER SCS 80 A 7080--SM-114
#SCS 80 SUPERVISOR CONTROL A 7080--SV-115
VERSION * #SD 1402 * SEARCH PROGRAM-CARD B 1401-01.4.020
#FLOATING POINT UNIVARIATE SEARCH B 0704-0692JPTAR
#FLOATING POINT BIVARIATE SEARCH B 0704-0692JPWEI
#END-OF-FILE SEARCH B 0705-EH-007-0
#BINARY TABLE SEARCH B 0705-PG-007-0
ONICAL REPRESENTATION. #SEARCH A FOURIER SERIES IN CAN B 0704-0788IBSFS
NE #KEYS SEARCH BCD LISTING TAPE ROUTI B 0709-0921VGKEY
#SEARCH MASTER PROGRAM TAPE B 0705-AO-011-0
#SD 1402 * SEARCH PROGRAM-CARD VERSION * B 1401-01.4.020
#TABLE SEARCH ROUTINE B 0704-0344RL014
#MURA EFFECTIVE ADDRESS SEARCH ROUTINE B 0704-0253MUEAS
#BINARY SEARCH ROUTINE NA 839 B 0709-0951NA083
#FORTRAN END CARD SEARCH. B 0704-0899MEFEN
#BINARY SEARCH, FORTRAN B 0709-0935NGBSF
C TIME SERIES #SEASONAL ADJUSTMENT OF ECONOMI B 0650-06.0.041
#CALCULATION OF SEASONAL ADJUSTMENTS B 0705-DP 0001
#PROGRAM TO CALCULATE SEASONALLY ADJUSTED INDICES B 0650-06.0.042
TION SUBROUTINE #SECOND ORDER DIFFERENTIAL EQUA B 0704-1073BCDIF
#KWIC SORT PROGRAM SECOND PART B 0704-0914NCKSP
OSE #VIPP MERGER. SECOND PHASE OF A GENERAL PURP B 0704-0926TAVIP
RUNGE-KUTTA INTEGRATION #SECOND,THIRD,AND FOURTH ORDER B 0704-1233AAINT
EAR-CODE # LOST A CROSS SECTION AVERAGING PROGRAM NUCL B 0650-08.2.004
#IOMRSB * SEE 0705-10-047 * A 0705-
#GET/PUT * SEE 0705-10-047 * A 0705-
#SYSTEM SUPERVISOR * SEE 1410-PR-108 * A 1410--SV-907
#AUTOCODER * SEE 1410-PR-108 * A 1410--AU-906
#IOCS CARD/TAPE * SEE 1410-PR-108 * A 1410--IO-909
#IOCS 1405 DISK * SEE 1410-PR-108 * A 1410--IO-911
. GENERAT. CARD/TAPE/1405 DISK * SEE 1410-PR-108 * #REPORT PRO A 1410--RG-910
#COBOL * SEE 7070-PR-075 A 7070--CB-923
RVAL VELOCITY * CVL * #SEISMOGRAM SYN FORM CONT. INTE B 0650-09.6.018
#TIME DOMAIN FILTERING OF SEISMOGRAMS B 0650-09.6.021
SE NEW ENG ELEC SYS PROG 18 #SELEC ECON. COND. SIZE-SPEC CA B 1620-09.4.004
#SOS PROGRAM LOADER. CALLS IN A SELECTED SOS PROGRAM B 7090-1229IQCSO
LYNOMIAL #FITTING TO SELECTED TERMS OF A GENERAL PO B 0704-1077GC000
#ECONOMIC CONDUCTOR SIZE SELECTION BY KELVINS LAW B 1620-09.4.005
INE #SELECTIVE FILE DUPLICATOR ROUT B 0709-0922AXSFD
. #704 SELECTIVE MONITOR TRACE SYSTEM B 0704-0708WHSMT
#704 SELECTIVE MONITOR TRACE. B 0704-0601WHSMT
#SELECTIVE PROGRAM TRACE. B 0709-0605WDLC2
#SELECTIVE PROGRAM TRACE. B 0709-0605WDLOC
#SELECTIVE TAPE PRINT B 0705-EQ-006-0
#SELECTIVE TRACE A 1620--AT-014
#SELECTIVE TRACE B 1620-01.4.001
#SELECTIVE TRACING ROUTINE B 0650-01.4.005
PUT DATA. #SELECTOR OF COMBINATIONS OF IN B 0704-0648AVSEL
#SELF DEMONSTRATOR B 1620-11.0.010
UMN BINARY CONVERTER #709 SELF LOADING ROW BINARY TO COL B 0709-0808GDRCC
INE #SELF LOADING TAPE WRITING ROUT B 0704-0781WH004
INE #SELF LOADING TAPE WRITING ROUT B 0704-0781WH004
M. #SELF LOADING TAPE WRITE PROGRA B 0704-0899METOU
#MODULUS 11 SELF-CHECKING DIGIT CALCULATOR B 7070-02.9.001
TOR #SELF-CHECKING LOAD DECK GENERA B 0650-01.6.033
R LOADER #SELF-LOADING BINARY-OCTAL LOWE B 0709-0999RL039
M #SELF-LOADING DRUM RESET PROGRA B 0704-0376UAZDR
#FORTRAN II AND/OR FORTRAN I TO SELF-LOADING TAPE 1 B 0704-0769TVF2T
#DECIMAL OUTPUT PROGRAM UNDER SENSE LIGHT CONTROL B 0704-0206NYOUT
#INPUT PROGRAM UNDER SENSE LIGHT CONTROL B 0704-0206NYINP
#INPUT PROGRAM UNDER SENSE LIGHT CONTROL B 0709-1025WPK06
#DECIMAL OUTPUT PROGRAM UNDER SENSE LIGHT CONTROL B 0709-1026WPK07
#SET SENSE LIGHTS B 0704-0654AMCHK
#INPUT PROGRAM UNDER SENSE SWITCH CONTROL B 0704-0206NYINP
#OPTIMUM SEPARATOR PRESSURE B 0650-09.6.005
#GSEL,FMCTR,LINK,MOVE,OPHLT,SEQCK,SIGN,STRIP,VMCTR B 0705-BW-002-0
#SEQUENCE CHECK B 0705-EQ-007-0
VING #SEQUENTIAL CIRCUIT PROBLEM SOL B 0704-1103PKSEQ
DATE SYMBOLIC PROGRAM TAPE USING SERIAL NUMBERS. # UP B 0709-1009WDSER
ONAL ADJUSTMENT OF ECONOMIC TIME SERIES #SEAS B 0650-06.0.041
TAPE. #WRITES A FOURIER SERIES AS ONE BINARY RECORD ON B 0704-0788IBWFS
#30 SERIES BUS LOAD FLOW PROGRAM B 0650-09.4.012
TMENT #TIME SERIES DECOMPOSITION AND ADJUS B 0704-0526TVTSD
TMENT #TIME SERIES DECOMPOSITION AND ADJUS B 0704-0861ERTSD
TMENT #TIME SERIES DECOMPOSITION AND ADJUS B 7090-1145ERTSD
#READS, WITH CHECKING, A FOURIER SERIES FROM BINARY TAPE B 0704-0788IBRFS
TION #INTEGRATES A FOURIER SERIES IN CANONICAL REPRESENTA B 0704-0788IBIFS
TION. #SEARCH A FOURIER SERIES IN CANONICAL REPRESENTA B 0704-0788IBSFS
TION. #CONVERTS A FOURIER SERIES IN CANONICAL REPRESENTA B 0704-0788IBWFS
UNPACKS THE INDICES FROM FOURIER SERIES INDEX WORDS, # B 0704-0788IBSPF
CARDS. #PUNCHES A FOURIER SERIES ONTO BINARY RELOCATABLE B 0704-0788IBPUF
FITTING #TAYLOR SERIES RATIONAL FUNCTION CURVE B 7090-1150RLRAT
#TIME SERIES ROUTING B 0705-E2-002-0
#CONVERTS A FOURIER SERIES TERM TO BCD FORM. B 0704-0788IBCFT
#TIME SERIES TREND EQUATIONS B 0650-09.2.049
#80 SERIES UTILITIES A 0705--UT-056
#ADDS OR SUBTRACTS TWO FOURIER SERIES. B 0704-0788IBASF
#ADDS A TERM TO A FOURIER SERIES. B 0704-0788IBATF
#COMBINES INDICES IN A FOURIER SERIES. B 0704-0788IBCIF
#EVALUATES A FOURIER SERIES. B 0704-0788IBEFS
THE REPRESENTATION OF A FOURIER SERIES. #EXPANDS B 0704-0788IBERF
#MULTIPLIES TWO FOURIER SERIES. B 0704-0788IBMFS
#SPLITS A FOURIER SERIES. B 0704-0788IBSPS
PARTIAL DERIVATIVE OF A FOURIER SERIES. #COMPUTES THE B 0704-0788IBPDF
#SERVICE TAPE GENERATOR B 0704-0425WBSRV
APPROXIMATION ON A FINITE POINT SET #MINIMAX POLYNOMIAL B 0650-06.0.043
RING #SET CODES NUCLEAR-CODE ENGINEE B 0704-NUCLEAR
#FN II AREA SET GENERATOR SUBROUTINE. B 0704-0848ARGEN
S FOR BESSEL FUNCTIONS #A SET OF INTERPRETIVE SUBROUTINE B 0650-03.2.007
#SET SENSE LIGHTS B 0704-0654AMCHK
#IFS * AFTER SETTING * XX B 0705-PG-005-0
#CHECK TAPE SETTINGS B 0705-PG-004-0
#SOAP TO SEVEN B 0650-01.6.014
#SEVEN-CARD PUNCH B 0650-01.3.010
#SEVEN-CARD-LOADER B 0650-01.2.009
#SEVEN-PER-CARD LOADER B 0650-01.2.002
#SEVEN-PER-CARD PUNCH ROUTINE B 0650-01.3.001
#SEVEN-TO-ONE CONVERTER B 0650-01.6.011
FOR PARTITIONING OF ARBITRARILY SHAPED AREA #A PROGRAM B 0650-09.6.013
#SHARE ASSEMBLER B 0704-0347UASAP
1401 PROGRAM. #SHARE CATALOG UPDATER, LISTER. B 0704-1224UCSCU
#A 1401 PROGRAM TO MAINTAIN THE SHARE LIBRARY ABSTRACTS B 0704-1165PNSLI
R #SOS SHARE-32K ASSEMBLY AND COMPILE A 0709--PR-064
#INPUT/OUTPUT SHCEDULING 1/CD&5/CD A 0650--UT-105
LATE NEUTRON ATTENUATION-REACTOR SHIELD NUCLEAR-CODE # CALCU B 0650-08.2.025
#SHIFF B 0650-01.6.047
#EARTHWORK LINE SHIFT B 0650-09.2.022
* #SHORT CIRCUIT ANALYSIS * CARD B 1620-09.4.006
ARD * #SHORT CIRCUIT CALCULATIONS * C B 1620-09.4.007
#RADIAL SHORT CIRCUIT PROGRAM B 0650-09.4.013
R SYS NETWORK #IMPROVED DIGITAL SHORT CIRCUIT SOLUTION OF POWE B 0650-09.4.004
#THREE CENTER CURVES FOR SHORT RADIUS TURNS B 0650-09.2.020
ULATION OF ELECTRIC POWER SYSTEM SHORT-CIRCUIT CURRENTS #CALC B 0650-09.4.007
#FORTRAN SNAP SHOT ROUTINE. B 0704-0595ERSNA
ES #LOCATION OF SHUNT CAPACITORS ON RADIAL-LIN B 1620-09.4.002
OR #SIFON4 MURA 650 ON 704 SIMULAT B 0704-0548MUSFN
#DOUBLE PRECISION SIGN COMPATIBILITY B 0704-0417PFCSF
RITE 6-DIGIT DECIMAL INTEGER AND SIGN ON CRT #W B 0704-0362NA117
GSEL,FMCTR,LINK,MOVE,OPHLT,SEQCK,SIGN,STRIP,VMCTR # B 0705-BW-002-0
HARDWARE SIMULATOR. #AB FLOAT SIM-ABREVIATED FLOATING POINT B 7070-05.2.001
#SIMPL-1 NUCLEAR-CODE TRANSPORT B 0704-NUCLEAR
#SIMPL-2 NUCLEAR-CODE TRANSPORT B 0704-NUCLEAR
S #SIMPLE CORRELATION COEFFICIENT B 0650-06.0.002
OR BASIC & AUGM. 650 #SIMPLE CORRELATION ROUTINE * F B 0650-06.0.062
#SIMPLE CORRELATION-COR1 B 0650-06.0.047
#SIMPLE IOCS B 7070-03.4.002
#STER-* SIMPLE TAPE ERROR ROUTINE * B 1401-01.4.018
#ASC SYSTEM AERONUTRONIC SIMPLIFIED CODING SYSTEM * B 1401-02.0.002
ROUTINE #SIMPLIFIED PRIORITY CARD/TAPE B 7070-02.4.004
#INTEGRAL EVAL., SIMPSONS RULE /EQU. INTERV./ B 0704-0116CLINT
NTEGRATION #SIMPSONS RULE FLOATING-POINT I B 0709-0982RWSI2
TH 704. #SIMULATE BASIC 650 COMPUTER WI B 0704-0480CE650
#SIMULATE PERIPHERAL EQUIPMENT A 0709--SI-071
RY. #SIMULATED PLANT RECORD AUXILIA B 0704-0604TVSPR
#CURVE FITTING- SIMULATED PLANT RECORD METHOD B 1620-09.4.009
AL ANALYZER TO SOLVE #SIMULATES A DIGITAL DIFFERENTI B 0704-0319GLDAS
ASIC 650. READS BCD #SIMULATES INPUT PLUGBOARD OF B B 0704-0480CE650
APE ORIENTED 7070 #SIMULATING THE CARD 650 ON A T B 7070-05.1.004
IT * TAPE * #1620 SIMULATION OF A ONE-ARMED BAND B 1620-11.0.002
STER IN SIR #SIMULATION OF AN INDEXING REGI B 0650-02.0.016
7070 #SIMULATION OF BASIC 650 ON THE B 7070-05.1.002
ON THE 7070 #SIMULATION OF CARD OR TAPE 650 B 7070-05.1.005
* CARD * #SIMULATION OF ONE-ARMED BANDIT B 1620-11.0.011
05 #SIMULATION OF THE 650 ON THE 7 B 0705-PG 0001
TAPE. #72/84 AND 80/84 SIMULATION OF THE 714 CARD TO B 0704-0676OR714
#650 SIMULATION ON THE 7070 A 7070--SI-079
#717/720 SIMULATION ON 1401 B 1401-10.2.001
#650 SIMULATION ON 1410 A 1410--SI-101
1410 SIMULATION ON 704/709/7090 A 1410--SI-042
#TOLERANCE SIMULATION PROGRAM B 0650-10.2.002
FLOATING TRAP SIMULATION. B 0704-0735PFMCF
#UNIT OPERATIONS SIMULATOR B 0650-09.6.022
#THE CORNELL RESEARCH SIMULATOR B 0650-10.2.001
#SIFON4 MURA 650 ON 704 SIMULATOR B 0704-0548MUSFN
#CHRYSLER INTERPRETER AND 650 SIMULATOR B 0704-0486CMCIS
TYDAC /PSEUDO COMPUTER/ SIMULATOR B 0704-0441CSTYD
#BINARY TAPE-TC-CARD SIMULATOR B 0704-0455BETCB
#TAPE TO PRINTER/PUNCH SIMULATOR B 0709-0651WDTPS
01 SCRAMBLE PERIPHERAL EQUIPMENT SIMULATOR #14 B 1401-13.3.001
#TRACE & 1A SIMULATOR B 1620-01.4.005
#7070 650 PANEL SIMULATOR B 7070-05.1.001
#AN INVENTORY MANAGEMENT SIMULATOR * CARD * B 1620-10.2.001
#INVENTORY MANAGEMENT SIMULATOR * CARD * B 1620-10.2.003
#INVENTORY MANAGEMENT SIMULATOR * TAPE * B 1620-10.2.002
NVERTER. #CARD TO TAPE SIMULATOR AND ROW TO COLUMN CO B 0704-1013ORCTT
#537 SIMULATOR GENERATOR B 0650-01.6.051
#1410 SIMULATOR ON THE 704/9/90 A 0704--SI-041
#1410 SIMULATOR ON THE 704/9/90 A 0704--SI-042
#650 SIMULATOR PROGRAM * CARD * B 1620-02.0.004
#650 SIMULATOR PROGRAM * TAPE * B 1620-02.0.005
#7070 SIMULATOR THE 650 * GRONK * B 7070-05.1.003
OATING PT. AND INDEXING REGISTER SIMULATOR WITH TRACE * FIRS#FL B 0650-01.6.050
#CARD TO TAPE SIMULATOR. B 0709-0605WDCTS
REVIATED FLOATING POINT HARDWARE SIMULATOR. #AB FLOAT SIM-AB B 7070-05.2.001
SION #INVENTORY MANAGEMENT SIMULATOR7070 FULL FORTRAN VER B 7070-12.1.001
OR TAPE TO PRINTER #SIMULTANEOUS CARD TO TAPE AND/ B 1401-13.1.010
TIONS #SOLUTION OF N SIMULTANEOUS DIFFERENTIAL EQUA B 0650-04.0.011
#SOLUTION OF SIMULTANEOUS EQUATIONS B 0650-07.0.003
N #GENERAL SIMULTANEOUS EQUATIONS SOLUTIO B 0650-05.2.019
#SIMULTANEOUS EQUATIONS COMPLEX B 0704-0116CLSME
#LEAST SQUARES SOL. OF SIMULTANEOUS EQUATIONS B 0704-0116CLLSQ
#SIMULTANEOUS EQUATIONS, REAL B 0704-0223CLSME
#SIMULTANEOUS EQUATIONS, REAL B 0704-0223CLSME
#NON-LINEAR SIMULTANEOUS EQUATIONS, REAL B 0704-0273CLSME
#NON-LINEAR SIMULTANEOUS EQUATIONS, REAL B 0704-0273CLSME
INE #SIMULTANEOUS EQUATIONS SUBROUT B 0704-0355GMSIM
#SIMULTANEOUS EQUATIONS SOLVER B 0704-0962SQSIM
* TAPE * #SIMULTANEOUS EQUATION PROGRAM B 1620-05.0.001
* CARD * #SIMULTANEOUS EQUATION SOLUTION B 1620-05.0.002
#7070 MATRIX INVERSION AND SIMULTANEOUS EQUATIONS B 7070-10.1.002
#LARGE DOUBLE PRECISION SIMULTANEOUS EQUATION SOLVER B 7090-1149AS012
#SOLUTION OF SYSTEMS OF SIMULTANEOUS LINEAR EQUATIONS B 0650-05.2.021

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#SOLUTION OF SIMULTANEOUS LINEAR EQUATIONS B 0650-05.1.002
#SYMMETRIC SIMULTANEOUS LINEAR EQUATIONS B 0650-05.2.010
MATRIX INVERSION AND SOLUTION OF SIMULTANEOUS LINEAR EQUAT # B 0650-05.2.011
OLUTION SUBROUTINE #FN II SIMULTANEOUS LINEAR EQUATION S B 0704-0848ARNXN
#SOLUTION OF SIMULTANEOUS LINEAR EQUATIONS B 1620-05.0.007
#SOLUTION OF SIMULTANEOUS LINEAR EQUATION B 7070-10.4.001
WITH PIVOTING #SLEP, SOLVES SIMULTANEOUS LINEAR EQUATIONS B 7070-10.4.002
ION, FLOATING POINT. #SIMULTANEOUS MULTIPLE INTEGRAT B 0704-0240NOSIG
IAL EQUATIONS SOLVER #SIMULTANEOUS PARTIAL DIFFERENT B 0704-1043JPSRC
ETERMINANT #SIMULTANEOUS REAL EQUATIONS, D B 0704-0116CLSME
#SIMULTANEOUS REAL EQUATIONS B 0704-0116CLSME
# DOUBLE PRECISION SIMULTANEOUS REAL EQUATIONS, B 0704-0356CA001
#WAVE RECORD ANALYSIS OF TWO SIMULTANEOUS RECORDS B 0704-0574CSTUK
#DOUBLE PRECISION SIN-COS ROUTINE B 0704-0929OLDPS
#SIN-COS SUBROUTINE B 0650-03.1.010
#MURA FIXED POINT SINE B 0704-0280MUSIN
#MURA FIXED POINT SINE B 0704-0280MUSIN
#ARC SINE - ARC COSINE SUBROUTINE B 0704-0246NA135
#FLOATING POINT SINE A AND COSINE A A 0650--LM-004
#ARC SINE AND ARC COSINE B 0704-0116CLASC
#INTERPRETABLE DOUBLE PRECISION SINE AND COSINE B 0704-0385BS9CC
NLLS. #SINE AND COSINE FUNCTIONS FOR B 0704-0837ORSCN
#SINE AND COSINE SUBROUTINE B 7070-08.1.002
#SINE AND COSINE SUBROUTINE B 7070-08.1.015
#SINE AND COSINE, FLOATING B 0704-0577RWSC5
#HYPERBOLIC SINE AND COSINE,FLOATING POINT B 0704-0417PFCSH
#FLOATING-POINT 709 HYPERBOLIC SINE AND HYPERBOLIC B 0709-0941RWHY3
#SINE COSINE SUBROUTINE B 7070-08.1.011
#SINE COSINE SUBROUTINE B 7070-08.1.021
L FUNCTIONS #INTER SUBROU FOR SINE INTEGRAL & COSINE INTEGRA B 0650-03.2.004
E #FN II SINE-COSINE INTEGRAL SUBROUTIN B 0704-0848ARCSI
#SINE-COSINE SUBROUTINE B 1401-03.0.005
#HYPERBOLIC SINE-COSINE, FLOATING B 0704-0224ASAS3
ROUTINE #HYPERBOLIC SINE, COSINE AND COTANGENT SUB B 7070-08.1.020
NALYSIS OF VARIANCE FOR PART. OR SING. REPLICATED KBY #A B 0650-06.0.063
RAN II INPUT SUBROUTINE #SINGLE DIMENSION SYMBOLIC FORT B 0704-0848ARINS
#SINGLE INTEGRATION SUBROUTINE B 0704-0368NA274
SUBROUTINE #SINGLE OR DOUBLE INTERPOLATION B 0704-1129AQALL
ION #SINGLE PRECISION MATRIX INVERS B 7070-10.1.003
CISION FORTRAN INPUT #SINGLE PRECISION TO DOUBLE PRE B 0709-1201NRDIC
NE #SINGLE-VALUED ARCTANGENT ROUTI B 0704-0355GMATN
#FLOATING POINT E A, 10 A, SINH A, COSH A B 0650-03.1.020
#A FLOATING POINT E AT 10 AT SINH AT CO B 0650-03.1.020
#SINH FIT B 0650-06.0.012
#SINH X AND COSH X B 0650-03.1.009
ATION OF AN INDEXING REGISTER IN SIR #SIMUL B 0650-02.0.016
#SIR PLUS B 0650-02.0.018
#SIR SOAP INTERPRETIVE ROUTINE B 0650-02.0.001
#SIX CARD UPPER LOADER B 0704-1183GDCOR
Y TUBE DISPLAY #MURA SIX COLUMN FRACTION CATHODE RA B 0704-0310MUSCP
#MURA SIX COLUMN FRACTION PRINT B 0704-0314MUPRF
TRAJECTORY PROGRAM #SIX DEGREE OF FREEDOM DYNAMIC B 0704-0821LRSFD
#SIX-PER-CARD LOADING ROUTINE B 0650-01.2.004
ANALYSIS PROGRAM * #SCRAP * SIXTEEN-TWENTY CARD REGRESSION B 1620-06.0.003
SORT 54 MODIFICATION TO USE FILE SIZE # B 0705-XE-002-0
#ECONOMIC CONDUCTOR SIZE SELECTION BY KELVINS LAW B 1620-09.4.005
S PROG 18 #SELEC ECON. COND. SIZE-SPEC CASE NEW ENG ELEC SY B 1620-09.4.004
#SIZZLE NUCLEAR-CODE BURNUP B 7090-NUCLEAR
#SKEWED BRIDGE ELEVATIONS B 1620-09.2.005
#GEORGIA SKEWED BRIDGE PROGRAM B 0650-09.2.008
PE AND PUNCHES #SKIPS ONE FILE ON A DECIMAL TA B 0704-1144NC014
#3-SPAN CURVED CONCRETE SLAB BRIDGE PROGRAM B 0650-09.2.060
AR EQUATIONS WITH PIVOTING #SLEP, SOLVES SIMULTANEOUS LINE B 7070-10.4.002
T SQRS. BEST 1/2WAVE POTENT. AND SLOPE OF A #CALC. OF THE LEAS B 0650-09.3.003
#SLOPE STABILITY ANALYSIS B 0650-09.2.026
#SLOPE TOPOG PROGRAM B 0650-09.2.024
#SMASHT B 7090-1130RLA14
ALLY SPACED DATA POINTS #SMOOTH AND DIFFERENTIATE UNEQU B 0704-0331CLSMD
POINTS #SMOOTH AND DIFFERENTIATE DATA B 0704-0223CLSMD
VE #SMOOTHED ORDINATE AND DERIVATI B 7090-1248MDSOD
#EXPONENTIAL SMOOTHING B 1620-10.2.004
TAL TERRAIN MODEL SYSTEM PROFILE SMOOTHING PROGRAM DA-3 #DIGI B 0650-09.2.063
#MADSMI CURVE SMOOTHING ROUTINE B 7090-1241MADSM
#FORTRAN SNAP SHOT ROUTINE. B 0704-0595ERSNA
#SNAPSHOT TRACER B 0704-0275NYSNA
#SNG NUCLEAR-CODE TRANSPORT B 0704-NUCLEAR
#FORTRAN SN6 NUCLEAR-CODE TRANSPORT B 7090-NUCLEAR
#NO SOAP B 0650-01.1.008
ESTION #650 SOAP CONTROL PANEL WIRING SUGG B 0650-12.0.006
M * ASCUP * #AUTOMATIC SOAP CONVERSION UTILITY PROGRA D 0650-01.6.045
R THE IBM 650 #A MODIFIED SOAP FLOATING POINT PACKAGE FO B 0650-01.1.009
#SOAP I TO SOAP II TRANSLATOR B 0650-01.6.016
#RELOCATABLE TO REGIONAL SOAP II B 0650-01.6.034
#GO SOAP II B 0650-12.0.004
#SOAP I TO SOAP II TRANSLATOR B 0650-01.6.016
OAD CARD #402 CONTROL PANEL FOR SOAP II 8-WORD LIST, AND 650 L B 0650-12.0.005
#SIR SOAP INTERPRETIVE ROUTINE B 0650-02.0.001
DOUBLE PRECISION FLOATING POINT SOAP INTERPRETIVE ROU #DOPSIR B 0650-02.0.010
#TRANSLATOR AND OTHER FORMATS TO SOAP RELOKS B 0650-01.6.048
#SOAP TO SEVEN B 0650-01.6.014
GRAM STRAP 4000 #SOAP TYPE OPTIMAL ASSEMBLY PRO B 0650-01.1.012
#A PROCEDURE FOR USING SOAP WITH A NUMERIC 650 B 0650-01.6.012
#BASIC SOAP 2A A 0650--SP-201
#TAPE SOAP 2A A 0650--SP-202
#SOAP 2L A 0650--SP-203
#SOAP 2L TAPE A 0650--SP-204
#SOAP 4000 A 0650--SP-205
#SOAP 42 A 0650--SP-206
GRAM STRAP #SOAP-TYPE OPTIMAL ASSEMBLY PRO B 0650-01.1.007
#SOAPY B 0650-01.1.005
#SOCOTT TAPE TEST SYSTEM B 0705-SI-001-0
#SOFOCATE NUCLEAR-CODE PHYSICS B 0704-NUCLEAR
#LEAST SQUARES SOL. OF SIMULTANEOUS EQUATIONS B 0704-0116CLLSQ
EQUATION #INTER SUBROU FOR SOLU OF ORDINARY DIFFERENTIAL B 0650-04.0.005
W/AUTO ERROR ANALYSIS #NUM SOLU OF ORDINARY DIFFERENTIAL B 0650-04.0.012
MATICAL PROGRAMMING SYSTEM I-ALL SOLUTIONS #MATHE B 0704-1092RSM1A
#EQU SOLV B 0650-05.2.020
DIGITAL DIFFERENTIAL ANALYZER TO SOLVE #SIMULATES A B 0704-0319GLDAS
#GENERATE MATRICES TO BE SOLVED BY NU TPL1 B 0704-1110NUGEN
# ZERO, MINIMUM SOLVER B 0704-1041JPZOM
#SIMULTANEOUS EQUATIONS SOLVER B 0704-0962SQSIM
#LINEAR MATRIX EQUATION SOLVER B 0704-0635RWMAT
#LINEAR EQUATION SOLVER B 0704-0742RWLE3
#DIFFERENTIAL EQUATIONS SOLVER B 0704-0825JPDEQ
S PARTIAL DIFFERENTIAL EQUATIONS SOLVER #SIMULTANEOU B 0704-1043JPSRC
PRECISION SIMULTANEOUS EQUATION SOLVER #LARGE DOUBLE B 7090-1149AS012
AL ONE DIMENSIONAL HEAT EQUATION SOLVER #MULTI-MATERI B 0704-0652RWHF2
NDRY CONDITION DIFFERENTIAL EQU. SOLVER #TWO POINT BOU B 0704-0238ATTPI
#LINEAR EQUATION SOLVER OF BAND MATRICES B 0709-0990RWLE4
ATIONS WITH PIVOTING #SLEP, SOLVES SIMULTANEOUS LINEAR EQU B 7070-10.4.002
#SEQUENTIAL CIRCUIT PROBLEM SOLVING B 0704-1103PKSEQ
ON 650 #RUNGE-KUTTA ROUTINE FOR SOLVING DIFFERENTIAL EQUATION B 0650-07.0.005
#DIFFERENTIAL EQUATION SOLVING SYSTEM B 0704-0144PKNID
TIONS #A PROGRAM FOR SOLVING SYSTEMS OF LINEAR EQUA B 1401-11.0.003
#RESTART PROGRAM FOR MD SORT B 0709-1160MDSRS
NERALIZED VARIABLE LENGTH RECORD SORT #709/7090 GE B 0709-1159MDSOR
#SORT DELETE A 0650--UT-106
#SORT GENERATOR B 0704-0404GISG
#SORT INTERNALLY B 0705-PG-009-0
#SORT PROGRAM B 0704-0427NSSRT
#GENERALIZED RAMAC SORT PROGRAM A 1410--SM-110
#KWIC SORT PROGRAM FIRST PART B 0704-0914NCKSP
#KWIC SORT PROGRAM SECOND PART B 0704-0914NCKSP
#GENERAL SORT ROUTINE B 0704-0359ELS08
#GENERAL LOGICAL CORE SORT SUBROUTINE FOR 32K704 B 0704-1054BSSEA
#PROGRAM TO SORT THE KEY WORDS FROM NC138 B 0704-1144NC013
#SORT 1 A 1401--SM-029
#SORT 1401 B 1401-01.2.001
#TAPE SORT 2 A 0650--SM-402
#SORT 2 A 1401--SM-043
#SORT 2, DECENDING B 0650-01.5.009
#TAPE SORT 3 A 0650--SM-403
#SORT 54 A 0705--SM-048
LE SIZE #SORT 54 MODIFICATION TO USE FI B 0705-XE-002-0
#SORT 54 T/ A 0705--SM-052
ION OF PHASE II #SORT 54 TECHNIQUE OF MODIFICAT B 0705-XE-001-0
#SORT 54/ A 0705--SM-051
#SORT 54T A 0705--SM-049
NE #SORT 55 CHECKING LOADING ROUTI B 0705-EQ-001-0
#SORT 57 A 0705--SM-050
#SORT 57 BLOCKED VARIABLE B 0705-CU-001-1
#SAVE MEMORY SORT 57-PH3 B 0705-CU-002-0
#SORT 57/ A 0705--SM-053
#SORT 58 B 0705-SB-001-0
#SORT 709 A 0709--SM-066
#SORT 80 A 0705--SM-054
#SORT 80 UNDER SCS 80 A 7080--SM-114
#SORT 90 A 7070--SM-077
#SORT/MERGE 11 A 1410--SM-111
#SORT/MERGE 12 A 1410--SM-112
LENGTH - 1 WORD. OPEN. #SORT, ALGEBRAIC. KEY AND ITEM B 0704-0570ORSRT
LENGTH - 1 WORD. CLOSED. #SORT, ALGEBRAIC. KEY AND ITEM B 0704-0570ORSRT
S. /WHOLE WORD KEYS ONLY/ #SORT, ALGEBRAIC. MULTIWORD KEY B 0704-0570ORSRT
# LOGICAL MEMORY SORT, MINIMUM TIME B 0704-0468CF005
#READS THE SORTED AUTHOR CROSS INDEX TAPE B 0704-1144NC014
NC 142 #READS THE SORTED BIBLIOGRAPHY TAPE FROM B 0704-1144NC014
#READS THE FINAL SORTED BIBLIOGRAPHY TAPE B 0704-1144NC014
#READS THE SORTED KEY WORDS FROM NC 139 B 0704-1144NC014
#READS THE FINAL SORTED TAPE FROM NC 139 B 0704-1144NC014
#709 VIPP SORTER. B 0709-1136BWVIP
AL PURPOSE #VIPP SORTER. FIRST PHASE OF A GENER B 0704-0926TAVIP
#CROWN LIFE INSURANCE COMPANY SORTING PROGRAM B 0650-01.5.006
# GENERALIZED TAPE SORTING ROUTINE B 0704-0468CF006
#SORTING SUBROUTINE B 0650-01.1.011
OM NC 138 #SORTS THE BIBLIOGRAPHY TAPE FR B 0704-1144NC014
#SOR9 A 7090--SM-922
LER #SOS IBM-32K ASSEMBLY AND COMPI A 0709--PR-063
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SELECTED SOS PROGRAM #SOS PROGRAM LOADER. CALLS IN A B 7090-1229IQCSO
PILER #SOS SHARE-32K ASSEMBLY AND COM A 0709--PR-064
P AND LOAD ROUTINE FOR IBM 650 * SOSF * #DUM B 0650-01.2.012
NE EDIT FOR FORTRAN MONITOR WITH SOURCE LANG DEBUG #OFFLI B 7090-1115GPFMS
#EXTENTION OF FORTRAN 2 SOURCE LANGUAGE B 0704-0812GPFMG
#FORTRAN SOURCE TAPE CORRECTOR B 1620-01.5.001
#BACKSPACE FILE,FORWARD SPACE FILE. B 0704-1003GNBSP
11 DIFFUSION EQUATION IN ¤X, Y¤ SPACE NUCLEAR-CODE # UNCLE B 0650-08.2.011
#FORTRAN WRITE-UP OF RW REQX.SPACE REQUIRED-122 CELLS B 0709-0946RWFEQ
#ERCO SPACE SAVER B 0650-02.0.007
OOTH AND DIFFERENTIATE UNEQUALLY SPACED DATA POINTS #SM B 0704-0331CLSMD
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O #SPAN-2 NUCLEAR-CODE MONTE CARL B 0704-NUCLEAR
TRANS * IT * COMPILER FOR USE OF SPECIAL CHAR #MODS OF INTER B 0650-02.1.002
#INTEGRATION OF SPECIAL FORM OF 2ND ORDER EQU. B 0704-0141LAS88
CES. #COMPUTES A SPECIAL FUNCTION F OF THE INDI B 0704-0788IBSPF
LIQUID #SPECIFIC VOLUME OF COMPRESSED B 7090-1095WHVCL
IQUID #SPECIFIC VOLUME OF SATURATED L B 7090-1095WHVSL
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APCR #ENTHALPY ENTROPY SPECIFIC VOLUME OF SATURATED V B 7090-1095WHHSV
# NEUTRON ENERGY SPECTRA IN WATER NUCLEAR-CODE B 0650-08.2.021
N OF AUTO-CORRELATION FUNCTION & SPECTRAL DENSITY #CALCULATIO B 0650-06.0.049
ATING #POWER SPECTRAL DENSITY FUNCTION, FLO B 0704-0577RWPS2
VECTORS OF A MATRIX #MOLECULAR SPECTROSCOPY LATENT ROOTS AND B 0650-05.2.024
#MOLECULAR SPECTROSCOPY MULT OF MATRICES B 0650-05.2.023
#AUTOCORRELATION AND POWER SPECTRUM B 0650-06.0.013
#POWER DENSITY SPECTRUM B 0704-0897AAPDS
#AUTO-CORRELATION AND POWER SPECTRUM ANALYSIS B 0704-0296NYCP2
NO. GEN., NERENSON-ROSEN FISSION SPECTRUM. FT.PT #RANDOM B 0704-0743ORFIS
#SPEED CHECK ANALYSIS B 0650-09.2.023
#SPEED CODING SYSTEM B 0650-02.0.005
# BEEHIVE & HORNET REACTOR CODE SPHERICAL GEO NUCLEAR-CODE B 0650-08.2.009
E # BALL A REACTOR CODE FOR SPHERICAL GEOMETRY NUCLEAR-COD D 0650-08.2.016
O #SPIC-1 NUCLEAR-CODE MONTE CARL B 0704-NUCLEAR
#TALBOT SPIRAL INTERSECTIONS D 0650-09.2.045
#TALBOT SPIRAL INTERSECTIONS B 0650-09.2.077
#SPLINE CURVE FIT B 0704-0483NA029
#SPLINE CURVE READ B 0704-0483NA029
R #NINE OPERATION SPLIT INSTRUCTION ROUTINE NOSI B 0650-02.0.006
#SPLITS A FOURIER SERIES. B 0704-0788IBSPS
#SPOOL SYSTEM A 7070--IO-070
#SPRSP B 0705-SR-008-0
10 SYMBOLIC PROGRAMMING SYSTEM * SPS * * CARD * #1620/17 A 1620--SP-020
10 SYMBOLIC PROGRAMMING SYSTEM * SPS * * TAPE * #1620/17 A 1620--SP-021
#SPS ONE PASS FOR PAPER TAPE A 1620--SP-007
#704 ASSEMBLY OF 1401 SPS PROGRAMS B 1401-13.2.001
#704 ASSEMBLY OF 1401 SPS PROGRAMS B 1401-01.1.007
#SPS TO FORTRAN SUBROUTINE EDIT B 1620-01.6.007
* REVISION * #SPS TO FORTRAN SUBROUTINE EDIT B 1620-01.6.009
#MAST *MINNEAPOLI ASSEMBLY OF SPS TWO * B 1401-01.1.005
ST *FULL MINNEAPOLIS ASSEMBLY OF SPS TWO * #FULL MA B 1401-01.1.006
#SPS TWO PASS FOR CARDS A 1620--SP-009
#SPS TWO PASS FOR PAPER TAPE A 1620--SP-008
#SYMBOLIC PROGRAMMING SYSTEM SPS 1 A 1401--SP-021
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#SPYCE B 0650-02.1.004
TH LINEAR INC. OF VEL. #LEAST SQ. DETER. FOR A VEL FUNCT. WI B 0650-09.6.016
N FOR REFRACT. T/D DATA #LEAST SQ. DETER. OF VELOCITY FUNCTIO B 0650-09.6.020
G BINARY ARITH #NORMALIZED SQ.ROOT-EXTENDED RANGE FLOATIN B 0704-0370RS013
SLOPE OF A #CALC. OF THE LEAST SQRS. BEST 1/2WAVE POTENT. AND B 0650-09.3.003
E #FN II NTH DEGREE LEAST SQU COEF COMPUTATION SUBROUTIN B 0704-0848ARPLN
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ENCY TABLE                #CHI SQUARE AND PHI FOR 2X2 CONTING B 0650-06.0.016
          #GENERAL LEAST SQUARE CURVE FITTING ROUTINE   B 0704-0775RWGLS
          #GENERAL LEAST SQUARE CURVE FITTING ROUTINE.  B 0704-0742RWLS3
NCY TABLE                 #CHI SQUARE FOR UP TO 10X10 CONTIGE B 0650-06.0.015
          #ARGONNE LEAST SQUARE LEGENDRE POLYNOMIAL FIT B 0704-0424ANE20
D EIGENVECTORS OF  NON-SYMMETRIC SQUARE MATRIX  #EIGENVALUES AN B 0650-05.2.018
SELF                            #SQUARE MATRIX TRANSPOSED ON IT B 0704-0290GESTO
ELF                             #SQUARE MATRIX TRANSPOSE ON ITS B 0704-0432MUMTR
SELF OR DISPLACED IN CORE       #SQUARE MATRIX TRANSPOSED ON IT B 0704-0661GDF02
N               #WEIGHTED LEAST SQUARE POLYNOMIAL APPROXIMATIO B 0650-06.0.009
 II/                      #LEAST SQUARE POLYNOMIAL FIT /FORTRAN B 0704-0772ANE20
                                #SQUARE ROOT                    A 0650--LM-006
      #TRIPLE PRECISION COMPLEX SQUARE ROOT                    B 0704-0565CA005
              #TRIPLE PRECISION SQUARE ROOT                    B 0704-0481CA003
#FLOATING-POINT DOUBLE-PRECISION SQUARE ROOT                    B 0704-0525PKSCR
                #1620 FIX POINT SQUARE ROOT                    B 1620-07.0.003
INE                  #FIXED POINT SQUARE ROOT * CLOSED * SUBROUT B 1620-03.0.002
 #INTERPRETABLE DOUBLE PRECISION SQUARE ROOT INSTRUCTION        B 0704-0385BSSQR
              #MURA FIXED POINT SQUARE ROOT ROUTINE            B 0704-0283MUSQR
              #MURA FIXED POINT SQUARE ROOT ROUTINE            B 0704-0263MUSQR
              #DOUBLE PRECISION SQUARE ROOT ROUTINE            B 7070-08.3.006
                #FLOATING POINT SQUARE ROOT SUBROUTINE         B 0650-07.0.011
                                #SQUARE ROOT SUBROUTINE         B 0650-03.1.001
                                #SQUARE ROOT SUBROUTINE         B 0650-03.1.002
                #FLOATING POINT SQUARE ROOT SUBROUTINE         A 0650--LM-010
                #FLOATING POINT SQUARE ROOT SUBROUTINE         B 0709-0619IBSQR
                                #SQUARE ROOT SUBROUTINE         B 1401-03.0.003
                #VARIABLE FIELD SQUARE ROOT SUBROUTINE         B 1620-03.0.001
                                #SQUARE ROOT SUBROUTINE         B 7070-08.3.007
                                #SQUARE ROOT SUBROUTINE         B 7070-08.3.008
                                #SQUARE ROOT SUBROUTINE         B 7070-08.3.009
                                #SQUARE ROOT SUBROUTINE         B 7070-08.3.010
           #ARCSIN X, ARCCOS X, SQUARE ROOT X                   B 0650-03.1.028
                                #SQUARE ROOT X                  B 7070-08.3.001
                                #SQUARE ROOT, FLOATING-POINT    B 0704-0399MISRT
ORTRAN LIB. VERSION             #SQUARE ROOT, FLOATING-POINT, F B 0704-0399MISRT
                                #SQUARE ROOT, FLOATING POINT    B 0704-0641CSSQT
                                #SQUARE ROOT, FLOATING POINT.   B 0704-0653CSSQT
9 CNLY                          #SQUARE ROOT, FLOATING POINT 70 B 0709-0485MISRT
                                #SQUARE ROOT, TOPLER METHOD     B 7070-08.3.002
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ANGULAR FORM.          #CONTRACT SQUARE SYMMETRIC MATRIX TO TRI B 0704-0460MICNT
                                #SQUARE TABLE LOOK UP           B 0705-AF-013-0
     #DOUBLE PREC. FLOATING PT. SQUARE-ROOT SUBROUTINE.         B 0704-0727IBSQD
                #FLOATING-POINT SQUARE-ROOT SUBROUTINE          B 0704-0817GIFPS
  #POLLY-POLYNOMIAL FIT BY LEAST SQUARES                        B 0650-06.0.010
                          #LEAST SQUARES                        B 7090-1243SILSQ
                  #GENERAL LEAST SQUARES ANALYSIS               B 0650-06.0.027
                          #LATIN SQUARES ANALYSIS OF VARIANCE   B 0704-0776RWAV5
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HOGONAL POLYNOMIALS       #LEAST SQUARES CURVE FITTING WITH ORT B 0650-06.0.023
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                          #LEAST SQUARES CURVE-FITTING ROUTINE  B 0709-0860RWCF
                #A GENERAL LEAST SQUARES FITTING PROCEDURE      B 0704-1076ANE20
                  #GENERAL LEAST SQUARES FORTRAN SUBPROGRAM.    B 0704-0635RWGLS
                        #A LEAST SQUARES ITERATION              B 0709-0934NOLSQ
#POLYNOMIAL OF BEST FIT BY LEAST SQUARES METHOD                 B 0650-06.0.006
ON.                       #LEAST SQUARES POLYNOMIAL APPROXIMATI B 0704-0617CA021
NG ROUTINE                #LEAST SQUARES POLYNOMIAL CURVE FITTI B 0705-A0-003-0
                          #LEAST SQUARES POLYNOMIAL FIT         B 0704-0116CLLSQ
      #THREE DIMENSIONAL LEAST SQUARES PROCEDURE.               B 0704-0533CF009
E FITTING                 #LEAST SQUARES RATIONAL FUNCTION CURV B 0704-0859GSL16
QUATIONS                  #LEAST SQUARES SOL. OF SIMULTANEOUS E B 0704-0116CLLSQ
              #NON-LINEAR LEAST SQUARES.                        B 0704-0837ORNLL
                   #FORTRAN TO SQUOZE CONVERTER                 B 0709-0875RCFNS
                                #SQUOZE TAPE EDITOR             B 0709-1000RSEDT
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ERTIES                          #STATISTICAL THERMODYNAMIC PROP B 0650-09.3.006
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Y SPECIFIC VOLUME OF SUPERHEATED STEAM          #ENTHALPY ENTROP B 7090-1095WHHSS
  #  THERMODYNAMIC PROPERTIES OF STEAM AND WATER                B 0704-0428GSSTP
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ROGRAM *               #STRAP * STEPWISE REGRESSION ANALYSIS P B 1620-06.0.004
NE *                            #STER * SIMPLE TAPE ERROR ROUTI B 1401-01.4.018
S PROG FOR 650-653 MAG DRUM CONE STGE COMPU      #MOD BELL TRAN B 0650-02.1.011
    #GENERAL FREEWAY ASSIGNMENT, STOCKTON REVISION              B 0650-09.2.079
AND ADC                #PK CLAD & PK STOD - DOUBLE PRECISION CLEAR  B 0704-0525PKCLA
                                #STOP NUMBER DRUM AND IAS       B 0650-01.6.027
  #7072 UTILITIES FOR ADDITIONAL STORAGE                        A 7072--UT-085
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                        #ON-LINE STORAGE DUMP                   B 0650-01.6.030
                                #STORAGE HISTORY TRACE          B 0704-0264ASAS4
              #WRITE BSS LOADER STORAGE MAP                     B 0704-0830MISTP
              #WRITE BSS LOADER STORAGE MAP                     B 0704-0830MISTP
                           #DUMP STORAGE, CORE, DRUM, AND TAPES B 0704-0496CSDS2
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E MATRIX                        #STORE ROW MATRICES INTO A LARG B 0704-0223CLMST
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EM                              #STRAIGHT LINE BRIDGE GRID SYST B 0650-09.2.058
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ING TO FIXED DECIMAL   #FIXER, A SUB. TO CONVERT NO. FROM FLOAT B 7070-08.9.002
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         #NTH ROOT FIXED POINT SUBROUTINE                       A 0650--LM-007
      #NTH ROOT FLOATING POINT SUBROUTINE                       A 0650--LM-009
   #FLOATING POINT SQUARE ROOT SUBROUTINE                       A 0650--LM-010
                 #ROOT FINDING SUBROUTINE                       B 0650-07.0.004
                     #EN * X * SUBROUTINE                       B 0650-07.0.008
                    #KIN * X * SUBROUTINE                       B 0650-07.0.009
   #FLOATING POINT SQUARE ROOT SUBROUTINE                       B 0650-07.0.011
   #CLEBSCH-GORDAN COEFFICIENT SUBROUTINE                       B 0650-07.0.012
                  #SQUARE ROOT SUBROUTINE                       B 0650-03.1.001
                     #SORTING SUBROUTINE                        B 0650-01.1.011
                  #SQUARE ROOT SUBROUTINE                       B 0650-03.1.002
                     #SIN-COS SUBROUTINE                        B 0650-03.1.010
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U AND MODIFIED MATHIEU FUNCTIONS SUBROUTINE            #MATHIE B 0650-03.2.006
           #HARMONIC ANALYSIS SUBROUTINE                        B 0704-0121GMHAS
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          #CONTINUED FRACTION SUBROUTINE                        B 0704-0225GMCFR
                 #EIGENVALUE SUBROUTINE                         B 0704-0225GMEIG
        #ARC SINE - ARC COSINE SUBROUTINE                       B 0704-0246NA135
            #GMITR3 ITERATION SUBROUTINE                        B 0704-0259GMITR
                   #ITERATION SUBROUTINE                        B 0704-0355GMITR
LE PRECISION FLOATING POINT LOAD SUBROUTINE              #DOUB B 0704-0385BSCON
      #DETERMINANT EVALUATING SUBROUTINE                        B 0704-0355GMDET
E PRECISION FLOATING POINT PRINT SUBROUTINE             #DOUBL B 0704-0385BSOUT
      #SIMULTANEOUS EQUATIONS SUBROUTINE                        B 0704-0355GMSIM
          #SINGLE INTEGRATION SUBROUTINE                        B 0704-0368NA274
          #DOUBLE INTEGRATION SUBROUTINE                        B 0704-0368NA275
          #TRIPLE INTEGRATION SUBROUTINE                        B 0704-0368NA276
     #ARBITRARY CURVE PLOTTER SUBROUTINE                        B 0704-0284WHWH2
                     #MONITOR SUBROUTINE                        B 0704-0302NYMON
            #ATMOSPHERIC DATA SUBROUTINE                        B 0704-0341AAATM
TINUOUS DERIVATIVE INTERPOLATION SUBROUTINE               #CON B 0704-0760GECDI
   #GENERAL ROOT FINDER FORTRAN SUBROUTINE                      B 0704-0635RWGRT
ENSION SYMBOLIC FORTRAN II INPUT SUBROUTINE         #MULTI-DIM B 0704-0848ARSYM
SAP-CODED MATRIX DIAGONALIZATION SUBROUTINE              #704- B 0704-0697MIHDI
 #PAGE HEADING OUTPUT FORTRAN II SUBROUTINE                     B 0704-0848ARHED
LY TRIANGULARIZATION OF A MATRIX SUBROUTINE              #NEAR B 0704-0635RWNTR
I FLOATING POINT OR INTEGER DUMP SUBROUTINE              #FN I B 0704-0848ARDMP
     #EIGENVECTOR DETERMINATOR SUBROUTINE                       B 0704-0635RWVCT
    #FN II SINE-COSINE INTEGRAL SUBROUTINE                      B 0704-0848ARCSI
A 6 DIGIT FLOATING POINT ARCSINE SUBROUTINE                  # B 0704-0649IBASN
        #FN II ERROR WALK-BACK SUBROUTINE                       B 0704-0848ARFER
         #RANDOM TABLE LOOKUP SUBROUTINE                        B 0704-0551CSDEV
   #FN II FACTORIAL COMPUTATION SUBROUTINE                      B 0704-0848ARTOR
            #POLAR POINT PLOT SUBROUTINE                        B 0704-0556ERPLO
   #FLOATING-POINT SQUARE-ROOT SUBROUTINE                       B 0704-0817GIFPS
ED,PACKAGED,ON-LINE INPUT-OUTPUT SUBROUTINE         #GENERALIZ B 0704-0573CF001
     #FIXED POINT EXPONENTIAL SUBROUTINE                        B 0704-0510IBEXP
                  #BCD OUTPUT SUBROUTINE                        B 0704-0500BSEWO
         #LINEAR PROGRAMMING SUBROUTINE                         B 0704-0523SCMUS
      #FLOATING POINT NTH ROOT SUBROUTINE                       B 0704-0525PKN00
  #FLOATING POINT N FACTORIAL SUBROUTINE                        B 0704-0525PKFAK
TING POINT NUMERICAL INTEGRATION SUBROUTINE              #FLOA B 0704-0525PKLAQ
TING POINT NUMERICAL INTEGRATION SUBROUTINE              #FLOA B 0704-0525PKLEQ
     #BINARY TO BCD CONVERSION SUBROUTINE                       B 0704-0525PKBCD
E PRECISION FLOATING POINT PRINT SUBROUTINE             #DOUBL B 0704-0529BSOUT
 GENERAL PURPOSE PRINT AND PUNCH SUBROUTINE         #POPOUT  A B 0704-0422NOPOU
            #ATMOSPHERIC DATA SUBROUTINE                        B 0704-0436AAATM
        #INTERVAL ARITHMETIC SUBROUTINE                         B 0704-0880IBINT
        #  GENERALIZED OUTPUT SUBROUTINE                        B 0704-0988NUOUT
            #ARDC ATMOSPHERE SUBROUTINE                         B 0704-0881HKATM
#FORTRAN II BINOMIAL COEFFICIENT SUBROUTINE                     B 0704-0918MEPYR
                   #CUBE ROOT SUBROUTINE                        B 0704-0931PKCBR
              #PSUEDO-INVERSE SUBROUTINE                        B 0704-0931PKPSI
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                      #INVERSE TANGENT/COTANGENT SUBROUTINE        B 7070-08.1.017
FLAT END HORIZONTAL CYLINDRICAL TANKS          #LIQUID VOLUMES IN B 0650-09.7.005
                       #SOAP 2L TAPE                               A 0650--SP-204
              #HOLLERITH CARD TO TAPE                              B 0704-0525PKCTH
          #WRITE CORE IMAGE ON TAPE                                B 0704-0830MIWTP
DS THE FINAL SORTED BIBLIOGRAPHY TAPE                         #REA B 0704-1144NC014
DS THE SORTED AUTHOR CROSS INDEX TAPE                         #REA B 0704-1144NC014
           #CREATE MASTER PROGRAM TAPE                             B 0705-AO-010-0
           #SEARCH MASTER PROGRAM TAPE                             B 0705-AO-011-0
  #FORTRAN WITH FORMAT FOR PAPER TAPE                              A 1620--FO-003
  #FORTRAN PRE-COMPILER FOR PAPER TAPE                             A 1620--FO-005
          #SPS ONE PASS FOR PAPER TAPE                             A 1620--SP-007
          #SPS TWO PASS FOR PAPER TAPE                             A 1620--SP-008
               #FORTRAN FOR PAPER TAPE                             A 1620--FO-001
                #GOTRAN FOR PAPER TAPE                             A 1620--PR-010
      #7070/2/4 COMPILER SYSTEMS TAPE                              A 7070--PR-075
DIMENSIONAL ARRAY BINARY INFO ON TAPE                  #TO WRITE 2 B 0704-0910NUWTB
NG, A FOURIER SERIES FROM BINARY TAPE           #READS, WITH CHECKI B 0704-0788IBRFS
                #MULTITRACE * TAPE *                               B 1620-01.4.006
           #1620 AUTOPLOTTER * TAPE *                              B 1620-01.6.003
IVE PROGRAMMING SYSTEM * IPS * * TAPE *                #INTERPRET B 1620-02.0.001
          #650 SIMULATOR PROGRAM * TAPE *                          B 1620-02.0.005
#SIMULTANEOUS EQUATION PROGRAM * TAPE *                            B 1620-05.0.001
  #REGRESSION ANALYSIS PROGRAM * TAPE *                            B 1620-06.0.001
ISE MULTIPLE LINEAR REGRESSION * TAPE *                    #STEPW B 1620-06.0.006
     #POLYNOMIAL CURVE FITTING * TAPE *                            B 1620-07.0.001
      #1620 SUBDIVISION PROGRAM * TAPE *                           B 1620-09.2.001
                  #CUT AND FILL * TAPE *                           B 1620-09.2.002
     #TRAVERSE ANALYSIS PROGRAM * TAPE *                           B 1620-09.2.007
          #GAS NETWORK ANALYSIS * TAPE *                           B 1620-09.3.001
     #ELECTRIC LOAD FLOW PROGRAM * TAPE *                          B 1620-09.4.001
#BBC-VIK BASEBALL DEMONSTRATOR * TAPE *                            B 1620-11.0.008
   #STRAIN GAGE DATA REDUCTION * TAPE *                            B 1620-09.6.002
INEAR PROGRAMMING FOR THE 1620 * TAPE *                        #L B 1620-10.1.001
INVENTORY MANAGEMENT SIMULATOR * TAPE *                        # B 1620-10.2.002
                       #LESS 11 * TAPE *                           B 1620-10.3.004
MULATION OF A ONE-ARMED BANDIT * TAPE *               #1620 SI B 1620-11.0.002
  #CHINESE BAR AND RING PUZZLE * TAPE *                            B 1620-11.0.003
               #EXECUTIVE GAME * TAPE *                            B 1620-11.0.004
              #BLACK JACK GAME * TAPE *                            B 1620-11.0.005
LETE ASSEMBLY ROUTINE ADAPTED TO TAPE *             #CARAT I * COMP B 1401-01.1.003
AST COST ESTIMATING&SCHEDULING * TAPE *            #1620 LESS * LE B 1620-10.3.001
LETE ASSEMBLY ROUTINE ADAPTED TO TAPE *            #CARAT II * COMP B 1401-01.1.004
LIC PROGRAMMING SYSTEM * SPS * * TAPE *            #1620/1710 SYMBO A 1620--SP-021
NERTIA & CENTROID CALCULATIONS * TAPE *           #M-100 MOMENT OF I B 1620-09.3.005
IED ASSEMBLY SYSTEM CONVERTED TO TAPE * MASCOT *          #MODIF B 1401-01.1.001
/ LOADER.       #FORTRAN CARD OR TAPE /ROW AND/OR COLUMN BINARY B 0709-1163MWRCT
    #SKIPS ONE FILE ON A DECIMAL TAPE AND PUNCHES                  B 0704-1144NC014
        #SIMULTANEOUS CARD TO TAPE AND/OR TAPE TO PRINTER          B 1401-13.1.010
OGRAM.                      #TAPE ASSIGNMENT AND CONTROL PR B 0709-0534CSENK
                            #TAPE CHARACTERISTICS                  B 0705-SP-001-0
                            #TAPE CHECK SUBROUTINE                 B 7070-03.4.004
                            #TAPE COMPARE * TPCMP *                B 0705-NW-003-1
                            #TAPE COMPARE FOR THE 709              B 0709-0502RLTC9
             #READ-WRITE TAPE CONTROL PROGRAM                      B 0704-0403MITCR
                 #1401 TCS * TAPE CONTROL SYSTEM *                 B 1401-01.4.006
TS * FOURTEEN O ONE INPUT-OUTPUT TAPE CONTROL SYSTEM *        #FI B 1401-01.4.011
E                    #CARD TO TAPE CONVERSION-EDITING ROUTIN B 0704-0387CE14E
                            #TAPE COPY AND COMPARE                 B 0709-0998RL039
                            #TAPE COPY PROGRAM.                    B 0704-0733PFDUP
                   #ONE CARD TAPE COPY ROUTINE                     B 0704-0540SC
                            #TAPE COPY ROUTINE                     B 7070-03.4.001
                    #TAPE TO TAPE COPY WITH CHANGES                B 0704-0425WBTTC
                            #TAPE CORRECTOR                        B 0704-0508DITPC
          #FORTRAN SOURCE TAPE CORRECTOR                           B 1620-01.5.001
SION                #BINARY TAPE CORRECTOR. NON-SYSTEM VER B 0709-1055DIBTC
ER SUBROUTINE.              #TAPE CREATING PROGRAM AND LOAD B 0704-0734PFPRO
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                        #READ TAPE DATA.                           B 0704-0587NORTD
                     #DECIMAL TAPE DUMP                            B 0704-0425WBPTD
                      #BINARY TAPE DUMP                            B 1401-01.4.008
INT/                       #TAPE DUMP FOR THE 709/OCTAL PR B 0709-0502RLTD9
                           #TAPE DUPLICATE AND COMPARE             B 0709-0887PPTDA
                           #TAPE DUPLICATION                       B 0705-IB 0007
E.                         #TAPE DUPLICATION AND/OR COMPAR B 0709-0717NA098
                      #1401 TAPE DUPLICATION OR COMPARE            B 1401-13.1.001
                   #NUMERIC TAPE DUPLICATOR AND CORRECTOR          A 1620--MI-016
                           #TAPE DUPLICATOR FOR THE 709            B 0709-0502RLTS9
                           #TAPE EDIT                              B 1620-01.5.003
         #709 SYMBOLIC TAPE EDITING PROGRAM                        B 0709-0995FDEDI
                    #SQUOZE TAPE EDITOR                            B 0709-1000RSEDT
H COMPARE                  #TAPE EDITOR AND DUPLICATOR WIT B 0704-0318GMTED
            #STER * SIMPLE TAPE ERROR ROUTINE *                    B 1401-01.4.018
          #MATES * MASTER TAPE EXECUTARY PROGRAMS *                B 7070-03.4.003
                      #1401 TAPE EXECUTIVE PROGRAM                 B 1401-01.4.015
G                          #TAPE FILE GENERATOR FOR TESTIN A 7070--MI-084
      #SORTS THE BIBLIOGRAPHY TAPE FROM NC 138                     B 0704-1144NC014
      #READS THE FINAL SORTED TAPE FROM NC 139                     B 0704-1144NC014
  #READS THE SORTED BIBLIOGRAPHY TAPE FROM NC 142                  B 0704-1144NC014
                   #SERVICE TAPE GENERATOR                         B 0704-0425WBSRV
                           #TAPE INPUT/OUTPUT                      B 0704-0690GDTIO
                           #TAPE INPUT/OUTPUT                      B 0705-SB-005-0
               #H.Q. USAF TAPE INPUT/OUTPUT PACKAGE                B 0705-AF-003-1
TINE                       #TAPE LABEL,TRA,CHECK POINT ROU B 0705-SR-001-0
 #GEN. TRA ROUTINE PROG TAPE OPR TAPE LBL&TRAILER CKN              B 0705-SR-002-0
                           #TAPE LIBRARY CONTROL SYSTEM            B 1401-02.0.001
                   #CARD TO TAPE LOAD                              B 0705-AF-012-0
       #BINARY OCTAL CARD OR TAPE LOADER                           B 0704-0690GDBOT
                    #BINARY TAPE LOADER                            B 0704-0425WBTSB
     #ARGONNE CARD TO BINARY TAPE LOADER                           B 0704-0503ANI11
                   #ARGONNE TAPE LOWER BINARY LOADER               B 0704-0503ANI11
                           #TAPE MANEUVERING ROUTINE.              B 0704-0688GKTMR
                           #TAPE MERGE 2                           A 0650--SM-401
                           #TAPE OPERATOR PROGRAM /TOP/            B 0704-0382GSTOP
       #GEN. TRA ROUTINE PROG TAPE OPR TAPE LBL&TRAILER CKN        B 0705-SR-002-0
  #GENERATE A FORTRAN II PROGRAM TAPE OR ABSOLUTE BINARY           B 0704-0754CEF2L
                    #BINARY TAPE OR DRUM DUMP                      B 0704-0213NYBTD
                  #READ BCD TAPE OR ON-LINE CARD READER            B 0704-0073UACSH
  #SIMULATING THE CARD 650 ON A TAPE ORIENTED 7070                 B 7070-05.1.004
4I2                  #FN II BCD TAPE OUTPUT FOR FORMAT 12F6.0, B 0704-1057TVMEP
                     # OCTAL TAPE PRINT                            B 0704-0301RL013
                 #SELECTIVE TAPE PRINT                             B 0705-EQ-006-0
                           #TAPE PRINT OUT                         B 0705-AF-011-0
             #1401 CARD TO TAPE PROGRAM                            B 1401-13.1.002
SALVAGE                    #TAPE PROGRAM FINDER,WRITER,AND B 0650-01.5.011
                 #OPTIMIZED TAPE READ FOR FORMAT 12F6.0            B 0704-0791TVMEO
UTINES                     #TAPE READING AND WRITING SUBRO A 1401--IO-040
                 #QUADOCTAL TAPE READING PROGRAM                   B 0704-0221UATSQ
                    #TRAP * TAPE RECORD ANALYZER PRINT *           B 1401-01.4.019
*                 #650 TO 7070 TAPE RECORD CONVERSION * XXA15 B 7070-02.4.001
RTRAN           #  CONVERTS BCD TAPE RECORDS ACCORDING TO A FO B 0704-0495CVI02
AND AUTOCODER ASSEMBLY     #TAPE REPORT PROGRAM GENERATOR          B 1401-01.3.002
                   #CARD TO TAPE ROUTINE                           A 0650--UT-002
                   #COPY BCD TAPE ROUTINE                          B 0709-0889GDBCD
       #KEYS SEARCH BCD  LISTING TAPE ROUTINE                      B 0709-0921VGKEY
                     #CHECK TAPE SETTINGS                          B 0705-PG-004-0
MN CONVERTER.       #CARD TO TAPE SIMULATOR AND ROW TO COLU B 0704-0130RCTT
                   #CARD TO TAPE SIMULATOR.                        B 0709-0605WDCTS
                           #TAPE SOAP 2A                           A 0650--SP-202
                           #TAPE SORT 2                            A 0650--SM-402
                           #TAPE SORT 3                            A 0650--SM-403
               #   GENERALIZED TAPE SORTING ROUTINE                B 0704-0468CF006
NTERPRETIVE SYS REVISED BELL LAB TAPE SYS   #REVISED BELL LAB I B 0650-02.0.015
      #1401 ASSEMBLY ON THE 650 TAPE SYSTEM                        B 0650-01.1.013
  #MULTIPLE UTILITY PROGRAM FOR TAPE SYSTEMS                       A 1401--UT-039
                  #MULTIPLE TAPE TEST ROUTINE                      B 7090-1113APMTT
                    #SOCOTT TAPE TEST SYSTEM                       B 0705-SI-001-0
                      #1401 TAPE TO CARD PROGRAM                   B 1401-13.1.003
                           #TAPE TO CARD UTILITY PROGRAM           A 1401--UT-028
                      #READ TAPE TO CORE                           B 0704-0387CEI4H
  #LOAD BINARY CARD IMAGES FROM TAPE TO CORE AND DRUMS             B 0704-0395LL010
SIMULTANEOUS CARD TO TAPE AND/OR TAPE TO PRINTER                 # B 1401-13.1.010
TPOP *                     #TAPE TO PRINTER OR PUNCH * UC          B 1401-01.4.016
                           #TAPE TO PRINTER PROGRAM                A 1401--UT-026
                           #TAPE TO PRINTER/PUNCH ROUTINE          A 0650--UT-003
R                          #TAPE TO PRINTER/PUNCH SIMULATO B 0709-0651WDTPS
                           #TAPE TO TAPE COPY WITH CHANGES         B 0704-0425WBTTC
         #1620 5-CHANNEL TAPE TRANSLATION PROGRAM                  B 1620-01.6.014
T WHICH IS           #TO ASSIGN TAPE UNIT USAGE OTHER THAN THA B 7090-1199PEIBL
        # UPDATE SYMBOLIC PROGRAM TAPE USING SERIAL NUMBERS.       B 0709-1009WDSER
                   #CARD TO TAPE UTILITY PROGRAM                   A 1401--UT-027
                   #FORTRAN TAPE WRITE PROGRAM.                    B 0704-0899MEFOT
              #SELF LOADING TAPE WRITE PROGRAM.                    B 0704-0899METOU
                   #PROGRAM TAPE WRITER                            B 1401-13.1.008
              #SELF LOADING TAPE WRITING ROUTINE                   B 0704-0781WH004
              #SELF LOADING TAPE WRITING ROUTINE                   B 0704-0781WH004
AND/OR FORTRAN I TO SELF-LOADING TAPE 1                #FORTRAN II B 0704-0769TVF2T
FROM ASSEMBLY PROG  PRINT RECORD TAPE 40K  #FLOW CHART LISTING  B 0705-IB 0003
      #SIMULATION OF CARD OR TAPE 650 ON THE 7070                  B 7070-05.1.005
84 SIMULATION OF THE 714 CARD TO TAPE.                #72/84 AND 80/ B 0704-0676OR714
RAN-LOADING TO COPY MEMORY ON TO TAPE.             #INTERRUPT FORT B 0709-1164MWFOT
R SERIES AS ONE BINARY RECORD ON TAPE.             #WRITES A FOURIE B 0704-0788IBWFS
SCAN.                  #BCD TAPE-CARD READING FOR MULTIPLE B 0704-0904SISCA
                    #BINARY TAPE-TO-CARD SIMULATOR                 B 0704-0455BETCB
                   #CARD TO TAPE, BINARY                           B 0704-0425WBCTB
STRESS ANALYSIS OF FLANGE WITH A TAPERED HUB * CARD *    #S-100 B 1620-09.7.004
109 STRESS ANALYSIS OF A FLANGED TAPERED HUB * CARD *        #S- B 1620-09.7.005
  #DUMP STORAGE, CORE, DRUM, AND TAPES                             B 0704-0420CSDS1
#GENERAL MATRIX ABSTRACTION FROM TAPES                             B 0704-0367MBMTX
                   #REWIND TAPES                                   B 0704-0223CLMRT
  #DUMP STORAGE, CORE, DRUM, AND TAPES                             B 0704-0496CSDS2
                #UNLOAD ALL TAPES                                  B 7090-1175WDSTO
ENERATE 1401 T/P PROG. ON OUTPUT TAPES.          #704 PROGRAM TO G B 0704-1231TVTPP
N CURVE FITTING            #TAYLOR SERIES RATIONAL FUNCTIO B 7090-1150RLRAT
                 #1401 TCS * TAPE CONTROL SYSTEM *                 B 1401-01.4.006
SYSTEM TERRAIN DATA EDIT PROGRAM TD-1   #DIGITAL TERRAIN MODEL   B 0650-09.2.039
           #ACT-AUTOMATIC CHECKOUT TECHNIQUE                       B 1401-13.1.004
#TRANSPORTATION PROBLEM * DENNIS TECHNIQUE *                       B 7070-12.9.001
HASE II                 #SORT 54 TECHNIQUE OF MODIFICATION OF P B 0705-XE-001-0
G                          #TEMP-2 NUCLEAR-CODE ENGINEERIN B 0704-NUCLEAR
EL ELEMENTS NUCLEAR-CODE     # TEMPERATURE DISTRIBUTION IN FU B 0650-08.2.026
D                          #TEMPERATURE OF SATURATED LIQUI D 7090-1095WHTSL
D FROM ENTHALPY            #TEMPERATURE OF SATURATED LIQUI B 7090-1095WHTSH
     #TRANSIENT OR STEADY STATE TEMPERATURES                       B 7090-12380RTOS
TIONS                      #TEMPEST NUCLEAR-CODE CROSS-SEC B 7090-NUCLEAR
SECTIONS                   #TEMPEST-II NUCLEAR-CODE CROSS- B 7090-NUCLEAR
                   #ROADWAY TEMPLATE GENERATOR                     B 0650-09.2.078
                    #DESIGN TEMPLATE PROGRAM                       B 0650-09.2.032
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UTINE                          #9X9 TEN MILLISECOND MULTIPLY SUBRO B 1401-03.0.001
LETE GAMMA FUNCTION WITH POISSON TERM       #NORMALIZED INCOMP B 7090-1177URGAM
                            #ADDS A TERM TO A FOURIER SERIES.     B 0704-0788IBATF
      #CONVERTS A FOURIER SERIES TERM TO BCD FORM.                B 0704-0788IBCFT
  #COMBINES INDICES IN A FOURIER TERM.                            B 0704-0788IBCIF
           #FITTING TO SELECTED TERMS OF A GENERAL POLYNOMIAL     B 0704-1077GC000
   #DIGITAL TERRAIN MODEL SYSTEM TERRAIN DATA EDIT PROGRAM TD-1 B 0650-09.2.039
. INTERP. PROG. DA-2 1  #DIGITAL TERRAIN MODEL SYS 4 POINT POLY B 0650-09.2.062
ATA EDIT PROGRAM TD-1   #DIGITAL TERRAIN MODEL SYSTEM TERRAIN D B 0650-09.2.039
L ALIGNMENT PROGRAMS    #DIGITAL TERRAIN MODEL SYSTEM HORIZONTA B 0650-09.2.040
ALIGNMENT PROGRAMS      #DIGITAL TERRAIN MODEL SYSTEM VERTICAL  B 0650-09.2.041
RY EARTHWORK PROGRAM    #DIGITAL TERRAIN MODEL SYSTEM PRELIMINA B 0650-09.2.042
MOOTHING PROGRAM DA-3   #DIGITAL TERRAIN MODEL SYSTEM PROFILE S B 0650-09.2.063
                     #MATRIX LOOP TEST                            B 0704-0085CLMLP
LOW, UNDERFLOW, AND DIVIDE CHECK TEST                     #OVERF B 0704-0248CLOUD
TN/ AND /LEV/ WITH FLOATING TRAP TEST            #FORTRAN II /R B 0704-0848ARR/L
          #GENERAL PURPOSE BOARD TEST DECK                        A 0305--MI-004
                           #AUTO TEST GENERATOR * ATG *           A 7070--AT-083
                #NON-PARAMETRICAL TEST OF DISTRIBUTIONS.          B 0704-0815PFTNP
ACTOR * FOURTEEN O ONE AUTO CONT TEST OPTIMIZING ROUT *        #F B 1401-01.4.007
                   #MULTIPLE TAPE TEST ROUTINE                    B 7090-1113APMTT
                     #SOCOTT TAPE TEST SYSTEM                     B 0705-SI-001-0
       #PROCEDURE FOR AUTOMATIC TEST*PAT*                         A 7070--AT-082
       #TAPE FILE GENERATOR FOR TESTING                           A 7070--MI-084
URTEEN O ONE AUTOMATED SYSTEM OF TESTING *             #FAST * FO B 1401-01.4.004
 #PRINTING CONSTANT DECIMALS AND TESTING RANDOMNESS OF DECIMALS B 1401-11.0.004
                                #TEXAS ENGINEERING SUBROUTINES  B 0650-09.2.010
PUT             #PRINTER PLOT BCD TEXT GENERATOR FOR FORTRAN OUT B 0709-1118URPLO
#TO ASSIGN TAPE UNIT USAGE OTHER THAN THAT WHICH IS               B 7090-1199PEIBL
SSIGN TAPE UNIT USAGE OTHER THAN THAT WHICH IS               #TO A B 7090-1199PEIBL
                                #THERMAL ANALYZER                 B 0704-0677NA031
                                #THERMAL ANALYZER                 B 0704-0248CLTHA
                     #STATISTICAL THERMODYNAMIC PROPERTIES        B 0650-09.3.006
EAM AND WATER                  #  THERMODYNAMIC PROPERTIES OF ST B 0704-0428GSSTP
TER AND STEAM                   #THERMODYNAMIC PROPERTIES OF WA B 7090-1095WH005
BEHAVIOR OF  LIGHT HYDROCARBON M#THERMODYNAMIC PROPS AND PHASE  B 0650-09.3.002
UTTA INTEGRATION          #SECOND,THIRD,AND FOURTH ORDER RUNGE-K B 0704-1233AAINT
O 20D OR 20S.          #GIVEN X, THIS PROGRAM CALCULATES LN X T B 0704-0498CA004
OLE /AC,MQ,IRA,IRB,IRC,         #THIS SUBROUTINE SAVES THE CONS B 0704-0345ELSAV
OLE /AC,MQ,IRA,IRB,IRC,         #THIS SUBROUTINE SAVES THE CONS B 0704-0345ELSAV
                                #THREACS                          B 0650-02.1.012
RADIUS TURNS                    #THREE CENTER CURVES FOR SHORT  B 0650-09.2.020
S PROCEDURE.                    #THREE DIMENSIONAL LEAST SQUARE B 0704-0533CF009
Ξ                               #THREE DIMENSIONAL TICK-TACK-TO B 0650-11.0.002
ROGRAM, PROCESS PANEL, POST TRAC#THREE TRACE PROGRAMS, STORED P A 0305--AT-007
TKO NUCLEAR-CODE GROUP DIFFUSION THREE-DIMENSIONAL             # B 0704-NUCLEAR
UFO NUCLEAR-CODE GROUP DIFFUSION THREE-DIMENSIONAL             # B 0704-NUCLEAR
                                #THREE-POINT SOLUTION             B 0650-09.2.056
                                #TIC-TAC-TOE                      B 0705-EQ-009-0
                #THREE DIMENSIONAL TICK-TACK-TOE                  B 0650-11.0.002
#   LOGICAL MEMORY SORT, MINIMUM TIME                             B 0704-0468CF005
                   #HUMAN REACTION TIME DEMONSTRATION ROUTINE     B 0650-11.0.005
OGRAMS                          #TIME DOMAIN FILTERING OF SEISM B 0650-09.6.021
#SEASONAL ADJUSTMENT OF ECONOMIC TIME SERIES                      B 0650-06.0.041
ADJUSTMENT                      #TIME SERIES DECOMPOSITION AND  B 0704-0526TVTSD
ADJUSTMENT                      #TIME SERIES DECOMPOSITION AND  B 0704-0861ERTSD
ADJUSTMENT                      #TIME SERIES DECOMPOSITION AND  B 7090-1145ERTSD
                                #TIME SERIES ROUTING              B 0705-E2-002-0
                                #TIME SERIES TREND EQUATIONS      B 0650-09.2.049
F FORMAT STATEMENTS AT EXECUTION TIME.               # READING O B 0704-0732PFMOD
               #MOVING AVERAGES OF TIME-SERIES DATA               B 0704-0335NYMA1
                              #K TIMES UNIT MATRIX                B 0704-0085CLMKO
 OF THE BESSEL FUNCTIONS Y SUB K TIMES Z              #ALL ORDERS B 0709-0985RWBF8
RDERS OF BESSEL FUNCTION J SUB K TIMES Z OR I               #ALL O B 0709-0984RWBF7
   #POLYNOMIAL ROOT EXTRACTION * TIREX *                          B 7070-09.1.001
                                #TITLE, HALT AND SWITCH PROGRAM B 0705-DE-002-0
ON THREE-DIMENSIONAL            #TKO NUCLEAR-CODE GROUP DIFFUSI B 0704-NUCLEAR
                                #TOLERANCE SIMULATION PROGRAM    B 0650-10.2.002
                    #SQUARE ROOT, TOPLER METHOD                   B 7070-08.3.002
                          #SLOPE TOPOG PROGRAM                    B 0650-09.2.024
                           #HASH TOTAL                            A 1620--MI-015
   #MULTICOMPONENT DISTILLATION TOWER DESIGN CALCULATIONS         B 1620-09.3.002
                  #TAPE COMPARE * TPCMP *                         B 0705-NW-003-1
RATE MATRICES TO BE SOLVED BY NU TPL1                        #GENE B 0704-1110NUGEN
  #TAPE TO PRINTER OR PUNCH * UC TPOP *                           B 1401-01.4.016
&IND. ADD. CONV  #STROBIC-SKELLY TR. ROUT. WITH OPTION BR&TRANS B 1620-01.4.004
 LBL&TRAILER CKN            #GEN. TRA ROUTINE PROG TAPE OPR TAPE B 0705-SR-002-0
                      #TAPE LABEL,TRA,CHECK POINT ROUTINE         B 0705-SR-001-0
RED PROGRAM, PROCESS PANEL, POST TRAC#THREE TRACE PROGRAMS, STO A 0305--AT-007
                  #STORAGE HISTORY TRACE                          B 0704-0264ASAS4
                        #SELECTIVE TRACE                          B 1620-01.4.001
                             #FLOW TRACE                          A 1620--AT-013
                        #SELECTIVE TRACE                          A 1620--AT-014
                                #TRACE  & 1A SIMULATOR            B 1620-01.4.005
INDEXING REGISTER SIMULATOR WITH TRACE * FIRS#FLOATING PT. AND  B 0650-01.6.050
N MEMORY PROGRAM                #TRACE AND RECORD ALTERATIONS I B 0704-0395LL003
                                #TRACE INSTRUCTION ALTERATION   B 0704-1079NOTIA
OR 709                          #TRACE INSTRUCTION ALTERATION F B 0709-1090NOTIA
                             #FLOW TRACE PROGRAM                  B 0704-0767UASPO
UTPUT                           #TRACE PROGRAM FOR CARD INPUT/O B 1620-01.4.002
, PROCESS PANEL, POST TRAC#THREE TRACE PROGRAMS, STORED PROGRAM A 0305--AT-007
ES FLOW OF CONTROL          #BACK TRACE SUBROUTINE WHICH DESCRIB B 0704-0907NUBAC
         #704 SELECTIVE MONITOR TRACE SYSTEM.                     B 0704-0708WHSMT
         #704 SELECTIVE MONITOR TRACE.                            B 0704-0601WHSMT
             #SELECTIVE PROGRAM TRACE.                            B 0709-0605WDLC2
             #SELECTIVE PROGRAM TRACE.                            B 0709-0605WDLOC
                             #TRAP TRACE, GI TRAP.                B 0704-0593GITRA
                             #FLOW TRACER                         B 0650-01.4.002
                         #SNAPSHOT TRACER                         B 0704-0275NYSNA
                      #OPTICAL RAY TRACING                        B 0650-08.1.001
STMAN KODAK CON. EDISON TRANSFER TRACING                       #EA B 0705-EK 0003
                             #ROOT TRACING                        B 7090-1169RCRTR
CENTROIDS OVER A ROAD NETWORK   #TRACING A MIN. PATH BET. ZONE  B 0650-09.2.080
                              #RAY TRACING PROGRAM                B 0650-08C1.003
                                #TRACING ROUTINE                  B 0650-01.4.003
                        #SELECTIVE TRACING ROUTINE                B 0650-01.4.005
                          #GENERAL TRACING ROUTINE                B 0650-01.4.010
             #MODIFIED SYMBOLIC TRACING ROUTINE                   B 0650-01.4.011
                          #GENERAL TRACING ROUTINE                A 0650--AT-001
                          #PRINT 1 TRACING ROUTINE                B 0705-A0-001-0
            #ABBREVIATED PRINT 1 TRACING ROUTINE                  B 0705-A0-002-0
 INDEXING REGISTERS           #SYM TRACING ROUTINE FOR 650 SYSTEM B 0650-01.4.007
                                #TRAFFIC SUMMARY                  B 0650-09.2.076
             #FORECASTING ZONAL TRAFFIC VOLUMES                   B 0650-09.2.011
                              #RAY TRAJECTORY MIGRATION           B 0650-09.6.017
  #SIX DEGREE OF FREEDOM DYNAMIC TRAJECTORY PROGRAM               B 0704-0821LRSFD
OF SPECIAL CHAR   #MODS OF INTER TRANS * IT * COMPILER FOR USE  B 0650-02.1.002
EQU *   #STRIDE * SUBROUTINE FOR TRANS FROM REMING TO IBM DATA  B 1401-01.4.013
M CONE STGE COMPU      #MOD BELL TRANS PROG FOR 650-653 MAG DRU B 0650-02.1.011
D NU                          #THE TRANSCENDENTAL FUNCTIONS MU AN B 0704-0311GMMUF
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                            #MATRIX TRANSFER                      B 0704-0223CLMTA
 BINARY ABSOLUTE, CORRECTION AND TRANSFER                #LOADS B 0704-0449MI9SI
                       #GENERALIZED TRANSFER ANY ROUTINE          B 0705-PG-001-0
                           #GENERAL TRANSFER ANY ROUTINE          B 0705-E3-002-0
         #ABSOLUTE AND CORRECTION TRANSFER CARD LOADER.           B 0704-0673WH005
                          #EXTENDED TRANSFER FUNCTION             B 0704-0575GIGOT
                                   #TRANSFER FUNCTION             B 0704-0575GITRA
                    #TRANSIENT HEAT TRANSFER PROGRAM              B 0650-08.1.002
        #EASTMAN KODAK CON. EDISON TRANSFER TRACING               B 0705-EK 0003
     #APPROXIMATION OF FUTURE TRIP TRANSFERS                      B 0650-09.2.035
                     #INVERSE LAPLACE TRANSFORM, INVERT           B 7090-1125MLCLI
                            #LAPLACE TRANSFORMATION               B 0650-04.0.004
               #FORTRAN INPUT/OUTPUT TRANSFORMATION               B 0704-0809PFTES
E MULT. REGRESSION WITH VARIABLE TRANSFORMATIONS        #STEPWIS B 7090-1194ERMPR
M                                  #TRANSIENT HEAT TRANSFER PROGRA B 0650-08.1.002
ERATURES                           #TRANSIENT OR STEADY STATE TEMP B 7090-1238ORTOS
NS      #ELECTRICAL POWER SYSTEM TRANSIENT STABILITY CALCULATIO B 0650-09.4.001
                               #FOR TRANSIT SUBROUTINE PACKAGE    B 0650-01.6.040
                           #NY BOL1 TRANSITION                    B 0704-0216NYPLB
 COMMON.                           #TRANSLATE CARD IMAGE TO BCD IN B 0709-0778AEIBC
 FOR CHECKING OPERATIONS NEEDING TRANSLATING       #709 PROGRAM B 0709-0482GASPO
                            #MATRIX TRANSLATION A/O TRANSPOSITION  B 0650-01.6.031
               #1620 5-CHANNEL TAPE TRANSLATION PROGRAM           B 1620-01.6.014
                 #SOAP I TO SOAP II TRANSLATOR                    B 0650-01.6.016
                        #EDITOR AND TRANSLATOR                    B 0704-0267PKEDI
 #0705/7080 COBOL AND COMMERCIAL TRANSLATOR                       A 0705--PR-131
               #704 TO 709 SYMBOLIC TRANSLATOR                    B 0709-0557RL020
  #PERIPHERAL EQUIPMENT SYMBOLIC TRANSLATOR                       B 0709-0961PPPES
          #GENERALIZED ALGEBRAIC TRANSLATOR * GAT *               B 0650-02.1.007
OR THE 650              #INTERNAL TRANSLATOR * IT * A COMPILER F B 0650-02.1.001
                 #WOLONTIS INTERNAL TRANSLATOR * WIT *            B 0650-02.0.019
OUTINES                        #MAD TRANSLATOR AND ASSOCIATED SUBR B 0704-1101UMMAC
O SOAP RELOKS                      #TRANSLATOR AND OTHER FORMATS T B 0650-01.6.048
               #709/7090 COMMERCIAL TRANSLATOR COMPILER           A 7090--CT-921
70-PR-075*             #COMMERCIAL TRANSLATOR-PRELIMINARY *SEE 70 A 7070--CT-903
Y FACTORS                          #TRANSMISSION LOSSES AND PENALT B 1620-09.4.008
                #CEPTR NUCLEAR-CODE TRANSPORT                     B 0704-NUCLEAR
                 #FLIT NUCLEAR-CODE TRANSPORT                     B 0704-NUCLEAR
    #HERD-1,2, AND 3 NUCLEAR-CODE TRANSPORT                       B 0704-NUCLEAR
                 #PIMG NUCLEAR-CODE TRANSPORT                     B 0704-NUCLEAR
              #SIMPL-1 NUCLEAR-CODE TRANSPORT                     B 0704-NUCLEAR
              #SIMPL-2 NUCLEAR-CODE TRANSPORT                     B 0704-NUCLEAR
                  #SNG NUCLEAR-CODE TRANSPORT                     B 0704-NUCLEAR
               #TRIP-1 NUCLEAR-CODE TRANSPORT                     B 0704-NUCLEAR
               #MUFT 4 NUCLEAR-CODE TRANSPORT                     B 0704-NUCLEAR
                #RANCH NUCLEAR-CODE TRANSPORT                     B 0704-NUCLEAR
                 #SAIL NUCLEAR-CODE TRANSPORT                     B 7090-NUCLEAR
          #FORTRAN SN6 NUCLEAR-CODE TRANSPORT                     B 7090-NUCLEAR
E # A MULTIGROUP P3, THE NEUTRON TRANSPORT EQUATION NUCLEAR-COD B 0650-08.2.028
                               #704 TRANSPORTATION CODE.          B 0704-0726SCXPC
                                   #TRANSPORTATION PROBLEM        B 0650-10.1.003
OR HUNGARIAN METHOD            #THE TRANSPORTATION PROBLEM, FLOW- B 0704-0464IBTFL
                                   #TRANSPORTATION PROBLEM        B 0705-PG-006-0
T ADDRESSING                       #TRANSPORTATION PROBLEM-INDIREC A 1620--LM-017
S TECHNIQUE *                      #TRANSPORTATION PROBLEM * DENNI B 7070-12.9.001
 IBM 1620                          #TRANSPORTATION PROGRAM FOR THE B 1620-10.1.003
0                                  #TRANSPORTATION PROGRAM FOR 162 B 1620-10.1.005
                            #MATRIX TRANSPOSE                     B 0704-0085CLMTR
                     #SQUARE MATRIX TRANSPOSE ON ITSELF           B 0704-0432MUMTR
CED IN CORE          #SQUARE MATRIX TRANSPOSED ON ITSELF OR DISPLA B 0704-0661GDF02
                            #MATRIX TRANSPOSED ON ITSELF          B 0704-0290GEMTO
                     #SQUARE MATRIX TRANSPOSED ON ITSELF          B 0704-0290GESTO
          #MATRIX TRANSLATION A/O TRANSPOSITION                   B 0650-01.6.031
SSION ANALYSIS PROGRAMS RAP RAPA TRAP            #MULTIPLE REGRE B 0650-06.0.030
INT *                              #TRAP * TAPE RECORD ANALYZER PR B 1401-01.4.019
          #704-SAP FLOATING-PT. TRAP MATRIX DIAGONALIZATION       B 0704-0705MIHDI
P SCOOP/                           #TRAP OCTAL MEMORY PRINT - /TRA B 0704-0278UASPO
                  #FLOATING POINT TRAP ROUTINE                    B 0704-0652RWFT2
                  #FLOATING POINT TRAP ROUTINE                    B 0704-0462SCFPT
CODED.            #FLOATING  POINT TRAP ROUTINE  704 FORTRAN SAP  B 0704-1071NUEFM
                         # FLOATING TRAP SIMULATION.              B 0704-0735PFMCF
II /RTN/ AND /LEV/ WITH FLOATING TRAP TEST              #FORTRAN  B 0704-0848ARR/L
                                   #TRAP TRACE, GI TRAP.          B 0704-0593GITRA
          #704-SAP FLOATING-POINT TRAP UNDERFLOW CORRECTION       B 0704-0705MIFLT
    #704-FORTRAN II FLOATING-PT. TRAP UNDERFLOW CORRECTION        B 0704-0705MIFLT
                  #TRAP TRACE, GI TRAP.                           B 0704-0593GITRA
                   #709 VIPP BUG TRAP.                            B 0709-1137DW9DU
                 #INTEGRAL EVAL., TRAPEZ. RULE /EQU. INTERVALS/   B 0704-0116CLINT
QUAL INTERVALS/           #N-STRIP TRAPEZOIDAL RULE INTEGRATION/E B 0704-0931PKMTZ
                #LAND AREA - SURVEY TRAVERSE                      B 0650-09.2.054
                            #SURVEY TRAVERSE                      B 0650-09.2.001
N          #REVISED TRAVERSE AND TRAVERSE ADJUSTMENT COMPUTATIO B 0650-09.2.015
                                   #TRAVERSE ADJUSTMENT           B 0650-09.2.083
RD *                               #TRAVERSE ANALYSIS PROGRAM * CA B 1620-09.2.006
PE *                               #TRAVERSE ANALYSIS PROGRAM * TA B 1620-09.2.007
M                                  #TRAVERSE AND COORDINATE PROGRA B 0650-09.2.021
ENT                        #REVISED TRAVERSE AND HORIZONTAL ALIGNM B 0650-09.2.084
NT COMPUTATION             #REVISED TRAVERSE AND TRAVERSE ADJUSTME B 0650-09.2.015
                            #SURVEY TRAVERSE PROGRAM              B 0650-09.2.027
                                   #TREE OUTPUT TO FREEWAY INPUT  B 0650-09.2.082
                                   #TREND ANALYSIS AND PREDICTION  B 0650-09.2.050
                       #TIME SERIES TREND EQUATIONS               B 0650-09.2.049
TRACT SQUARE SYMMETRIC MATRIX TO TRIANGULAR FORM.          #CON B 0704-0460MICNT
DETERMINANT EVALUATOR FOR NEARLY TRIANGULAR MATRICES          # B 0704-0635RWDET
MMETRIC FORM.              #EXPAND TRIANGULAR MATRIX TO SQUARE SY B 0704-0460MIEXA
SUBROUTINE                 #NEARLY TRIANGULARIZATION OF A MATRIX  B 0704-0635RWNTR
                                   #TRICOM II                     B 1401-01.4.005
INE                                #TRIGONOMETRIC FUNCTION SUBROUT B 7070-08.1.007
             #2DT A TWO-DIMENSIONAL TRIM ROUTINE                  B 0650-10.3.003
                  #CONTOUR CHART OF TRIP DESIRES                  B 0650-09.2.016
            #APPROXIMATION OF FUTURE TRIP TRANSFERS               B 0650-09.2.035
                                   #TRIP-1 NUCLEAR-CODE TRANSPORT  B 0704-NUCLEAR
                            #VECTOR TRIPLE CROSS PRODUCT          B 0709-0885VGVPR
                                   #TRIPLE INTEGRATION SUBROUTINE  B 0704-0368NA276
CKAGE                              #TRIPLE PRECISION ARITHMETIC PA B 0704-0378CA001
                                   #TRIPLE PRECISION ARITHMETIC   B 0704-0481CA004
METIC PACKAGE                      #TRIPLE PRECISION COMPLEX ARITH B 0704-0546CA005
E ROOT                             #TRIPLE PRECISION COMPLEX SQUAR B 0704-0565CA005
OUTINE                             #TRIPLE PRECISION EXPONENTIAL R B 0704-0565CA004
                                   #TRIPLE PRECISION OUTPUT       B 0704-0378CA002
                                   #TRIPLE PRECISION SQUARE ROOT  B 0704-0481CA003
                                   #TRIVARIATE TABLE LOOK-UP      B 0704-0452SCTRI
           #ESTIMATION FROM DOUBLY TRUNCATION SAMPLES             B 0704-0878BEMSD
                     # CHEBYSHEV TRUNCATION SYSTEM                B 0704-1008IBCTR
UNDANCY PROGS FOR INDERTERMINATE TRUSS ANAL  #CONNECTOR AND RED B 0650-09.2.007
                                   #TRUSS ANALYSIS                B 0650-09.2.006
NE LOADER FOR COL. BIN. ABS. AND TSF. CARDS              #ON-LI B 0704-1012ORCBL
                               #WB TSG-1 NUCLEAR-CODE ENGINEERING B 0704-NUCLEAR
            #GENERAL CATHODE RAY TUBE COUPLE SUBROUTINE.          B 0704-0439NA029
 SIX COLUMN FRACTION CATHODE RAY TUBE DISPLAY              #MURA B 0704-0310MUSCP
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#MURA CATHODE RAY TUBE POINT PLOTTER B 0704-0321MUSCP
#TURBO NUCLEAR-CODE BURNUP B 0704-NUCLEAR
G #TURF-6 NUCLEAR-CODE ENGINEERIN B 0704-NUCLEAR
E CENTER CURVES FOR SHORT RADIUS TURNS #THRE B 0650-09.2.020
O #TUT-T5 NUCLEAR-CODE MONTE CARL B 0704-NUCLEAR
ED IN 305 BULLETIN NO. 1 #TWELVE UTILITY PROGRAMS OUTLIN A 0305--UT-008
#TWENTY-GRAND NUCLEAR-CODE B 7090-NUCLEAR
#MATHEMATICAL PROGRAMMING SYSTEM TWO B 0709-1037SCM2
MAST •MINNEAPOLI ASSEMBLY OF SPS TWO • # B 1401-01.1.005
FULL MINNEAPOLIS ASSEMBLY OF SPS TWO • #FULL MAST • B 1401-01.1.006
ER #TWO CARD BINARY AND OCTAL LOAD B 0704-0381ASAS5
#ADDS OR SUBTRACTS TWO FOURIER SERIES. B 0704-0788IBASF
#MULTIPLIES TWO FOURIER SERIES. B 0704-0788IBMFS
#TWO MACHINE LOADER. B 0709-0709RWTML
.RAINFALL DATA #FITTING DATA TO TWO PARA. GAMMA DIST-SPEC REF B 0650-06.0.051
#SPS TWO PASS FOR CARDS A 1620--SP-009
#SPS TWO PASS FOR PAPER TAPE A 1620--SP-008
FFERENTIAL EQU. SOLVER #TWO POINT BOUNDRY CONDITION DI B 0704-0238ATTPI
#WAVE RECORD ANALYSIS OF TWO SIMULTANEOUS RECORDS B 0704-0574CSTUK
&CORRELATION #TWO VARIABLE LINEAR REGRESSION B 0650-06.0.054
#ITERATION, ONE OR TWO VARIABLES B 0704-0433MCITR
URE NUCLEAR-CODE GROUP DIFFUSION TWO-DIMENSIONAL #C B 0704-NUCLEAR
Q-2 NUCLEAR-CODE GROUP DIFFUSION TWO-DIMENSIONAL #PD B 0704-NUCLEAR
Q-3 NUCLEAR-CODE GROUP DIFFUSION TWO-DIMENSIONAL #PD B 0704-NUCLEAR
REM NUCLEAR-CODE GROUP DIFFUSION TWO-DIMENSIONAL # B 0704-NUCLEAR
-90 NUCLEAR-CODE GROUP DIFFUSION TWO-DIMENSIONAL #PDQ2 B 7090-NUCLEAR
ATION CALCULATIONS. #TWO-DIMENSIONAL MESH FOR RELAX B 0704-0725PKMER
#2DT A TWO-DIMENSIONAL TRIM ROUTINE B 0650-10.3.003
#COMPUTATION OF A MINIMUM TWO-LEVEL AND-OR SWITCHING B 0704-0787PKMIN
#IBM 650 PROGRAM FOR ANALYSIS OF TWO-LEVEL FACTORIAL DESIGNS B 0650-07.0.019
TOR # TYDAC /PSEUDO COMPUTER/ SIMULA B 0704-0441CSTYD
STRAP 4000 #SOAP TYPE OPTIMAL ASSEMBLY PROGRAM B 0650-01.1.012
#PYRAMID OF RANOMAN U B 0650-07.0.013
#TAPE TO PRINTER OR PUNCH • UC TPOP • B 1401-01.4.016
ON THREE-DIMENSIONAL #UFO NUCLEAR-CODE GROUP DIFFUSI B 0704-NUCLEAR
#GENERALIZED MERGE PROGRAM FOR UNBLOCKED RECORDS B 1401-01.2.002
CYLINDRICAL GEO NUCLEAR-CODE # UNCLE 1 DIFFUSION EQUATION IN B 0650-08.2.010
%X, Y¤ SPACE NUCLEAR-CODE # UNCLE 11 DIFFUSION EQUATION IN B 0650-08.2.011
ONE DIMENSION NUCLEAR-CODE #UNCLE 3 DIFFUSION EQUATION IN B 0650-08.2.012
#UNCLE 4 NUCLEAR-CODE B 0650-08.2.018
#SORT 80 UNDER SCS 80 A 7080--SM-114
#DECIMAL OUTPUT PROGRAM UNDER SENSE LIGHT CONTROL B 0704-0206NYOUT
#INPUT PROGRAM UNDER SENSE LIGHT CONTROL B 0704-0206NYINP
#INPUT PROGRAM UNDER SENSE LIGHT CONTROL B 0709-1025WPK06
#DECIMAL OUTPUT PROGRAM UNDER SENSE LIGHT CONTROL B 0709-1026WPK07
#INPUT PROGRAM UNDER SENSE SWITCH CONTROL B 0704-0206NYINP
#704-SAP FLOATING-POINT TRAP UNDERFLOW CORRECTION B 0704-0705MIFLT
704-FORTRAN II FLOATING-PT. TRAP UNDERFLOW CORRECTION # B 0704-0705MIFLT
ST #OVERFLOW, UNDERFLOW, AND DIVIDE CHECK TE B 0704-0248CLOUD
#SMOOTH AND DIFFERENTIATE UNEQUALLY SPACED DATA POINTS B 0704-0331CLSMD
#NUMERICAL INTEGRATION OF UNEQUALLY SPACED POINTS B 0704-1157TU900
D SURFACE FITTING ON EQUALLY FOR UNEQUALLY SPACED PT #CURVE AN B 0650-06.0.021
ABLE #EXTREMUM OF UNIMODAL FUNCTIONS OF ONE VARI B 0704-0878BEMIM
#K TIMES UNIT MATRIX B 0704-0085CLMKO
#UNIT OPERATIONS SIMULATOR B 0650-09.6.022
CH IS #TO ASSIGN TAPE UNIT USAGE OTHER THAN THAT WHI B 7090-1199PEIBL
ROC.ENG. INTER CODING SYS #UNIV OF HOUSTON ASSEMBLR FOR P B 0650-02.0.017
ON #UNIVARIATE POLYNOMIAL EVALUATI B 0704-0375UAUPE
ON FOR FORTRAN I PROGRAMS #UNIVARIATE POLYNOMIAL EVALUATI B 0704-0375UAUPE
#FLOATING POINT UNIVARIATE SEARCH B 0704-0692JPTAR
ENSING ROUTINE #UNIVERSAL MEMORY DUMP AND COND B 0650-01.6.028
#BUMP, BOSTON UNIVERSITY MATRIX PROGRAM B 0650-02.1.006
#UNLOAD ALL TAPES B 7090-1175WDSTO
#LOAD AND UNLOAD DISK FILE 1 A 0650--UT-103
#LOAD 2 UNLOAD DISK FILE 2 A 0650--UT-104
ARITHMETIC PACKAGE 1. # UNNORMALIZED DOUBLE-PRECISION B 0704-0614NUUDP
ARITHMETIC PACKAGE 2. # UNNORMALIZED DOUBLE-PRECISION B 0704-0614NUUDP
ER SERIES INDEX WORDS, #UNPACKS THE INDICES FROM FOURI B 0704-0788IBSPF
N INDEX WORD. #UNPACKS UP TO 6 INDICES FROM A B 0704-0788IBUPF
#BCD TO BINARY CONVERSION OF UNRESTRICTED INTEGERS. B 0704-0423BSDCH
#BINARY TO BCD CONVERSION OF UNRESTRICTED INTEGERS. B 0704-0423BSFRE
#SQUARE TABLE LOOK UP B 0705-AF-013-0
#N DIMENSIONAL TABLE LOOK UP B 7090-1204MACUR
#CHI SQUARE FOR UP TO 10X10 CONTIGENCY TABLE B 0650-06.0.015
WORD. #UNPACKS UP TO 6 INDICES FROM AN INDEX B 0704-0788IBUPF
SING SERIAL NUMBERS. # UPDATE SYMBOLIC PROGRAM TAPE U B 0709-1009WDSER
#SHARE CATALOG UPDATER, LISTER. 1401 PROGRAM. B 0704-1224UCSCU
#RELOCATING BINARY LOADER, UPPER B 0704-0525PKCSB
#RELOCATING BINARY LOADER,UPPER B 0709-0563SE9UR
#LINEAR PROGRAMMING WITH UPPER BOUNDS ON VARIABLES B 0704-0973RSBP1
#709 FOUR CARD ROW BINARY-OCTAL UPPER CARD LOADER B 0709-0819GDBOC
#ONE CARD UPPER LOAD B 0705-EK 0002
#SIX CARD UPPER LOADER B 0704-1183GDCOR
#ABSOLUTE BINARY UPPER LOADER ONE CARD B 0709-1102SE9DU
ONE CARD ABSOLUTE BINARY UPPER LOADER. B 0704-0473CSBUL
R /ONE CARD/ #MURA UPPER RELOCATABLE BINARY LOADE B 0704-0432MURBL
#H.Q. USAF TAPE INPUT/OUTPUT PACKAGE B 0705-AF-003-1
#TO ASSIGN TAPE UNIT USAGE OTHER THAN THAT WHICH IS B 7090-1199PEIBL
#SORT 54 MODIFICATION TO USE FILE SIZE B 0705-XE-002-0
INTER TRANS • IT • COMPILER FOR USE OF SPECIAL CHAR #MODS OF B 0650-02.1.002
#80 SERIES UTILITIES A 0705--UT-056
#709 UTILITIES A 0709--UT-068
#FILE UTILITIES A 1401--UT-051
#DISK UTILITIES A 1410--UT-107
#INDIVIDUAL CARD/TAPE UTILITIES A 1410--UT-106
#RAMAC UTILITIES A 7070--UT-080
#7070 UTILITIES A 7070--UT-081
#7080 UTILITIES A 7080--UT-089
GE #7072 UTILITIES FOR ADDITIONAL STORA A 7072--UT-085
SUDS • #STANDARDIZED UTILITY DECK OF SUBROUTINES • B 0650-03.1.034
#ERL GENERAL UTILITY PROGRAM B 0650-01.6.035
#CARD TO TAPE UTILITY PROGRAM A 1401--UT-027
#TAPE TO CARD UTILITY PROGRAM A 1401--UT-028
#AUTOMATIC SOAP CONVERSION UTILITY PROGRAM • ASCUP • B 0650-01.6.045
MS #MULTIPLE UTILITY PROGRAM FOR TAPE SYSTE A 1401--UT-039
#CARD SYSTEMS UTILITY PROGRAMS A 1401--UT-001
#1401-1009 UTILITY PROGRAMS A 1401--UT-066
05 BULLETIN NO. 1 #TWELVE UTILITY PROGRAMS OUTLINED IN 3 A 0305--UT-008
#MISCELLANEOUS UTILITY ROUTINES B 0650-01.6.023
#LADPAC UTILITY ROUTINES B 0650-01.6.039
#UTILITY SUBROUTINES B 0650-01.6.043
#PAT UTILITY SYSTEM • 10/20K • A 1410--AT-104
#PAT UTILITY SYSTEM • 40K • A 1410--AT-105
AIN OF ONE INVESTMENT #PRES VAL-RATE OF RET-PV2A-FINITE CH B 0650-07.0.018
#VALADON 1/CDC5/CD A 0650--MI-107
VALPROD NUCLEAR-CODE B 0650-08.2.013
A • • INF. CHAIN MACH • #PRESENT VALUE AND RATE OF RETURN • PVI B 0650-07.0.017
OPY SPECIFIC VOLUME OF SATURATED VAPOR #ENTHALPY ENTR B 7090-1095WHHSV
#ROOTS OF A FUNCTION OF A REAL VARIABLE B 0650-07.0.002
MUM OF UNIMODAL FUNCTIONS OF ONE VARIABLE #EXTRE B 0704-0878BEMIM

#SORT 57 BLOCKED VARIABLE B 0705-CU-001-1
#MURA VARIABLE COLUMN FRACTION PRINT B 0704-0357MUPRF
#MURA VARIABLE COLUMN FRACTION PRINT B 0704-0357MUPRF
T # A VARIABLE FIELD PERIPHERAL INPU B 0704-0209NOVNP
ROUTINE #VARIABLE FIELD SQUARE ROOT SUB B 1620-03.0.001
D #VARIABLE FIXED FORMAT CARD REA B 0704-0381ASAS5
G PACKAGE EQUIVALENCE #VARIABLE INFORMATION PROCESSIN B 0704-0856CVVIP
G PACKAGE #VARIABLE INFORMATION PROCESSIN B 0704-0856CVVIP
G PACKAGE #709 VARIABLE INFORMATION PROCESSIN B 0709-1135BWVIP
#709/7090 GENERALIZED VARIABLE LENGTH RECORD SORT B 0709-1159MDSOR
RELATION #TWO VARIABLE LINEAR REGRESSION&COR B 0650-06.0.054
#VARIABLE METRIC MINIMIZATION B 0704-0980ANZ01
#STEPWISE MULT. REGRESSION WITH VARIABLE TRANSFORMATIONS B 7090-1194ERMPR
#MOVE VARIABLE, GROUPED FIELDS B 0705-PG-010-0
#MULTIPLE CORRELATION FOR 50 VARIABLES B 0650-06.0.007
PROGRAMMING WITH UPPER BOUNDS ON VARIABLES #LINEAR B 0704-0973RSBP1
TION ROUTINE FOR A FUNCTION OF N VARIABLES #MINIMIZA B 0704-0804RWMIN
#ITERATION, ONE OR TWO VARIABLES B 0704-0433MCITR
#CORRELATING PROGRAM-UP TO 30 VARIABLES B 1620-06.0.009
#GENERAL ANALYSIS OF VARIANCE B 0650-06.0.036
#FOUR WAY ANALYSIS OF VARIANCE B 0650-06.0.053
#ANALYSIS OF VARIANCE B 0704-0421AAANV
#GENERAL ANALYSIS OF VARIANCE B 0704-0491RWAV2
#LATIN SQUARES ANALYSIS OF VARIANCE B 0704-0491RWAV3
#GENERAL ANALYSIS OF VARIANCE B 0704-0776RWAV4
#LATIN SQUARES ANALYSIS OF VARIANCE B 0704-0776RWAV5
#ANALYSIS OF VARIANCE B 1620-06.0.010
PLICATED KBY #ANALYSIS OF VARIANCE FOR PART. OR SING. RE B 0650-06.0.063
-ORTH/D & STAT. DESIGN #ANALY OF VARIANCE OR COVARIANCE FOR NON B 0650-06.0.059
UST MEANS PROGRAM #ANALYSIS OF VARIANCE OR COVARIANCE AND ADJ B 0650-06.0.034
#ANALYSIS OF VARIANCE OR COVARIANCE B 7090-1212MFAOV
#ANALYSIS OF VARIANCE PROGRAM B 0650-06.0.004
#GENERAL PURPOSE ANALYSIS OF VARIANCE PROGRAM B 0709-0933NOANA
50 #AN ANALYSIS OF VARIANCE PROGRAM FOR THE IBM 6 B 0650-06.0.044
BERS #ANALYSIS OF VARIANCE,DISPROP. SUBCLASS NUM B 0650-06.0.058
#FLOATING POINT /N/ VARIATE PROBABILITY INTEGRAL B 0704-0794RWNP3
#NORMALIZED VARIMAX FACTOR ROTATION B 7070-11.3.008
ECLIPTIC ROTATION-ROTATE A GIVEN VECTOR #EQUATOR- B 0709-0953RWROB
ULTIPLICATION #VECTOR BY SYMMETRICAL MATRIX M B 0650-05.2.014
#VECTOR DOT PRODUCT B 0704-0223CLMVP
650#LINEAR PRG. FORCED INVERSION VECTOR PART. CODE FOR AUGMENT B 0650-10.1.010
#VECTOR TRIPLE CROSS PRODUCT B 0709-0885VGVPR
#TO ROTATE A GIVEN VECTOR X FROM THE EQUINOX OF B 0709-0945RWREQ
#CHARACTERISTIC ROOTS AND VECTORS B 0704-0148NYCRV
#LATENT ROOTS AND VECTORS OF A MATRIX B 0650-05.2.016
AR SPECTROSCOPY LATENT ROOTS AND VECTORS OF A MATRIX #MOLECUL B 0650-05.2.024
ATRIX. #EIGENVALUES AND VECTORS OF A REAL, SYMMETRIC M B 0704-0460MIHDI
VEL. #LEAST SQ. DETER. FOR A VEL FUNCT. WITH LINEAR INC. OF B 0650-09.6.016
A VEL FUNCT. WITH LINEAR INC. OF VEL. #LEAST SQ. DETER. FOR B 0650-09.6.016
ISMOGRAM SYN FORM CONT. INTERVAL VELOCITY • CVL • #SE B 0650-09.6.018
T/D DATA #LEAST SQ. DETER. OF VELOCITY FUNCTION FOR REFRACT. B 0650-09.6.020
MOVEOUT COMP. FOR LINEAR INC. OF VELOCITY WITH DEPTH #NORMAL B 0650-09.6.019
#PERIPHERAL CARD VERIFIER B 0704-0262NYPCV
#PERIPHERAL LINE PRINTER VERIFIER B 0704-0262NYPLV
OT, FLOATING-POINT, FORTRAN LIB. VERSION #SQUARE RO B 0704-0399MISRT
INARY TAPE CORRECTOR. NON-SYSTEM VERSION #B B 0709-1055DIBTC
EMENT SIMULATOR7070 FULL FORTRAN VERSION #INVENTORY MANAG B 7070-12.1.001
#SD 1402 • SEARCH PROGRAM-CARD VERSION • B 1401-01.4.020
#ARCTAN A/B, FORTRAN II VERSION,SAP CODED. B 0704-0603WH005
#DIGITAL TERRAIN MODEL SYSTEM VERTICAL ALIGNMENT PROGRAMS B 0650-09.2.041
TINES TO READ A CHRONO-LOG CLOCK VIA 716 ECHO ENTRY #ROU B 0704-0843ORCLK
#709 VIPP BUG TRAP. B 0709-1137BW9BU
#VIPP INSERT LEADING BLANKS. B 0704-0895TAVIL
#VIPP MERGER. B 0709-1136BWVIP
GENERAL PURPOSE #VIPP MERGER. SECOND PHASE OF A B 0704-0926TAVIP
#709 VIPP SORTER. B 0709-1136BWVIP
GENERAL PURPOSE #VIPP SORTER. FIRST PHASE OF A B 0704-0926TAVIP
#709 VIPP SYNONYM DECK B 0709-1137BW9SY
#VISCOSITY OF LIQUID WATER B 7090-1095WHVIS
#VISCOSITY OF STEAM B 7090-1095WHVIS
LINK,MOVE,OPHLT,SEQCK,SIGN,STRIP,VMCTR #GSEL,FMCTR, B 0705-BW-002-0
RAMAC #CUT & FILL-EARTHWORD VOLUME CALCULATIONS ON THE 305 B 0305-09.2.001
#GRID SYSTEM VOLUME DETERMINATION B 0650-09.6.009
#SPECIFIC VOLUME OF COMPRESSED LIQUID B 7090-1095WHVCL
#SPECIFIC VOLUME OF SATURATED LIQUID B 7090-1095WHVSL
#ENTHALPY ENTROPY SPECIFIC VOLUME OF SATURATED VAPOR B 7090-1095WHHSV
#ENTHALPY ENTROPY SPECIFIC VOLUME OF SUPERHEATED STEAM B 7090-1095WHHSS
#FORECASTING ZONAL TRAFFIC VOLUMES B 0650-09.2.011
CYLINDRICAL TANKS #LIQUID VOLUMES IN FLAT END HORIZONTAL B 0650-09.7.005
#LOADOMETER W-6 TABLE B 0650-09.2.037
#W-6TABLE SUMMARY B 0650-09.2.071
UM SOLU OF ORDINARY DIFFERENTIAL W/AUTO ERROR ANALYSIS #N B 0650-04.0.012
DEC INTERP SYS 650 MAG DRUM CALC W/IMMED ACCESS BELL 111 #FL B 0650-02.0.021
#RANDOM WALK •SIMULATION• B 1620-11.0.009
#FN II ERROR WALK-BACK SUBROUTINE B 0704-0848ARFER
IFFUSION ONE-DIMENSIONAL #WANDA 2,3 NUCLEAR-CODE GROUP D B 0704-NUCLEAR
FUSION ONE-DIMENSIONAL #WANDA-4 NUCLEAR-CODE GROUP DIF B 0704-NUCLEAR
ODYNAMIC PROPERTIES OF STEAM AND WATER # THERM B 0704-0428GSSTP
#VISCOSITY OF LIQUID WATER B 7090-1095WHVIS
#THERMODYNAMIC PROPERTIES OF WATER AND STEAM B 7090-1095WH005
#DISTRIBUTION OF WATER FLOW IN A PIPE NETWORK B 1620-09.7.001
#HARDY-CROSS SOLUTION OF WATER FLOW NETWORK B 0650-09.7.003
NEUTRON ENERGY SPECTRA IN WATER NUCLEAR-CODE B 0650-08.2.021
RS #WATER SURFACE PROFILE PARAMETE B 0650-09.2.051
#WATERWAY COMPUTATIONS B 1620-09.2.004
MULTANEOUS RECORDS #WAVE RECORD ANALYSIS OF TWO SI B 0704-0574CSTUK
#FOUR WAY ANALYSIS OF VARIANCE B 0650-06.0.053
#3 WAY MERGE PROGRAM B 0704-0427NSMRG
ING #WB TSG-1 NUCLEAR-CODE ENGINEER B 0704-NUCLEAR
709 FORTRAN. # WDPC BUFFERED I/O PACKAGE FOR B 0709-0978WDIOF
#WEGSTEIN ITERATION B 0704-1234AAWEG
#AUTOMATIC MINIMUM WEIGHT DESIGN OF STEEL FRAMES B 0650-09.2.052
AL APPROXIMATION #WEIGHTED LEAST SQUARE POLYNOMI B 0650-06.0.009
#THE BUCKLEY-LAVERETT WELGE CALCULATIONS B 0650-09.6.010
#WELLBORE DEVIATION RECORD B 0650-09.6.001
R ENTROPY IN LIQUID SUPERHEAT OR WET REGIONS #ENTHALPY O B 7090-1095WHSSI
ANALYSIS #THE WHERRY-WINER METHOD OF FACTOR B 0650-06.0.028
L #BACK TRACE SUBROUTINE WHICH DESCRIBES FLOW OF CONTRO B 0704-0907NUBAC
TAPE UNIT USAGE OTHER THAN THAT WHICH IS #TO ASSIGN B 7090-1199PEIBL
#WHIRLAWAY NUCLEAR CODE B 7090-NUCLEAR
#650 SOAP CONTROL PANEL WIRING SUGGESTION B 0650-12.0.006
-DECIMAL FUNCTION SUBROUTINES #WISCONSIN FUNDAMENTAL FLOATING B 0650-03.1.032
#WOLONTIS INTERNAL TRANSLATOR • WIT • B 0650-02.0.019
WIT • #WOLONTIS INTERNAL TRANSLATOR • B 0650-02.0.019
#HOLLERITH WORD GENERATOR B 0709-1219WDHOL
#KEY WORD IN CONTEXT B 0704-0884PKKWI
LGEBRAIC. MULTIWORD KEYS. /WHOLE WORD KEYS ONLY/ #SORT, A B 0704-0570ORSRT
#24 WORD PER CARD BINARY LOADER B 0704-0263MUL8L
50 FORTRAN MODIFIED FOR THE 4000 WORD 650 #6 B 0650-02.1.008
KS UP TO 6 INDICES FROM AN INDEX WORD. #UNPAC B 0704-0788IBUPF

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GEBRAIC. KEY AND ITEM LENGTH - 1 WORD. CLOSED.        #SORT, AL B 0704-0570ORSRT
GEBRAIC. KEY AND ITEM LENGTH - 1 WORD. OPEN.          #SORT, AL B 0704-0570ORSRT
          #READS THE SORTED KEY WORDS FROM NC 139               B 0704-1144NC014
       #PROGRAM TO SORT THE KEY WORDS FROM NC138                B 0704-1144NC013
NDICES FROM FOURIER SERIES INDEX WORDS,          #UNPACKS THE I B 0704-0788IBSPF
                                 #WRITE BSS LOADER STORAGE MAP  B 0704-0830MISTP
                                 #WRITE BSS LOADER STORAGE MAP  B 0704-0830MISTP
                                 #WRITE CORE IMAGE ON TAPE      B 0704-0830MIWTP
                            #READ WRITE DRUM.                   B 0704-0647NPRWD
                    #FORTRAN TAPE WRITE PROGRAM.                B 0704-0899MEFOT
               #SELF LOADING TAPE WRITE PROGRAM.                B 0704-0899METOU
RY INFO ON TAPE               #TO WRITE 2 DIMENSIONAL ARRAY BINA B 0704-0910NUWTB
AND SIGN ON CRT                  #WRITE 6-DIGIT DECIMAL INTEGER  B 0704-0362NA117
IRED-122 CELLS          #FORTRAN WRITE-UP OF RW REQX.SPACE REQU B 0709-0946RWFEQ
         #ERROR CORRECTION CODE WRITER                          B 0709-0938VGWEC
                    #PROGRAM TAPE WRITER                        B 1401-13.1.008
           #TAPE PROGRAM FINDER,WRITER,AND SALVAGE              B 0650-01.5.011
 BINARY RECORD ON TAPE.          #WRITES A FOURIER SERIES AS ONE B 0704-0788IBWFS
               #SELF LOADING TAPE WRITING ROUTINE               B 0704-0781WH004
               #SELF LOADING TAPE WRITING ROUTINE               B 0704-0781WH004
                #TAPE READING AND WRITING SUBROUTINES           A 1401--IO-040
          #TO READ AND CHECK NU WTB-WRITTEN RECORDS             B 0704-0911NURTB
                  #SINH X AND COSH X                            B 0650-03.1.009
#ARCSIN X, ARCCOS X, SQUARE ROOT X                              B 0650-03.1.028
                         #CUBE ROOT X                           B 0650-03.1.029
                       #NTH ROOT OF X                           B 7070-08.3.003
                            #ARCTAN X                           B 7070-08.1.001
                       #SQUARE ROOT X                           B 7070-08.3.001
                            #EN * X * SUBROUTINE                B 0650-07.0.008
                           #KIN * X * SUBROUTINE                B 0650-07.0.009
                            #SINH X AND COSH X                  B 0650-03.1.009
      #TO ROTATE A GIVEN VECTOR X FROM THE EQUINOX OF           B 0709-0945RWREQ
                          #ARCSINE X SUBROUTINE FOR THE IBM 7070 B 7070-08.1.006
EN X, THIS PROGRAM CALCULATES LN X TO 20D OR 20S.          #GIV B 0704-0498CA004
NVECTORS OF THE PRODUCT OF A AND X.        #EIGENVALUES AND EIGE B 0704-0652RWEG2
RY ARITH.        #NORMALIZED E TO X-EXTENDED RANGE FLOATING BINA B 0704-0370RS013
                            #ARCSIN X, ARCCOS X, SQUARE ROOT X   B 0650-03.1.028
                 #ARCSIN X, ARCCOS X, SQUARE ROOT X             B 0650-03.1.028
X TO 20D OR 20S.           #GIVEN X, THIS PROGRAM CALCULATES LN  B 0704-0498CA004
 FORTRAN * FUNCTION              #XRANF * SUBROUTINE FOR A BASIC B 7070-01.9.002
         #IFS * AFTER SETTING * XX                              B 0705-PG-005-0
TO 7070 TAPE RECORD CONVERSION * XXA15 *                  #650  B 7070-02.4.001
                                 #XY SUBROUTINE                 B 7070-08.1.018
L CRDERS OF THE BESSEL FUNCTIONS Y SUB K TIMES Z            #AL B 0709-0985RWBF8
                #BESSEL FUNCTION Y SUB N /X/.                   B 0704-0704RWBF4
CLE 11 DIFFUSION EQUATION IN %X, Y¤ SPACE NUCLEAR-CODE     # UN B 0650-08.2.011
      #BESSEL FUNCTIONS J0/X/AND Y0/X/                          B 0704-0833RWBJY
      #BESSEL FUNCTION J1/X/ AND Y1/X/                          B 0704-0833RWBJY
E BESSEL FUNCTIONS Y SUB K TIMES Z             #ALL ORDERS OF TH B 0709-0985RWBF8
OF BESSEL FUNCTION J SUB K TIMES Z OR I             #ALL ORDERS  B 0709-0984RWBF7
                 #CLEAR BLOCK TO ZERO                           B 0650-01.6.006
                                 #ZERO DISK-FILE 1/CD&5/CD      A 0650--UT-102
      #BESSEL FUNCTIONS OF ORDER ZERO.                          B 0704-0636RWBF2
                                # ZERO, MINIMUM SOLVER          B 0704-1041JPZOM
                                 #ZEROS OF A COMPLEX POLYNOMIAL  B 0704-0405PFZPC
                                 #ZEROS OF A COMPLEX POLYNOMIAL  B 0704-0225GMZER
E PRECISION                      #ZEROS OF A POLYNOMIAL IN DOUBL B 0704-0766ANC20
                                 #ZEROS OF A REAL POLYNOMIAL.    B 0704-0405PFZPR
                                 #ZEROS OF COMPLEX POLYNOMIALS   B 0650-07.0.006
                                # ZEROS OF COMPLEX POLYNOMIALS   B 0704-0692JPZPO
AL/ZERP/.                        #ZEROS, EXTENDED RANGE POLYNOMI B 0704-0565CA004
                                 #ZEROS,ARBITRARY FUNCTION/ZARF/ B 0704-0565CA005
 COMPUTER SYSTEM               #* ZEUS PROGRAM ANALYSIS * *ZPA * B 7070-01.9.004
                                 #ZIP * INSTANT PRINTING *       B 1401-01.4.009
                    #FORECASTING ZONAL TRAFFIC VOLUMES          B 0650-09.2.011
WORK   #TRACING A MIN. PATH BET. ZONE CENTROIDS OVER A ROAD NET B 0650-09.2.080
ION ONE-DIMENSIONAL              #ZOOM NUCLEAR-CODE GROUP DIFFUS B 0704-NUCLEAR
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IBM Application & Systems Programs Library Abstract **File Number** 0305-AT-007

THREE TRACE PROGRAMS, STORED PROGRAM, PROCESS PANEL, POST TRACE

Abstract:

Purpose: One program traces the store process; the second allows the control panel to be traced by the RAMAC 305 independent of the store program.

IBM Application & Systems Programs Library Abstract **File Number** 0305-LM-005

PROGRAMMED DIVISION

Abstract:

Purpose: This program presents two methods of division. They are division using a tape of reciprocals, and division by iterative techniques.

Restrictions: The method of reciprocals is feasible if there are not more than 10,000 divisors.

IBM Application & Systems Programs Library Abstract **File Number** 0305-LM-006

FLOATING POINT SUBROUTINES FOR THE 305 RAMAC

Abstract:

Purpose: Six floating point subroutines have been developed: Three perform the arithmetic operations of (1) floating point add or subtract; (2) floating point multiply; and (3) floating point divide. Three routines provide for comparison of floating point numbers and conversion routines between fixed and floating point numbers.

Restrictions: The range of floating point numbers may extend from $\pm .10000000 \times 10^{-99}$ to $\pm .99999999 \times 10^{99}$. Two versions of each routine are available. One utilizes the general purpose process control panel and the other requires a special wired panel.

Storage Requirements: Three drum tracks.

Remarks: All operations take approximately 1/2 to 1 second. The shorter times are gained by use of the special purpose panel.

IBM Application & Systems Programs Library Abstract **File Number** 0305-MI-003

LINEAR PROGRAMMING ROUTINE

Abstract:

Purpose: The program allows the solution of linear programming problems.

Method: The simplex method is used.

Restrictions: The maximum array that can be operated upon is 82 x 97.

Storage Requirements: One disk.

Machine Requirements: Automatic division.

Additional Requirements: All arithmetic computations are performed by floating point subroutines. Data may be entered in fixed or floating point format.

IBM Application & Systems Programs Library Abstract **File Number** 305-MI-004

305 GENERAL PURPOSE BOARD TEST DECK

Abstract:

Purpose: This card deck is utilized to insure the proper wiring of a General Purpose Process Control Panel. Proper communications with the punch, printer, and typewriter are checked. The program prints out the results of program exit tests as they are accomplished.

Method: Not applicable

Restrictions, Range: Not applicable

Storage Requirements: No disk storage area is required.

Equipment Specifications: No optional features are required.

(Continued on next column)

Additional Remarks: User should be aware of "Record Advance Overflow" modifications which must be made to General Purpose Process Control Panel before operating test deck. Program is written for use with the 370 Printer.

IBM Application & Systems Programs Library Abstract **File Number** 0305-PR-001

A COMPUTER PACKAGE FOR THE IBM 305 RAMAC

Abstract:

Purpose: The computer package is an interpretive programming system for performing scientific and engineering computations on the RAMAC 305.

Restrictions: The package will handle either fixed or floating point numbers. Fixed point numbers are carried as 10 digits. Floating point numbers are carried in a 2 and 8 notation.

Additional Remarks: The simulated instructions are of the 2 address variety. Each address may be notified by one of 9 pseudo index registers. The following functions are included:

Square root
Sine
Cosine
Logarithm
Exponential
Arctangent
Arcsine

Machine Requirements: Automatic division.

Storage Requirements: 60 disk tracks.

IBM Application & Systems Programs Library Abstract **File Number** 305-SP-003

SYMBOLIC PROGRAMMING AND ASSEMBLY FOR THE IBM RAMAC 305

Abstract:

Purpose: This system provides the programmer with a symbolic programming language for the IBM RAMAC 305. In addition, an assembly program is provided for translating the symbolic language into the machine language of the RAMAC 305. The language contains operations for handling normal program exits and General Purpose Process Control Panel instructions. The output of the program is a deck of self-loading, one-instruction-per-card load cards, and a listing of the symbolic program steps and their translation.

Method: Not applicable.

Restrictions, Range: Not applicable.

Storage Requirements: The General Purpose Process Control Panel is required for operating the assembly program. Any control panel may be used for operating the assembled program. The assembly program requires 300 sectors of disk storage.

Equipment Specifications: The program requires no optional features.

Additional Remarks: The 300 sectors of disk storage referred to for operating the assembly program must be contained in the file containing addresses 000000 to 099999 on a RAMAC 305 which has six character RAMAC addresses. No op code which contains a disk storage address as an operand can be utilized with a six digit disk address.

IBM Application & Systems Programs Library Abstract **File Number** 305-UT-008

305 UTILITY PROGRAMS

Abstract:

Purpose: The programs contained in this package may be classified as follows:

(1) programs which transfer data from punched cards to a specific location within the RAMAC;
(2) programs which transfer data from one location within the RAMAC to another (e.g., from processing drum to disk storage, and vice versa); and
(3) programs which transfer data from specific locations in disk storage to cards or printed input.

Method: Not applicable.

Restrictions, Range: Not applicable

Storage Requirements: All of the programs operate from track I.

Equipment Specifications: No optional features are required

Additional Remarks: The programs which utilize disk storage will only operate on the file containing sectors 000000 - 099999 on an IBM RAMAC 305 which utilizes six digit disk addresses.

IBM Application & Systems Programs Library Abstract **File Number** 650-AT-001

GENERAL TRACING ROUTINE

Abstract:

Purpose: This program has been designed to aid programmers in debugging programs written in SOAP II language for any 650 system.

Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

Mathematical Method: Does not apply.

Storage Required: The program is available in either regional or symbolic form. The symbolic program requires 200 + 3N + 5M + K drum locations, where N is the number of points within the program to begin tracing, M the number of distinct loops to be traced, and K the number of stopping points. The regional program does not require the additional K locations, and is available for output synchronizers 1 or 2. A maximum of 45 stopping points is allowed in either program.

Speed: Not given.

Relocatability: Not given.

Remarks: The program will trace all 650 system instructions. There are two conditions which will cause an automatic skip-out: if a load card is read, or if an inquiry is made while in the tracing mode. When either of these occurs tracing ceases, and the program being traced will resume at high speed. The tracing program will be re-entered at the next encountered skip-in point. If the D-address of a branch-on-inquiry instruction is chosen as a skip-in point, the inquiry subroutine may be traced. The programmer, if he so desires, may trace index registers by including a control card.

Requests for program decks should specify which type is desired, i.e., symbolic or regional for output synchronizer 1, or regional for output synchronizer 2.

650 System: One 533 required.

Special Devices: Alphabetic device for SOAP assembly.

IBM Application & Systems Programs Library Abstract **File Number** 650-FO-301

FORTRANSIT I

Abstract:

Purpose: Program converts source program written in FORTRAN language into machine language instructions. Three card passes are required.

Restrictions: The program processes the following statements: Arithmetic; GO TO n; GO TO (n_1 . . . n_i), i; IF; PAUSE; STOP; DO; CONTINUE; DIMENSION; READ; PUNCH; END.

Machine Requirements: 533 with alphabetic device.

IBM Application & Systems Programs Library Abstract **File Number** 650-FO-302

FORTRANSIT I S

Abstract:

Purpose: Program converts source program written in FORTRAN language into machine language instructions. Three card passes are required.

Restrictions: The program processes the following statements: Arithmetic; GO TO n; GO TO (n_1 . . . n_i), i; IF; PAUSE; STOP; DO; CONTINUE; DIMENSION; READ; PUNCH; END.

Machine Requirements: 533 with special character device.

IBM Application & Systems Programs Library Abstract **File Number** 650-FO-303

FORTRANSIT II

Abstract:

Purpose: Program converts source program written in FORTRAN language into machine language instructions. Three card passes are required.

Restrictions: The program processes the following statements: Arithmetic; GO TO n; GO TO (n_1 . . . n_i), i; IF; PAUSE; STOP; DO; CONTINUE; DIMENSION; READ; PUNCH; END.

Machine Requirements: Floating Point Arithmetic, Indexing Registers, 533 with alphabetic device.

IBM Application & Systems Programs Library Abstract **File Number** 650-FO-304

FORTRANSIT II S

Abstract:

Purpose: Program converts source program written in FORTRAN language into machine language instructions. Three card passes are required.

Restrictions: The program processes the following statements: Arithmetic; GO TO n; GO TO (n_1 . . . n_i), i; IF; PAUSE; STOP; DO; CONTINUE; DIMENSION; READ; PUNCH; END.

Machine Requirements: Floating Point Arithmetic, Indexing Registers, 533 with special character device.

IBM Application & Systems Programs Library Abstract **File Number** 650-FO-305

FORTRANSIT III

Abstract:

Purpose: Program converts source program written in FORTRAN language into machine language instructions.

Restrictions: The program processes the following statements: Arithmetic; GO TO n; GO TO (n_1 . . . n_i), i; IF; PAUSE; STOP; DO; CONTINUE; DIMENSION; EQUIVALENCE;READ; PUNCH; END; READ TAPE; READ INPUT TAPE; WRITE TAPE; WRITE OUTPUT TAPE; PRINT; BACKSPACE; REWIND; END FILE.

Machine Requirements: Floating Point Arithmetic; Indexing Registers; 533 with alphabetic device; three 727 tape drives; standard 407.

IBM Application & Systems Programs Library Abstract **File Number** 650-LM-004

FLOATING POINT SINE A AND COSINE A

Abstract:

Purpose: This subroutine computes the sine or cosine of the angle A expressed in radians.

Range: Accepts any argument where $|A| < (2\pi \cdot 10^7) - \frac{\pi}{2}$.

Accuracy:

Range of Argument	Maximum error
$\|A\| < .2\pi$	3.5 in the 8th significant digit
$.2\pi \le \|A\| < 2\pi$	2.7×10^{-7}
$2\pi \le \|A\| < 20\pi$	5.4×10^{-7}
$2\pi \cdot 10^{7-K} \le \|A\| < 2\pi \cdot 10^{8-K}$	3.1 in the Kth decimal place (K = 1. 2, . . . , 6)

Floating/Fixed: Uses floating point.

Mathematical Method: The Rand Approximation is used for Sin X where $-\pi/2 \le X \le \pi/2$. The method of reduction and the solution originated with Mr. D. W. Sweeney.

Storage Required: The routine requires 55 storage locations between 0000 and 0068 inclusive. The 14 unused locations are available to the programmer.

Speed: The routine takes 123 ms. for Sine and
128 ms. for Cosine.

Relocatability: Relocatable SOAP II cards.

Remarks: Relocate only by an even amount.
Note: As the power of 10 increases, the number of significant digits in the result decreases. This is due to the limitation of significant digits available in the original Angle A.

650 System: One 533 and automatic floating decimal arithmetic.

IBM Application & Systems Programs Library Abstract **File Number** 650-LM-005

FLOATING POINT ARCTANGENT

Abstract:

Purpose: This subroutine computes the arctangent of floating point numbers. The result is in radians.

Range: The routine accepts all arguments X where

$$3.1622777 \times 10^{-26} \le |X| < 3.1622777 \times 10^{24}$$

Accuracy: The absolute error is less than 10^{-7}.

Floating/Fixed: The routine is written utilizing automatic floating point arithmetic.

Mathematical Method: The method is based on the work of Dr. E. G. Kogbetliantz, IBM, WHQ, and utilizes a continued fraction form of the expansion of 1/X arctan X in the interval (0, 1).

Storage Required: The routine requires 49 locations.

Speed: Execution time is 127 milliseconds.

Relocatability: Routine is written in relocatable SOAP II form.

Remarks: Relocate by an even amount. One indexing register is used; the contents are not restored.

650 System: One 533, automatic floating decimal arithmetic, and one indexing register are required.

Special Devices: For SOAP assembling, an alphabetic device is required.

IBM Application & Systems Programs Library Abstract **File Number** 650-LM-006

SQUARE ROOT

Abstract:

a) Computes the square root of X for any $X \ge 0$ in floating decimal form.

b) Range: Any floating decimal argument,

$00 \le$ machine exponent ≤ 99. The error is less than one in the eighth place.

c) Method is a linear approximation involving a table look up followed by two iterations with Newton's formula.

d) Storage required: 56 locations. Relocatable. Execution time approximately 75 milliseconds.

e) The program is in relocatable SOAP II form.

f) Alphabetic device used (for SOAP II assembly).

IBM Application & Systems Programs Library Abstract **File Number** 650-LM-007

Nth ROOT FIXED POINT SUBROUTINE

Abstract:

a) Computes the Nth root of a single precision fixed point argument A.

b) Range: $0.0000\ 00001 \le A \le 0.9999\ 99999$, $N > 0$. The number of significant places is approximately equal to ten minus the number of preceding zeros in A. Maximum accuracy - nine digits.

c) Iteration of Bailey's function.

d) Relocatable SOAP II; occupies 78 locations. Speed is dependent upon N and the desired accuracy. The average speed is approximately 600 m. s.

e) The desired accuracy may be determined by the adjustment of a constant.

f) Minimum 650.

IBM Application & Systems Programs Library Abstract **File Number** 650-LM-008

FLOATING POINT EXPONENTIAL

Abstract:

Purpose: This routine computes 10^x and e^x for floating point arguments using automatic floating decimal arithmetic and three indexing registers.

Range: The routine accepts arguments for 10^x
$|x| < 49$
The routine accepts arguments for e^x
$|x| \le 112.82666$
An error stop is provided for arguments outside this range.

Accuracy: The maximum error is 1 in the 8th significant digit for positive exponents and less than 1 in the 7th significant digit for negative exponents.

Floating/Fixed: Floating decimal arithmetic.

Mathematical Method: (Adapted for floating decimal arithmetic and index registers from W. E. Stuart's "FRATS" library program 3.1.026)
e^x is reduced to $10^{(\log e)x} = 10^{.43429448x}$ which is computed in fixed point using a Hastings polynomial approximation over the range $0 \le u \le 1/10$.
For negative exponents, $e^x = 1/e^{|x|}$.

Storage Required: Requires 84 drum locations within a group of 100 locations. The unused locations are available to the programmer.

Speed: 120 ms. for 10^x
127 ms. for e^x

Relocatability: Relocatable SOAP II form.

Remarks: Three indexing registers are used and not restored to their original values.

650 System: One 533, automatic floating decimal arithmetic, and three indexing registers.

Special Devices: Alphabetic device for SOAP II assembly.

IBM Application & Systems Programs Library Abstract **File Number** 650-LM-009

Nth ROOT FLOATING POINT SUBROUTINE

Abstract:

Purpose: This routine computes the Nth root of a single precision floating point argument A.

Range: +.0000000000 ≤ A ≤ +.9999999999, N > 0.

Accuracy: The subroutine exits to the main program when two successive approximations differ by 2×10^{-8}.

Floating/Fixed: The format of the floating point number is .xxxxxxxxmm, with floating zeros in the form 00 0000 0000.

Mathematical Method: Iteration of Bailey's Function.

Storage Required: 79 locations.

Speed: Speed is dependent upon N and the desired accuracy.

Relocatability: The subroutine is furnished in relocatable SOAP II form.

Remarks: The desired accuracy may be modified by the adjustment of a constant.

650 System: One 533 and automatic floating decimal arithmetic.

Special Devices: Alphabetic device for SOAP II assembly.

IBM Application & Systems Programs Library Abstract **File Number** 650-LM-010

FLOATING POINT SQUARE ROOT SUBROUTINE

Abstract:

Purpose: This routine computes the square root of numbers in floating decimal form using an initial approximation and five iterations with Newton's method. This program was designed to use a minimum of drum space.

Range: This routine accepts floating point numbers of the form. .DDDDDDDDMM. Answers are in floating point form and all eight significant digits are exact.

Mathematical Method: After taking an initial approximation, Newton's method is used to find the square root. With the initial approximation used, this method converges to eight significant figures in five iterations.

Storage Required: 21 Permanent drum locations including a programmed stop for negative arguments. 3 Temporary storage locations.

Speed: 140 ms.

The deck is in SOAP II form.

Remarks: The routine uses index register B which is not reset.

IBM 650 System: This routine requires a 650 with floating decimal arithmetic device and one index register. An alphabetic device is needed for SOAP II assembly.

IBM Application & Systems Programs Library Abstract **File Number** 650-LM-011

FORTRAN SUBROUTINES

Abstract:

Purpose: This is a collection of subroutines to be used in conjunction with the 650 FORTRAN, Program #650-FO-306. The subroutines are: absolute value, cosine, sine, and square root.

IBM Application & Systems Programs Library Abstract **File Number** 650-LM-012

FORTRANSIT SUBROUTINES

Abstract:

Purpose: This is a collection of subroutines to be used with the 650 FORTRANSIT programs. The subroutines are absolute value, cosine, sine, and square root.

IBM Application & Systems Programs Library Abstract **File Number** 650-SM-402

SORT 2

Abstract:

Purpose: Sort 2 is a generalized tape sorting program.

Restrictions: Program sorts unblocked fixed-length records. Maximum record is 60 words. Maximum of 5 control fields. File must be within 1 or 2 reels of tape.

Method: 2-way merge.

Equipment Specifications: 4 727 Magnetic Tape Units

Additional Remarks: Routines for tape labeling, error corrections, restart procedures, record count, and hash totals are included.

IBM Application & Systems Programs Library Abstract **File Number** 0650-SP-201

BASIC SOAP 2A

Abstract:

Purpose: This program processes programs written in symbolic language and produces one-for-one machine language instructions.

Restrictions: A maximum of 300 labels are processed per pass of card deck. It assembles instructions for a 2K machine.

Machine Requirements: 533 with alphabetic device.

IBM Application & Systems Programs Library Abstract **File Number** 0650-SP-202

TAPE SOAP 2A

Abstract:

Purpose: This program processes programs written in symbolic language and produces one-for-one machine language instructions.

Restrictions: A maximum of 300 labels are processed per pass. It assembles instructions for a 2K machine.

Machine Requirements: 533 with alphabetic device; two 727 tape drives.

IBM Application & Systems Programs Library Abstract **File Number** 0650-SP-203

SOAP 2L

Abstract:

Purpose: This program processes programs written in symbolic language and and produces one-for-one machine language instructions. SOAP 2L will process LITERALS and three other pseudo-ops. not handled by SOAP IIA.

Restrictions: A maximum of 300 labels are processed per pass of card deck. It assembles instructions for a 2K machine.

Machine Requirements: 533 with alphabetic device.

IBM Application & Systems Programs Library Abstract **File Number** 0650-SP-204

TAPE SOAP 2L

Abstract:

Purpose: This program processes programs written in symbolic language and produces one-for-one machine language instructions. SOAP 2L processes LITERALS and three other pseudo-ops. not handled by SOAP II A.

Restrictions: A maximum of 300 labels are processed per pass. It assembles instructions for a 2K machine.

Machine Requirements: 533 with alphabetic device. Two 727 tape drives.

IBM Application & Systems Programs Library Abstract **File Number** 0650-SP-205

SOAP II A - 4000

Abstract:

Purpose: This program processes programs written in symbolic language and produces one-for-one machine language instructions.

Restrictions: A maximum of 1200 labels are processed per pass of card deck. It assembles instructions for a 4K machine.

Machine Requirements: 533 with alphabetic device. 4K drum.

IBM Application & Systems Programs Library Abstract **File Number** 0650-SP-206

SOAP 42

Abstract:

Purpose: This program processes programs written in symbolic language and produces one-for-one machine language instructions.

Restrictions: A maximum of 300 labels are processed per pass of card deck. It assembles instructions for a 4K machine.

Machine Requirements: 533 with alphabetic device.

IBM Application & Systems Programs Library Abstract **File Number** 650-UT-002

CARD-TO-TAPE ROUTINE

Abstract:

Purpose: This utility routine for the 650 tape system is designed to convert card records to tape records.

Range: Numerical or alphanumerical records contained in from one to fifteen cards can be converted to tape records of from one to sixty words.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

Mathematical Method: Does not apply.

Storage Required: The program and its five-per-card loading routine use 273 drum locations including the 1951 read band.

Speed: When tape writing is in the alphanumerical mode, operating speed is approximately 200 cards per minute if not more than six words are taken from each card. If writing is in the numerical mode, the same speed will be maintained if not more than seven words are taken from each card. These rates apply to 533 input; if input is by means of a 537 or a 407, the maximum card reading rate (150 cards per minute) will be maintained regardless of the number of words taken from each card.

Relocatability: Not in relocatable form.

Remarks: None.

650 System: One 727 tape unit and any card input device.

Special Devices: None.

IBM Application & Systems Programs Library Abstract **File Number** 650-UT-003

TAPE-TO-PRINTER/PUNCH ROUTINE

Abstract:

Purpose: This utility routine is designed to punch or print records from a reel of magnetic tape. Output is eight words per card or per line.

Range: Numerical or alphanumerical records of any length can be processed.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

Mathematical Method: Does not apply.

Storage Required: The routine requires 50 locations plus the read and punch areas of the 1950 band. (If indexing registers are not used, 56 locations are needed.)

Speed: Operates at maximum punch or print rates.

Relocatability: Written in SOAP II regionalized form.

Remarks: The program consists of two versions: one for a system with indexing registers and one for a system without that feature. Requests for card decks should specify which version is desired.

650 System: One 533 or one on-line 407 printer; one 727 tape unit.

Special Devices: None.

IBM Application & Systems Programs Library Abstract File Number 0704-FO-037

4K 704 FORTRAN PROGRAMMING SYSTEM

Abstract:

Purpose: The IBM Formula Translating System, 4K 704 FORTRAN, is an automatic coding system for the IBM 704 Data Processing System. More precisely, it is a 704 program which accepts a source program written in the FORTRAN language, closely resembling the ordinary language of mathematics, and which produces a machine-language object program ready to be run on a 704.

IBM Application & Systems Programs Library Abstract File Number 0704-FO-038

8K 704 FORTRAN PROGRAMMING SYSTEM

Abstract:

Purpose: The IBM Formula Translating System, 8K 704 FORTRAN, is an automatic coding system for the IBM 704 Data Processing System. More precisely, it is a 704 program which accepts a source program written in the FORTRAN language, closely resembling the ordinary language of mathematics, and which produces a machine-language object program ready to be run on a 704.

IBM Application & Systems Programs Library Abstract File Number 0704-FO-039

32K 704 FORTRAN PROGRAMMING SYSTEM

Abstract:

Purpose: The IBM Formula Translating System, 32K 704 FORTRAN, is an automatic coding system for the IBM 704 Data Processing System. More precisely, it is a 704 program which accepts a source program written in the FORTRAN language, closely resembling the ordinary language of mathematics, and which produces a machine-language object program ready to be run on a 704.

IBM Application & Systems Programs Library Abstract File Number 0704-SI-041

Simulation of the 1410 with the 704/709/7090

Abstract

Purpose: The program enables the user to test and correct 1410 programs prior to installation of an IBM 1410 data processing system. The system will trace or dump simulated programs.

Restrictions: The program simulates standard card and tape systems. The simulated 1410 has 20,000 core storage positions. Using Basic Autocodes the simulator will assemble 1410 programs. A maximum of one disk of 1405 storage can be simulated.

Timing: The 704 takes approximately 20 times longer than if the program was running on a 1410.

Equipment Specifications:
32,676 words of core storage
4 tape units + 1 for simulated 1410 tape units + 2 for disk

Additional Remarks: This program is distributed on a systems tape.

IBM Application & Systems Programs Library Abstract File Number 0704-SI-042

Simulation of the 1410 with the 704/709/7090

Abstract

Purpose: The program enables the user to test and correct 1410 programs prior to installation of an IBM 1410 data processing system. The system will trace or dump simulated programs.

Restrictions: The program simulates standard card and tape systems. The simulated 1410 has 20,000 core storage positions. Using Basic Autocodes the simulator will assemble 1410 programs. A maximum of one disk of 1405 storage can be simulated.

Timing: The 709 takes approximately 20 times longer than if the program was running on a 1410.

Equipment Specifications:
32,676 words of core storage
4 tape units + 1 for simulated 1410 tape units + 2 for disk

Additional Remarks: This program is distributed on a card deck.

IBM Application & Systems Programs Library Abstract File Number 0705-AT-057

APTS 80

Abstract:

Purpose: An automatic program testing system for the IBM 705 III, consisting of a coordinated set of the "80 Series" utility programs that are used in testing, modified so that the utility programs themselves may be loaded automatically from a utility tape, and their control cards from the card reader or other input device independent of the utility tape. With APTS 80, all programs being tested may be loaded from a single tape, and test data cards and program correction cards may be read from the card reader.

IBM Application & Systems Programs Library Abstract File Number 0705-CV-045

705-1401 A ASSEMBLY PROGRAM

Abstract:

Purpose: To assemble, on the 705, programs written in 1401 symbolic language; to produce as the end result of the assembly a listing and program cards in 1401 machine language.

Machine Requirements: The 705-1401A Assembly Program will run on a Model I, II, III, TCU, TRC, DS.

Magnetic Tape Drives Required: Three (3) if card reader input.
Three (3) if tape input-single assembly.
Four (4) if tape input-multiple assemblies.

IBM Application & Systems Programs Library Abstract File Number 0705-IO-047

705 III IOCS

Abstract:

Purpose: IOCS handles reading and writing, checkpoint and restart, error correction, beginning and end-of-reel and beginning and end-of-file processing, tape record blocking and de-blocking, and label checking. Macro-instructions and control parameters coded by the programmer cause generation of linkages to IOCS subroutines, which in turn perform the specified functions.

An input/output memory restore system (IOMR SB) operates in conjunction with IOCS to restore program status from periodically recorded checkpoints, so that in the event of program interruption, previous processing need not be repeated.

Storage Requirements: Preassembled IOCS occupies 17,074 locations.

Equipment Specifications: 705 Model III
767 Data Synchronizer

IBM Application & Systems Programs Library Abstract File Number 0705-MI-058

LIST 75

Abstract:

Purpose: This program, using program cards as input, produces a sorted listing of a program's instructions by storage location, storage unit, mnemonic operation code, and address. This output is helpful in analyzing a program for transfer points, modified instructions, instructions that set or reset switches, etc.

Equipment Specifications: 705 Model I or Model II
754 Tape Control

IBM Application & Systems Programs Library Abstract File Number 0705-MI-059

LIST 77

Abstract:

Purpose: This program, using program cards as input, produces a sorted listing of a program's instructions by storage location, storage unit, mnemonic operation code, and address. This output is helpful in analyzing a program for transfer points, modified instructions, instructions that set or reset switches, etc.

Equipment Specifications: 705 Model I or Model II
2 777 TRC's

IBM Application & Systems Programs Library Abstract File Number 0705-PR-044

7058 PROCESSOR

Abstract:

Purpose: The 7058 Processor accepts six programming languages: Autocoder III; Decision; Report/File Writing; Arithmetic; Table Creating; and FORTRAN. It will operate with any input/output device, on a 705, 705 III, or 7080 and assemble programs for any model 705 or a 7080.

7058 Processor languages, described below, permit a wide variety of programming to be stated in terms of the data processing results desired, rather than the machine operations required to accomplish it. Extensive use of these languages will greatly reduce coding effort and the incidence of clerical and logical errors, and will simplify problems of debugging and program maintenance. A statement in any of the languages may cause generation of an entire pretested routine that will efficiently perform the data processing defined by the statement. Within any one program, routines in the various Processor languages may be intermixed.

Autocoder III: This advanced programming language provides a vocabulary of menmonics corresponding to actual machine operations, and a set of macro-instructions which, when processed, produce coding sequences that will transmit data, control program branching, perform automatic-decimal-point arithmetic, and modify addresses. The operands or Autocoder III statements may be written as symbolic representations of the information to be operated upon, and symbolic addresses, or tags, may be used to define the memory locations of data or of particular routines within the program. Data input and output fields may be defined in terms of the format of the data including the placement of decimal points, commas, dollar signs, etc.

Report/File Writing: This language consists of a vocabulary of nineteen words which, when used in a prescribed manner, cause generation of routines that will create tape files or produce printed reports. Statements in this language describe the format of print lines or tape records by specifying the contents and spacing of report headings, page headings, and detail lines. A date and page numbering may be included in the report. Provision is made also for accumulating counts or totals of any designated fields in the records being processed, and for printing these in stated formats upon the occurrence of changes in selected fields of the records. Routines in the Report/File Writing language may be included at appropriate points in programs, and when compiled by the Processor will result in error-free sequences of optimal coding that will produce reports or tape files, the contents and format of which will be precisely as specified.

Decision-Making: By use of this language, a single logical statement may be written at any point in an Autocoder III portion of a program to specify all the conditions on which a program decision is to be based, and the alternative courses the program is to follow if the conditions are satisfied or not satisfied. A single word, TEST, is the vocabulary of the language and is written as the operation of a Decision-Making statement. The operand is composed of tags, literal constants, and special codes that express the relationships (e.g., higher than, not zero, etc.) that define the individual conditions. Conditions are linked within a statement by logical connectors and are grouped in a prescribed manner to form the complete conditional statement. Decision-Making statements are translated by the Processor into instruction sequences that will perform the necessary analyses and other processing by the best possible methods.

Arithmetic: With statements similar to Decision-Making statements, mathematical operations upon any number of fields may be specified, in order to create a result field. The word MATH in the operation field signals that the operand contains a free-form arithmetic expression consisting of tags and/or literals separated by add, subtract, multiply or divide symbols, with possible parenthesization. Specialized error protection, field modification, and redefinition of intermediate results are some optional features. These statements are translated by the Processor into automatic-decimal-point macro-instructions, chained to produce the most efficient machine coding.

Table-Creating: This language permits automatic use of memory searching techniques by creating a string of variables with their associated data and a set of controls to accomplish the searching. Following a statement with TABLE in the operation field and containing defining parameters, the programmer supplies the table entries or range of entries. These entries are translated by the Processor into a table suitable for serial or binary searching. Such a table may be utilized by macro-instructions, Report/File Writing statement and/or Decision-Making statements.

FORTRAN: This is a language for programming generalized computational problems. 705 FORTRAN programs may contain Autocoder statements at appropriate points. 705 FORTRAN permits three subscripts and constant values of range 10^{-99}. All the advantages of 7058 Processor assembly are available to the user.

Equipment Specifications: 40,000 positions of storage
8 tape drives.

IBM Application & Systems Programs Library Abstract File Number 0705-PR-131

705/7080 COBOL and COMMERCIAL TRANSLATOR PROCESSOR

Abstract:

Purpose: The processor translates programs written either in COBOL 61 or Commercial Translator to machine language programs for the 705 Models I, II and III, and the 7080. Use of the processor in programs written for the 705 Models I and II is restricted, in that input/output routines must be written in Autocoder language. For the 705 Model III and the 7080 it is possible to write programs completely in COBOL or Commercial Translator. (Continued on next page)

The 705/7080 COBOL and Commercial Translator Processor includes all the features of the 7058 Processor, Version #2. It may be used to compile programs written in Autocoder, FORTRAN, Report Writer or the Decision, Arithmetic and Table languages as well as COBOL and Commercial Translator. Further, a COBOL or Commercial Translator program may utilize any of the languages available with the 7058 Processor.

Machine Configuration: A 705 Model II, 705 Model III or 7080 with a minimum of eight tape units plus a card reader or additional tape unit for the source program. The availability of additional tape units will normally result in increased speed of compilation.

IBM Application & Systems Programs Library Abstract **File Number** 0705-SM-048

SORT 54

Abstract:

Purpose: Sort 54 is a generalized three-way merge sorting program. It is capable of modifying itself according to control card specifications.

Equipment Specifications:

IBM 705 (Model I or Model II)
754 Tape Control
7 727 Tape Drives
717 Printer

Additional Remarks: Sort 54 incorporates checkpoint, restart, and interrupt sort procedures. It accepts single or blocked fixed length records or single variable length records.

IBM Application & Systems Programs Library Abstract **File Number** 0705-SM-049

SORT 54T

Abstract:

Purpose: Sort 54T is a generalized three-way merge sorting program. It is capable of modifying itself according to control card specifications.

Equipment Specifications: IBM 705 (Model I or Model II)
777 Tape Record Coordinator
7 727 Tape Drives
717 Printer

Additional Remarks: Sort 54T incorporates checkpoint, restart, and interrupt sort procedures. It accepts single or blocked fixed length records or single variable length records.

IBM Application & Systems Programs Library Abstract **File Number** 0705-SM-050

SORT 57

Abstract:

Purpose: Sort 57 is a generalized four-way merge sorting program. It is capable of modifying itself according to control card specifications.

Equipment Specifications: IBM 705 (Model I or Model II)
2 777 Tape Record Coordinators
7 727 tape drives
717 Printer

Additional Remarks: Sort 57 incorporates checkpoint, restart, and interrupt sort procedures. It accepts single or blocked fixed length records.

IBM Application & Systems Programs Library Abstract **File Number** 0705-SM-051

SORT 54/

Abstract:

Purpose: Sort 54/ is a generalized three-way merge sorting program. It is capable of modifying itself according to control card specifications.

Equipment Specifications: IBM 705 Model III
754 Tape Control
7 727 Tape Drives
717 Printer

Additional Remarks: Sort 54/ incorporates checkpoint, restart, and interrupt sort procedures. It accepts single or blocked fixed length records or single variable length records.

IBM Application & Systems Programs Library Abstract **File Number** 0705-SM-052

SORT 54T/

Abstract:

Purpose: Sort 54T/ is a generalized three-way merge sorting program. It is capable of modifying itself according to control card specifications.

Equipment Specifications: IBM 705 Model III
777 Tape Record Coordinator
7 727 Tape Drives
717 Printer

Additional Remarks: Sort 54T/ incorporates checkpoint, restart, and interrupt sort procedures. It accepts single or blocked fixed length records or single variable length records.

IBM Application & Systems Programs Library Abstract **File Number** 0705-SM-053

SORT 57/

Abstract:

Purpose: Sort 57/ is a generalized four-way merge sorting program. It is capable of modifying itself according to control card specifications.

Equipment Specifications: IBM 705 Model III
2 777 Tape Record Coordinators
7 727 Tape Drives
717 Printer

Additional Remarks: Sort 57/ incorporates checkpoint, restart, and interrupt sort procedures. It accepts single or blocked fixed length records.

IBM Application & Systems Programs Library Abstract **File Number** 0705-SM-054

SORT 80

Abstract:

Purpose: A generalized sorting program that will sort files of fixed- or variable-length data records, single or blocked, on a control data word as long as 100 characters and consisting of as many as five fields. To facilitate program scheduling, Sort 80 will use whatever tape units are specified in the control information supplied by the user.

Optional features of Sort 80 include an Extended Sort made for sorting particularly large files, and provisions for label processing and for the accumulation and checking of hash totals. Exits are provided at logical points in the program to allow the user to include additional routines. Sort 80 also provides checkpoints, interrupt and restart procedures, and routines which facilitate the correction, or deletion and later recovery of unreadable records.

Equipment Specifications: 705 Model III or 7080
767 Data Synchronizer
4 Tape Drives

IBM Application & Systems Programs Library Abstract **File Number** 0705-SM-055

MERGE 80

Abstract:

Purpose: A generalized two- to ten-way merging program that will merge files of fixed- or variable-length data records, single or blocked, on a control data word as long as 100 characters and consisting of as many as five fields. To facilitate program scheduling, Merge 80 will use whatever tape units are specified in the control information supplied by the user.

Optional features of Merge 80 include provisions for label processing and for the accumulation and checking of hash totals. Exits are provided at logical points in the program to allow the user to include additional routines. Merge 80 also provides checkpoint, interrupt and restart procedures, and routines which facilitate the correction, or deletion and later recovery of unreadable records.

Equipment Specifications: 705 Model III or 7080
767 Data Synchronizer
4 tape drives

IBM Application & Systems Programs Library Abstract **File Number** 0705-UT-056

80 SERIES UTILITIES

Abstract:

Purpose: All "80 Series" utility programs except LOAD 80 and CLRM80 contain routines that will check labels set up in conformance with IBM standards, if desired.

Single Card Load (LOAD80): Loads standard 705 program cards from the card reader or a 729 DS tape.

Clear Memory (CLRM80): Sets memory positions 00160 - 39999 (or 79999) to blanks, and resets the accumulator and ASUs 01 - 11 without interrupting automatic operation.

Expanded Loads (LOAD81 and LOAD82): Load standard and/or expanded format program cards from one or a combination of two input units. Both programs feature the ability to locate a specified program on a tape.

Tape File Assembler (TPF180): Assembles tape files from cards or card images on tape. Output may be fixed- or variable-length tape records, single or blocked. Tapes must be used on 729 tape units.

Memory Print (MEPR80): Produces a printed listing of the contents of any tape mounted on a 729 tape unit, either directly on a 717, 720, or 730 printer or on a 729 I tape for later off-line printing.

Tape Duplication (TPDP80): Duplicates any 767 Data Synchronizer-controlled tape or tapes, or any selected file or files thereon.

Equipment Specifications: 705 Model III, or
7080

IBM Application & Systems Programs Library Abstract **File Number** 0709-CV-065

704/709 INPUT/OUTPUT COMPATIBILITY PROGRAM

Abstract:

Purpose: To make possible the execution of 704 programs on the 709 by assuming responsibility for all input/output functions, and to simulate 704 drum storage in cores if drums are not present in the 709 system.

IBM Application & Systems Programs Library Abstract **File Number** 0709-CV-070

709 CARD CONVERSION

Abstract:

Purpose: This is a collection of four programs for conversion of card formats. They are:

1.	IBRBO1	Hollerith to BCD, or Column Binary to Row Binary
2.	IBRBO3	BCD to Hollerith
3.	IBRBO5	Row Binary to Column Binary
4.	IBRBO7	BCD to live image

Restrictions: Hollerith input may contain only those characters listed in Appendix I of The Share 709 System (SOS) Manual, Part I, Preliminary Edition, July, 1958, including the symbols "normally not used". Any other character will cause an error return.

Column binary input must be identified by 1's in the sign positions of the 9-left and 7-left words of the card image (corresponding to the control punches in a column binary card). Absence of these bits will cause the routine to treat the image as Hollerith, or to transfer to the error returns as specified by the calling sequence.

Timing:

IBRBO1	80-105 ms
IBRBO3	38 ms
IBRBO5	158 ms
IBRBO7	30-40 ms

Storage Requirements:

IBRBO1	258 + I/O words
IBRBO3	131 + I/O words
IBRBO5	66 + I/O words
IBRB)7	182 + I/O words

IBM Application & Systems Programs Library Abstract **File Number** 0709-FO-062

32K 709/7090 FORTRAN PROGRAMMING SYSTEM

Abstract:

Purpose: The IBM Formula Translating System, 32K 709/7090 FORTRAN, is an automatic coding system for the IBM 709/7090 Data Processing System. More precisely, it is a 709/7090 program which accepts a source program written in the FORTRAN language, closely resembling the ordinary language of mathematics, and which produces a machine-language object program ready to be run on a 709 or 7090. The system also contains the FAP Assembler and FORTRAN Monitor, enabling jobs to be compiled, assembled, and executed automatically.

IBM Application & Systems Programs Library Abstract **File Number** 0709-PR-060

709/90 9PAC

Abstract:

Purpose: 9PAC is a collection of three systems, known as File Processor, Reports Generator and 9PAC Sort. They respectively maintain, write reports from, and sort a file. The source language is written on a series of specialized forms and describes the function to be performed or a pictorial view of the output reports. I/O is handled by the system and need not concern the programmer. The mode of operation may be either compile and execute, or load and execute.

IBM Application & Systems Programs Library Abstract **File Number** 0709-PR-063

SHARE OPERATING SYSTEM - IB MONITOR VERSION

Abstract:

Purpose: SOS is a set of components controlled by a one-phase monitor operating on stacked jobs. The system compiles symbolic machine-oriented language into condensed squozed form and/or performs one-pass loading of squozed decks with symbolic modification. The output includes absolute decks, listings, and new squoze deck. Features include programmer macros, library facilities, system macros, and routines for symbolic debugging. Tape assignments and system references are symbolic.

IBM Application & Systems Programs Library Abstract **File Number** 0709-PR-064

SHARE OPERATING SYSTEM - SHARE MONITOR VERSION

Abstract:

Purpose: SOS is a set of components controlled by a three-phase monitor operating on stacked jobs. The system compiles symbolic machine-oriented language into condensed squozed form and/or performs one-pass loading of squozed decks with symbolic modification. The output includes absolute decks, listings, and new squoze deck. Features include programmer macros, library facilities, system macros, and routines for symbolic debugging. The SOS system includes job data editors operating to and following job execution. Tape assignments and system references are symbolic.

IBM Application & Systems Programs Library Abstract **File Number** 0709-SI-071

SIMULATE PERIPHERAL EQUIPMENT

Abstract:

Purpose: This is a collection of three programs to simulate off-line peripheral equipment. They are:

1.	IBRBO2	Card-to-Tape
2.	IBRBO4	Tape-to-Card Hollerith
3.	IBRBO6	Tape-to-Card Binary
4.	IBRBO8	Tape-to-Printer

Restrictions: Hollerith input may contain only those characters listed in Appendix I of The Share 709 System (SOS) Manual, Part I, Preliminary Edition, July, 1958, including the symbols "normally not used". Any other characters will cause an error halt.

Column binary input must be identified by "control punches" in the sign positions of the 9-left and 7-left words of the card. Absence of these punches will cause the program to treat the card as Hollerith, or to come to an error halt, as specified by the entry keys.

Only the first 72 columns of each card are used. Tape records may be any length.

Storage Requirements:

IBRBO2	407 words
IBRBO4	261 words
IBRBO6	188 words
IBRBO8	591 words

IBM Application & Systems Programs Library Abstract **File Number** 0709-SM-066

SORT 709

Abstract:

Purpose: This is a generalized sort program. This program uses a 2 through 5-way merge. Input is binary or BCD from tape. The tape may consist of one or more reels of fixed-length records. Input file is sorted into ascending sequence based upon 1 through 5 control fields arbitrarily arranged within the record. The control fields may have a total of up to 360 bits.

Use: Control cards specify record length, input and output blockings, control fields, memory available, merge order, and tape units. Program may be interrupted at any point and later restarted.

IBM Application & Systems Programs Library Abstract **File Number** 0709-SM-067

GENERALIZED MERGE

Abstract:

Purpose: This is a generalized merge on 2, 3, 4 or 5 BCD or binary files. The input may be one or more reels of fixed-length records. The files are merged into ascending sequences on as many as 360 bits of controlled data contained in up to 5 control fields. Output is in the same format as input, but blocked as per control card. Sequenced input files may arise from splitting a large file to stay within the capacity of Sort 709, or from batch processing.

Timing: Timing is essentially that of one-tape pass for the output file.

IBM Application & Systems Programs Library Abstract **File Number** 0709-UT-068

709 UTILITIES

Abstract:

Purpose: This is a collection of 8 utility routines:

1. RAFG generates a file of random binary or BCD digits.
2. 9OAL loads instructions punched in absolute octal with their alphabetic mnemonic operation codes.
3. YMSG prints on-line messages.
4. TCMP compares two tapes word for word.
5. SEQK checks the sequence of a file of records. Records may be blocked and have up to five control fields.
6. SPTR provides a high-speed spot trace. The information is stored in upper memory and prints upon completion of program.
7. TBLD builds short tapes for testing and other special purposes.
8. TD provides an octal or BCD print of tape.

IBM Application & Systems Programs Library Abstract **File Number** 0709-UT-069

709 DATA PROCESSING PACKAGE

Abstract:

Purpose: The 709 Data Processing Package is a collection of miscellaneous programming aids to the handling of commercial data on the 709. At present it consists of generalized subroutines which permit numeric data to be converted from and to binary and to be edited for visible output, and alphanumeric data to undergo movement, validity checking, and comparison.

IBM Application & Systems Programs Library Abstract **File Number** 1401-AT-017

1401 CARD SYSTEM ERROR-DETECTION AIDS

Abstract:

Purpose: To provide a simple 1401 system for checking out programs.

Method: Does not apply.

Restrictions, Range: Does not apply.

Storage Requirements: Does not apply.

Equipment Specifications: No special features required.

Remarks: The programs provide a control card method for "patching" a 1401 program with instructions that will either:

1. Halt the program at selected times;
2. Print selected areas of storage at selected times.

Means for conveniently removing the patches are also provided.

IBM Application & Systems Programs Library Abstract **File Number** 1401-AU-037

1401 AUTOCODER PROGRAM

Abstract:

Purpose: To provide more powerful tools for programmers to enable them to concentrate their efforts on the problems of program logic rather than coding. In addition, to provide an extremely fast assembly system.

Method: Does not apply.

Restrictions, Range: Does not apply.

Storage Requirements: Does not apply.

Equipment Specifications:

4000 core-storage positions
4 (four) 729 II or IV Tape Units
1403 Printer Model 3
1402 Card Read-Punch
Advanced Programming Features
High-Low-Equal Compare

Additional Remarks:

1. Some of the tools provided are:
   (1) Macro instructions
   (2) Literals
   (3) Symbolic origins
2. Compatibility with SPS is provided.
3. Assembly is completely automatic.
4. Complete diagnostics are provided.
5. Many optional outputs are provided.
6. The user can provide his own macro-instructions and subroutines.

IBM Application & Systems Programs Library Abstract **File Number** 1401-FO-050

1401 FORTRAN

Abstract:

Purpose:

1401 FORTRAN makes available to 1401 DPS installations the established FORTRAN programming language, the principal use of which is to describe solutions to scientific and engineering problems. The FORTRAN compiler translates such descriptions, or source programs, into 1401 machine language. Use of the FORTRAN system will produce higher program writing efficiency; i. e., more reliable programs produced more quickly. In addition, because of the machine-independence of the FORTRAN language, programs written in FORTRAN and tested on the 1401 can be applied directly and quickly to any other machine for which a FORTRAN system is available.

1401 FORTRAN features are: 1) fast compiling speed, 2) operability on a 1401 Card System (no tape required), and 3) "load-and-go" system organization.

(Continued on next column)

Use of program:

The user's FORTRAN program statements, punched on cards, are entered into the 1401 DPS, followed by the FORTRAN compiler, which may be on cards or tape. The source program is translated by the compiler into the equivalent 1401 machine language program in core storage, ready for execution. A listing is provided during the compilation which includes the source program statements, diagnostic information relating to the intelligibility and consistency of the source program, and other useful information comprising a record of the compilation.

Machine Configuration:

For compilation of source programs:

1 1401 Processing Unit (any model with 8000 or more core storage positions)

Advanced Programming Feature

High-Low-Equal Compare Feature

Multiply-Divide Feature

1 1402 Card Read-Punch

1 1403 Printer (Model 1 or 2)

One Tape Unit (Model 729 II, 729 IV, 729 V, 729 VI, or 7330) may be used if installed to store and load the 1401 FORTRAN compiler

Sense switches may be used if installed to provide a 1403 listing of the object program during various stages of the compilation.

For execution of compiled programs:

1 1401 Processing Unit (any model with 8000 or more core storage positions)

Advanced Programming Feature

High-Low-Equal Compare Feature

Multiply-Divide Feature

1 1402 Card Read-Punch

1 1403 Printer (Model 1 or 2)

Tape Units (Model 729 II, 729 IV, 729 V, 729 VI, or 7330) - only as required for input and output data.

Sense switches - may be used if installed.

IBM Application & Systems Programs Library Abstract **File Number** 1401-IO-040

1401 TAPE READING AND WRITING SUBROUTINES

Abstract:

Purpose: To provide 1401 users with closed subroutines which are consistent with the Applied Programming Tape Standards for Tape Reading and Writing.

The Subroutines consist of a Tape Read/Write Routine, a Read Routine and a Write Routine.

Included are:

1. Error checking procedures
2. Noise record procedures
3. Dumping of unreadable records
4. Statistics concerning retries.

Method: Does not apply.

Restrictions, Range: Does not apply.

Storage Requirements: Does not apply.

Equipment Specifications:

Any 4K tape system
*Advanced Programming Features

*Necessary only with 1401 Read/Write Tape Routine

IBM Application & Systems Programs Library Abstract **File Number** 1401-IO-065

1401 INPUT/OUTPUT CONTROL SYSTEM

Abstract:

Purpose: The 1401 IOCS consists of a set of library routines which, when called for in a 1401 Autocoder source program by macro instructions, are selected and tailored and included in the object program. These routines perform I/O functions and provide linkage to the user 's object program. The specific statements generated at assembly time depend completely on the particular specifications contained in the user's source program.

Use of Program: The 1401 IOCS library routines are to be placed in the 1401 Autocoder system (Version 3 or later Version) through a librarian run.

Machine Configuration: The 1401 IOCS will perform the I/O functions and associated housekeeping for tape, card reader, card punch and printer. The object machine must have, in addition to any of the above I/O units, advanced programming features and the high-low-equal compare feature. The amount of core storage required varies widely from program to program and must be determined at assembly time.

IBM Application & Systems Programs Library Abstract **File Number** 1401-LM-007

1401 CARD SYSTEM SUBROUTINES

Abstract:

Purpose: To provide a few frequently used arithmetic subroutines.

Method: Does not apply.

Restrictions, Range: Does not apply.

Remarks: Programs provided:

Multiply I (for storage space economy)
Multiply II (for speed economy)
Divide
Dozens-to-Units Conversion
Units-to-Dozens Conversion

Note: Closed subroutine linkage instructions provided.

IBM Application & Systems Programs Library Abstract **File Number** 1401-RG-045

FARGO (Fourteen-O-One Automatic Report Generating Operation)

Abstract:

Purpose: To provide a simple-to-learn, easy-to-use method of converting accounting reports from unit record equipment (602A - 402 - 514 - 604 - 407 - 519 types) to an IBM 1401 Data Processing System.

Programming Language: 1401 Symbolic Programming System

Method: Load & Go, which means there is no intermediate symbolic assembly operations. This means that the FARGO condensed program decks with the inserted control cards containing the report specifications are read into the 1401 followed by the report data cards, and the report is begun when the first detail card is read.

Range:

1. List or Tabulate with or without Summary Punching.
2. Print one full line of Report Heading on the 1st line of each page of the report.
3. Print 1 or 2 full lines of Columnar or Field Headings on each page.
4. Control on a maximum of four fields of any length.
5. Group Indicate a maximum of four fields on the first line of each minor control group.
6. Recognize up to 10 types of detail cards by any single column character. If more than one card column must be tested to identify a given type of card, a patch is required. Note: Each of the 10 types may be in separate card columns
7. Add, Subtract, Multiply*, Divide* operations may be performed on Detail or Total lines. *These operations require Multiply/Divide feature.
8. Print multiple lines from one card (MLP).

IBM Application & Systems Programs Library Abstract **File Number** 1401-RG-048

1401 REPORT PROGRAM GENERATOR

Abstract:

Purpose:

1401 RPG is a programming system which generates report writing programs which are specified by the user in the RPG language established for IBM 1400-series machines. The generated report program will accept source data contained in either a card file, magnetic tape file or disk storage file. The language facilitates specifying the classic report writing functions of heading and detail lines, total lines controlled by control field breaks, offset total printing, summary punching, cross-footing and calculation, page and serial numbering, etc.

The output report can be obtained at the printer, on cards, on tape, or on any combination of the three.

Use of Program:

Report specifications, punched on cards, are entered into the 1401 DPS together with the RPG system deck. The output is a punched deck containing the generated report program in symbolic (1401 SPS) language. This deck is further processed by one of the 1401 assembly systems (SPS-1, SPS-2, or Autocoder) to obtain the machine language report writing program ready for loading.

Machine Configuration:

For report program generation:

1 1401 Processing Unit (any model with 4000 or more Core Storage positions)

1 1402 Card Read Punch

1 1403 Printer (Model 1 or 2)

For report program execution:

1 1401 Processing Unit (any model - core storage size required depends upon complexity of report)

1 1402 Card Read Punch

Tape Units (Model 729 II, 729 IV, 729 V, 729 VI, or 7330), 1403 Printer (Model 1 or 2), 1405 Disk Storage Unit - only as required for input data file and output report media.

Multiply-Divide Special Feature - may be used if installed.

Sense Switches Special Feature - may be used if installed

IBM Application & Systems Programs Library Abstract **File Number** 1401-SM-029

1401 SORT I

Abstract:

Purpose: To provide a generalized 2-way SORT program for 1401 users. The program internally sorts input records and merges the sorted blocks into sequenced output records. SORT 1 may also be used as a merge program if input tapes are already ordered.

Method: Does not apply.

Restrictions, Ranges: Does not apply.

Storage Requirements: Does not apply.

Equipment Specifications: 4000 positions of storage
High-Low-Equal compare
Minimum of four (4) tape drives

Additional Remarks:

1. SORT 1 may handle single or blocked records.
2. The sort will be on a maximum of five (5) control fields.
3. SORT 1 will allow a maximum of 800 character blocking for single control field records and 735 for multiple control field records.

(Continued on next page)

4. Restart procedure is provided before each pass.
5. Output can be reblocked.
6. SORT 1 will process input labels and provides the insertion of a different output lable if desired.
7. Three (3) options are provided for disposing of unreadable records:
   (1) Accept record by correcting invalid character
   (2) Punch unreadable block
   (3) Write unreadable block on fifth tape (if available).

IBM Application & Systems Programs Library Abstract File Number 1401-SM-043

1401 SORT II

Abstract:

Purpose: To provide a sort program for advanced 1401 systems. The program consists of an internal sort, which orders a large block of records internally, and a two or three way merge which creates an ordered sequence as output.

Method: Does not apply.

Restrictions, Range: Does not apply.

Storage Requirements: Does not apply.

Equipment Specifications: Minimum of 8000 positions of memory
High-Low-Equal Compare
Advanced Programming Features
Minimum of four (4) tapes

Additional Remarks:

1. SORT II is a generalized sort program adapted for a particular application by use of a control card. It will adapt for 8K, 12K or 16K machines, and may be used as either a two or three way merge.
2. Input records may be singly or multiply blocked.
3. A maximum of ten (10) control fields can be specified by the user.
4. The user may specify size of patch area desired. The program will modify itself to reserve space for any specified patch. Convenient exits are provided in the program.
5. The allowable blocking is dependent on machine size and patch size. Maximum blocking for a 16K machine with no patch area is 3,999 characters.
6. Restart and unreadable record procedures are similar to those of SORT 1.

1401 SORT II

7. SORT II will handle both header and trailer labels and allows for new labels if desired.
8. SORT II will specify both record count and hash total after Phase 1 and on the completion of each pass.
9. Output may be reblocked if desired.
10. The program will optimize the internal sort and merge based on control card parameters.

IBM Application & Systems Programs Library Abstract File Number 1401-SM-044

1401 MERGE II

Abstract:

Purpose: To provide a two, three, four or five way generalized merge program for advanced 1401 systems.

Method: Does not apply.

Restrictions, Range: Does not apply.

Storage Requirements: Does not apply.

Equipment Specifications: Minimum of 8000 positions of memory
High-Low-Equal Compare
Advanced Programming Features
Minimum of three (3) tapes

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Additional Remarks:

1. Merge II is a generalized merge program adapted from a control card for each specific job.
2. The program can handle both blocked and unblocked records, with or without header and/or trailer labels.
3. The header and/or trailer labels may be altered by use of additional label cards.
4. Output may be reblocked if desired by user.
5. The merge may be accomplished on a maximum of ten (10) control fields.
6. Patch area is provided for user application.
7. Unreadable record options are similar to those of 1401 Sort 1 and II.

IBM Application & Systems Programs Library Abstract File Number 1401-SP-021

SYMBOLIC PROGRAMMING SYSTEM 1 (SPS-1)

Abstract:

Purpose: To provide a basic symbolic programming language and processor for the IBM 1401.

Method: Does not apply.

Restrictions, Range: Does not apply.

Storage Requirements: Does not apply.

Equipment Specifications: 1400 positions of storage
1402 Reader-Punch
1403 Printer Model 1

Additional Remarks:

1. SPS-1 is designed to run on a machine with minimum hardware specifications.
2. Additional storage, up to 4000 positions is used if available.
3. Read release option used if available.

IBM Application & Systems Programs Library Abstract File Number 1401-SP-030

SYMBOLIC PROGRAMMING SYSTEMS 2 (SPS-2)

Abstract:

Purpose: To provide a symbolic language processor for machines with greater than 4000 positions of core storage.

Method: Does not apply.

Restrictions, Range: Does not apply.

Storage Requirements: Does not apply.

Equipment Specifications: 4000 positions of storage
1402 Reader-Punch
1403 Printer, Model 1

Additional Remarks:

Additional storage, up to 16,000 positions, is used if available.

IBM Application & Systems Programs Library Abstract File Number 1401-UT-001

1401 CARD SYSTEM UTILITY PROGRAMS

Abstract:

Purpose: Utility Programs to load or to output programs and data.

Method: Does not apply.

Restrictions, Range: Does not apply.

Storage Requirements: Does not apply.

(Continued on next page)

Remarks: Programs provided:

Clear Storage
Card Loader
Print Storage
Punch Storage
Punch-List-Sequence Check

Equipment Specifications: No special features required.

IBM Application & Systems Programs Library Abstract **File Number** 1401-UT-026

1401 TAPE-TO-PRINTER UTILITY PROGRAM

Abstract:

Purpose: 1. To enable the printing of various tape configurations in many print configurations without the need for specific programs.

2. To simulate the 717, 720 and 730 off-line printers for tapes prepared on 700-7000 series computers.

Method: Does not apply.

Restrictions, Range: Does not apply.

Storage Requirements: Does not apply

Equipment Specifications:
*1401 Model C3
1403 Model 2 Printer
1 (one) 729 Model II or IV
*1402 Card Read Punch
High-Low-Equal Compare

*May run on Model D3 if system tape produced on Model C3.

Additional Remarks:

Timing Varies according to record types (i.e. Fixed length or Variable length), and according to spacing and skipping requirements. Fixed length records which are single spaced obtain maximum speed (600 lines/minute).

1. Maximum block size allowable is 1496 characters without Editing; 1279 with Editing.

2. Multi-reel files and multi-file reels may be handled.

3. Sequence checking and exception testing are provided.

IBM Application & Systems Programs Library Abstract **File Number** 1401-UT-027

IBM 1401 CARD-TO-TAPE UTILITY PROGRAM

Abstract:

Purpose: The Card-to-Tape program provides for writing information contained in punched cards onto magnetic tape.

Method: Does not apply.

Restrictions, Range: Does not apply.

Storage Requirements: Does not apply.

Equipment Specifications:
1401 Model C3
High-Low-Equal Compare
1402 Model 1 Card Reader-Punch
1 (one) 709 Model II or IV
1403 Model 2 Printer

Additional Remarks:

1. Input record in from 1 to 99 cards.

2. Rearrangement of input prior to output is allowed.

3. Up to 16 fields may be selected for output.

4. Blocking of 1499 characters of BCD records and 1599 characters for Column Binary records.

5. Sequence checking of cards and records can be performed.

6. An exception record procedure is provided.

7. Header and trailer labels may be inserted.

8. Column Binary records and intermixed Column Binary and BCD records can be written on tape if the 1401 system being used has the Column Binary Device.

(Continued on next column)

IBM 1401 Card-to-Tape Utility Program

9. A count of the number of data cards read and of the records written, exclusive of header and trailer cards and records, is printed out at the end of each file.

IBM Application & Systems Programs Library Abstract **File Number** 1401-UT-028

1401 TAPE-TO-CARD UTILITY PROGRAM

Abstract:

Purpose: To transfer information recorded on magnetic tape into punched cards, with a variety of output column designations.

Method: Does not apply.

Restrictions, Range: Does not apply.

Storage Requirements: Does not apply.

Equipment Specifications:
1401 Model C3
1403 Model 2 Printer
729 Model 2 or 4 Tape Drive
1402 Card Reader-Punch
High-Low-Equal Compare

Additional Remarks:

Timing: Varies from 200 to 250 c.p.m., depending upon the number of options desired by the user.

1. Maximum block size allowable 1197 characters.

2. Additional information not contained within the record may be punched.

3. Field sequence checking and field selection is permitted.

4. Multiple file reels are processed according to the user's specifications.

5. Exception record processing and card sequence numbering is allowed.

6. Header and Trailer labels are optionally treated.

IBM Application & Systems Programs Library Abstract **File Number** 1401-UT-039

MULTIPLE UTILITY PROGRAM FOR IBM 1401 TAPE SYSTEM

Abstract:

Purpose: To simulate current off-line processing by 700 series equipment, and allow any combination of Tape-to-Card, Tape-to-Printer and Card-to-Tape operations to be performed at the same time.

Method: Does not apply.

Restrictions, Range: Does not apply.

Storage Requirements: Does not apply.

Equipment Specifications:
1401 Model C3
1402 Reader-Punch
1403 Model 2 Printer
729 Model 2 or 4 Tape unit (as many as user desires for 1, 2, or 2 simultaneous operations)
High-Low-Equal Compare
Advanced Programming Features
Column Binary feature (if user desires)
*Print Storage

*Print Storage is not a mandatory specification. More rapid processing of data will occur when this feature is a part of 1401 system.

Additional Remarks:

Timing Maximum speed will be effected when any one single operation is being performed. Tape-to-Printer 600 lpm, Card-to-Tape 800 c/pm, Tape-to-Card 250 c/pm.

When more than one operation is desired simultaneously, the following time speeds are applicable:

(Continued on next page)

Multiple Utility Program for IBM 1401 Tape System

Card-to-Tape - Tape-to-Printer, single space printing 510 c & 1/pm.
Card-to-Tape - Tape-to-Printer, 1st character forms control 400 c & 1/pm.
Card-to-Tape - Tape-to-Card, 310 card read, 160 card punch/pm.
Tape-to-Printer - Tape-to-Card, 325 1/pm, 160 c/pm.
Card-to-Tape - Tape-to-Printer, Tape-to-Card 275 1/pm. 275 card read, 140 card punch/pm.

1. High and low densities may be intermixed on the several tape drives while running simultaneous operations.

2. Binary and BCD operations may be processed at the same time except that the same operation (i.e., Taoe-to-Card BCD as operation #1, and Taoe-to-Card Binary as operation #2) is not permitted.

3. Any combination of the following may be processed at the same time considering the restrictions stated in 2 above: Tape-to-Card BCD, Tape-to-Card Binary, Card-to-Tape, BCD, Card-to-Tape Binary, Card-to-Tape processing files containing both Binary and BCD records, and Tape-to-Printer. Only Tape-to- Printer may be blocked and to a maximum of 1000 characters.

4. Interrupt (switch E) allows interruption of processing to delete or activate additional functions after which the program continues governed by the new sense switch settings.

IBM Application & Systems Programs Library Abstract **File Number** 1401-UT-051

FILE UTILITIES

Abstract:

Purpose: This is a set of six independent programs to perform many common tasks associated with the 1405 disk storage. The programs are: Clear Disk, Disk to Printer, Tape to Disk, Disk to Tape, Card to Disk, and Disk to Card.

Use: Control cards are used to specify the affected portions of the disk file.

Restrictions: The Tape to Disk and Card to Disk are companion programs to the Disk to Tape and Disk to Card programs, and are designed to load the data generated by these programs. Memory requirements are from 2K to 4K, depending upon which program is used.

Equipment Specifications: 1401 Model F, 1402, 1403, 1405, tape drives as required for programs.

IBM Application & Systems Programs Library Abstract **File Number** 1401_UT-057

FILE ORGANIZATION ROUTINES

Abstract:

Purpose:

The chaining method of File Organization is an efficient method of handling the problem of duplicate file addresses, when control data (item number, man number, etc.) are converted to disk storage addresses. The 1401-1405 File Organization Program will efficiently load and maintain a chained disk file so as to minimize the amount of unused storage, as well as the retrieval time for each record.

1401 File Organization features are: 1) an edit program which will edit a symbolic version of the program so as to provide the most efficient program for any size 1401, 2) ability to make additions and deletions to a chained file, 3) load and add trailer records to a file, 4) unload a file onto cards or tape for reorganization, 5) an audit list consisting of the control data of records being loaded and their addresses, 6) input data records may be on card or tape.

Use of Program:

The Load and Additions programs are used in conjunction with the edit program. The user provides the specifications of his file and machine in a control card which is examined by the edit program to create a symbolic version of the load and additions programs which meet those specifications. The edited program and the users conversion routine (routine to convert control data to disk address) are assembled with either SPS or Autocoder. The assembled program will then load the users data file (on card or tape) with a given format onto the disk file in the desired area. The program will create the necessary chain linkages.

The remaining programs are not edited, but must be assembled with the users conversion routine. The control card is examined at object time and the users data is operated upon according to the specifications in the control card.

All of the programs provide for all I/O error checking. The programs utilize one or two access arms depending upon the number available. If there are two arms, and one fails, the program will continue to operate with one arm.

Machine Configuration:

1 1401 Processing Unit (4000 core storage positions are minimum)
1 1402 Card Read-Punch
1 1403 Printer (Model 1 or 2)
1 1405 Disk Storage Unit (Model 1 or 2)
1 or 2 Tape Units (Model 729 II, 729 IX, 729 V, or 7330) may be used if data is on tape.

IBM Application & Systems Programs Library Abstract **File Number** 1401-UT-066

1401-1009 UTILITY PROGRAMS

Abstract:

Purpose: The 1401-1009 Utility transmits data to or receives data from another terminal on either cards or magnetic tape.

Use of Program: The four uses are:

1. Transmit data from cards - blocked or unblocked.
2. Transmit data from magnetic tape.
3. Receive blocked or unblocked data on cards.
4. Receive data on tape.

Machine Configuration:

1 1401 Processing Unit with 4000 or more Core Storage positions
Sense Switches special feature is required

1 1402 Card Read Punch

1 1009 Data Transmission Unit
Serial I/O Adapter

1 Tape Unit (Model 729 II, 729IV, 729V, or 7330) is optional

IBM Application & Systems Programs Library Abstract File Number 1410-AT-104

1410 PAT UTILITY SYSTEM (10/20K)

Abstract:

Purpose: The 1410 PAT system facilitates the testing of newly developed 1410 programs by reducing the amount of machine time and programmer effort required during the testing stage of program development. In addition to the automatic testing facility, the PAT system provides a number of 1410 card, tape and 1405 disk utility programs.

Use of Program: At the direction of the user and under control of a PAT program, the PAT routines are arranged on a PAT tape in conjunction with the programs to be tested. The routines and programs are arranged in the order they are to be executed. Testing the programs merely requires the loading of the PAT tape and an identification card for each program to be tested.

Machine Configuration: The 1410 PAT System (10/20K) requires an IBM 1410 system with the following minimum configuration:

10,000 positions of core storage
IBM 1402 Card Read-Punch
IBM 1403 Printer, Model 2
2 IBM 729 II, 729 IV, or 7330 Magnetic Tape Units on Channel one (1)

IBM Application & Systems Programs Library Abstract File Number 1410-AT-105

1410 PAT UTILITY SYSTEM (40K)

Abstract:

Purpose: The 1410 PAT System facilitates the testing of newly-developed 1410 programs. This automatic testing procedure reduces the amount of machine time and programmer effort required during the testing stage of program development. The PAT System also lends itself to remote testing. The PAT System provides the automatic testing facility plus a number of 1410 card, tape, and 1405 disk utility programs.

Use of Program: The 1410 PAT System comprises a series of program testing routines and utility programs that, at the direction of the user and under control of the PAT program, are arranged in conjunction with the program to be tested on a PAT tape.

The routines and programs are arranged on tape in the order they are to be executed. Testing the program merely requires the loading of the PAT tape and an identification card for each program to be tested. The routines and programs on tape are automatically executed in predetermined sequence.

Machine Configuration: The 1410 PAT System requires:

a. An IBM 1410 with 40K positions of core storage
b. An IBM 1402 Card Reader-Punch
c. An IBM 1403 Model 2 Printer
d. At least two IBM 729 or 7330 Tape Units on Channel one (1).

IBM Application & Systems Programs Library Abstract File Number 1410-AU-102

1410 BASIC AUTOCODER

Abstract:

Purpose: The 1410 Basic Autocoder relieves the user from writing his routines in machine language. He may now write his routine using a well defined set of mnemonic operation codes in conjunction with useful and significant labels, which he defines, and then processes them with Basic Autocoder to produce an operating object program. If the user requires a more detailed description of this program, he may obtain it by requesting the Basic Autocoder Bulletin listed in the references.

Use of Program: The source symbolic program is combined with this program in a predescribed manner and is operated on by the compiler to produce an operating object program.

Machine Configuration: The machine configuration required by the Basic Autocoder program is:

1. Minimum of 10,000 core locations.
2. One 1402 Reader-Punch.
3. One 1403 Printer.

IBM Application & Systems Programs Library Abstract File Number 1410-AU-906

1410 AUTOCODER

Abstract:

Purpose: The 1410 Autocoder relieves the user from writing his routines in machine language. He can write his routine using a well defined set of mnemonic operation codes in conjunction with useful and significant labels, which he defines, and then processes with Autocoder to produce an operating system deck. He may also write macro statements and include subroutines in the library. A more detailed description of this program is contained in the Autocoder bulletin listed in the references.

Use of Program: The source symbolic program is set up in a prescribed manner and is operated on by the Autocoder to produce an operating system deck.

Machine Configuration: The machine configuration required by the Autocoder is:

1. Minimum of 20 K storage.
2. Four IBM 729 II, IV, or 7330 Magnetic Tape Units.
3. An IBM 1402 Card Read Punch. *
4. An IBM 1403 Printer, model 2. *

* Options are available to trade 1, 2, or 3 magnetic tape units for the 1402 and 1403 unit record devices.

IBM Application & Systems Programs Library Abstract File Number 1410-CB-912

1410 COBOL PROCESSOR

Abstract:

Purpose: 1410 COBOL Processor accepts programs written in the COBOL 61 language as input and produces complete object programs to perform the functions specified in the source statements.

Use of Program: The process involves a COBOL run (which produces COBOL diagnostics and the source program translated into Autocoder language and format) followed by an Autocoder run (which produces the object program assembly listing and a condensed deck). The process is continuous and complete if

(1) no serious diagnostic errors are discovered, and

(2) if the system configuration provides tape input to the Autocoder Processor.

Machine Configuration: Basic requirements are:

1. Minimum of 20 K storage.
2. An IBM 1402 Card Read Punch, model 2.
3. An IBM 1403 Printer, model 2.
4. Four IBM 729 II, IV or 7330 Magnetic Tape Units (may be intermixed).

IBM Application & Systems Programs Library Abstract File Number 1410-FO-913

1410 FORTRAN II PROCESSOR

Abstract:

Purpose: The 1410 FORTRAN (FORmula TRANslating) II Processor is a 1410 machine-language program. This program converts a source program written in the FORTRAN II language (which closely resembles the language of mathematics) into an object program ready to run on the IBM 1410. The FORTRAN processor thus makes it possible for personnel trained in mathematics but not in programming to prepare problems for the computer.

Use of Program: The processor is used in two phases: a FORTRAN phase and an Autocoder phase. During the FORTRAN phase, the processor compiles a symbolic program in Autocoder format. During the Autocoder phase, the processor converts this Autocoder program into a 1410 object program.

Machine Configuration: Minimum machine requirements for the use of the program are:

20,000 positions of core storage

1 IBM 1402 Card Read-Punch, Model 2

1 IBM 1403 Printer, Model 2

4 IBM 729 II, IV, or 7330 Magnetic Tape Units (may be intermixed)

IBM Application & Systems Programs Library Abstract **File Number** 1410-IO-909

1410 INPUT/OUTPUT CONTROL SYSTEM (CARD/TAPE IOCS)

Abstract:

Purpose: The 1410 Card/Tape IOCS relieves the user from coding input and output routines for unit record equipment and magnetic tapes. It enables the programmer to handle logical records merely by using GET, PUT, and related IOCS macro-instructions. The blocking and deblocking of records is handled automatically by IOCS. Also, IOCS can be instructed to provide the coding required for the overlapping of input and output operations with processing if the 1410 is equipped with the Overlap and Priority special features.

Use of Program: For each program which is to utilize the IOCS, the programmer must:

1. Use the IOCS macro-instruction in his program.
2. Write one set of DIOCS statements.
3. Write one set of DTF statements for each file used by his program.
4. Write proper DA statements for each area used by the IOCS.

The IOCS routines are generated by the Autocoder and placed in the user's program when it is compiled.

Machine Configuration: IOCS has no machine configuration requirements. Autocoder configurations are, of course, required during IOCS generation

IBM Application & Systems Programs Library Abstract **File Number** 1410-IO-911

1410 INPUT/OUTPUT SYSTEM FOR 1405 DISK STORAGE

Abstract:

Purpose: The 1405 Disk IOCS provides several macro-instructions and related routines that handle the scheduling of 1405 input and output operations for random and/or sequential processing.

Use of Program: This IOCS is used in conjunction with 1410 Card/Tape IOCS. The appropriate disk I/O routines are generated by 1410 Autocoder according to file specifications and placed in the user's program when it is compiled.

Machine Configuration: The machine configuration required by the Input/Output System for 1405 Disk Storage is:

1. Minimum of 20K storage
2. 1405 Disk storage
3. Processing Overlap and Priority special features.

IBM Application & Systems Programs Library Abstract **File Number** 1410-PR-108

PROCESSOR OPERATING SYSTEM TAPE

Abstract:

Purpose: This is a systems tape containing the following 7 programs:

1410-SV-907	System Supervisor
1410-AU-906	Autocoder
1410-IO-909	IOCS Card/Tape
1410-IO-911	IOCS 1405 Disk
1410-RG-910	Report Program Generator
1410-CB-912	COBOL 61
1410-FO-913	FORTRAN II

IBM Application & Systems Programs Library Abstract **File Number** 1410-RG-103

1410 CARD REPORT PROGRAM GENERATOR

Abstract:

Purpose: The 1410 Card RPG condensed deck accepts specifications and produces a symbolic deck in Basic Autocoder for a report program. Processing is sequential, without allowance for overlap and priority, both in RPG itself, and in the generated report program. The latter can produce reports in a wide range of formats, extracting its data from a card file and performing calculations very much after the fashion of an IBM 407 Accounting Machine, save that multiply, divide and compare, in addition to more basic calculations, may be performed at any point in the total reporting process.

Use of Program: A control card and specifications cards must be placed at definite points in the RPG condensed deck. The standard card loader is used.

Machine Configuration: The 1410 Card RPG will handle card input and card-printer output only. Machine requirements are:

10K	storage
1402	card reader/punch
1403	printer (either 100 or 132 character positions)

The report program generated by RPG will have machine requirements dependent on the specifications provided. The minimum would be:

10K	storage
1402	card/reader punch

IBM Application & Systems Programs Library Abstract **File Number** 1410-RG-910

1410 REPORT PROGRAM GENERATOR (CARD/TAPE/1405 - DISK RPG)

Abstract:

Purpose: The 1410 RPG accepts report specifications and produces a symbolic program deck (Autocoder format) for the desired report program. The generated report program can produce a wide range of formats, extracting its data from a card, tape or disk file (one only) and performing calculations at any point in the reporting process. RPG-generated programs utilize the 1410 IOCS.

Use of Program: A control card and the report-specifications cards are placed in proper order in the card reader. The Processor Operating System Tape, 1410-PR-108, and one work tape are used in the RPG run. An Autocoder run must follow to produce the program deck for the report program. The output of the generated program can be a printed report and/or punched cards, or tape records in the move mode, even parity.

Machine Configuration:

Minimum requirements are --

1. For RPG (to generate the report program) - 1410 system... 20 K storage... 1402 Card Read Punch... two magnetic tape units (729 II, IV, or 7330).
2. For Autocoder (to assemble the report program) - 1410 system... 20 K storage... 1402 Card Read Punch... four magnetic tape units (729 II, IV, or 7330)... 1403 Printer, model 2. (See configuration of Autocoder for options.)
3. For the report program (to produce the report) - 1410 system... 20 K storage... 1402 Card Read Punch... other I/O units appropriate to the program.

IBM Application & Systems Programs Library Abstract **File Number** 1410-SI-042

Simulation of the 1410 with the 704/709/7090

Abstract

Purpose: The program enables the user to test and correct 1410 programs prior to installation of an IBM 1410 data processing system. The system will trace or dump simulated programs.

Restrictions: The program simulates standard card and tape systems. The simulated 1410 has 20,000 core storage positions. Using Basic Autocodes the simulator will assemble 1410 programs. A maximum of one disk of 1405 storage can be simulated.

Timing: The 709 takes approximately 20 times longer than if the program was running on a 1410.

Equipment Specifications:
32,676 words of core storage
4 tape units + 1 for simulated 1410 tape units + 2 for disk

Additional Remarks: This program is distributed on a card deck.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1410-SI-101

SIMULATION OF THE IBM 650 ON THE IBM 1410

(Continued on next page)

Abstract:

Purpose: The 650 Simulation provides means to run 650 programs on a production basis on the 40K 1410. If the user requires a more detailed description on the program, he may obtain it by requesting the Simulation of IBM 650 on IBM 1410 Bulletin.

Use of Program: The 650 Simulation is to be entered into the 1410 along with control information indicating the system being simulated. Then the 650 program is run monitored through the 650 Simulator Program.

Machine Configuration: The machine configuration required by the Simulation of IBM 650 on IBM 1410 program is:

1. Minimum of 40,000 core locations.
2. One 1402 Reader-Punch.

IBM Application & Systems Programs Library Abstract **File Number** 1410-SM-110

1410 SORT 10

Abstract:

Purpose: Sort 10 is a generalized sorting program which employs from 1 to 5 IBM 1405 Disk Storage Units and the Processing Overlap and Priority Special Features. Input records can be either on tape or in disk storage and can be fixed or variable length, single or blocked. Output will be on tape in ascending order.

Use: A minimum of four control cards must be prepared by the user prior to operating Sort 10 on the 1410. These cards supply the program with information it needs to make itself specific for the data characteristics and for the machine configuration.

Machine Configuration: Sort 10 requires an IBM 1410 Data Processing System with the following minimum configurations:

a) 20,000 positions of core storage.
b) 1 IBM 1405 Disk Storage Unit.
c) Processing and Overlap Special Features.
d) 1 IBM 729 II, 729 IV or 7330 Magnetic Tape Unit.
e) IBM 1402 Card Read-Punch, Model 2.

If storage size is 40K, Sort 10 will use the additional storage, when necessary, to increase the size of its input/output areas and work areas.

IBM Application & Systems Programs Library Abstract **File Number** 1410-SM-111

SORT/MERGE 11

Abstract:

Purpose: Sort-Merge 11 is a generalized un-buffered tape sorting and merging program designed to permit either the sorting or the merging of data so as to produce ordered output data. Input records can be fixed or variable length, single or blocked. Output can be either in ascending or descending order. Any order of merge up to 5-way may be employed.

Use: A minimum of two control cards must be prepared by the user prior to operating Sort/Merge 11 on the 1410. These cards supply the program with information it needs to make itself specific for the function to be performed, for the data characteristics and for the machine configuration.

Machine Configuration: Sort/Merge 11 requires an IBM 1410 Data Processing System with the following minimum configuration:

a) 20,000 positions of core storage
b) 4 IBM 729 II, 729 IV, and/or 7330 Magnetic Tape Units (may be inter-mixed) if Sort/Merge 11 is to function as a Sort. (To perform a 2-way Merge, only three tapes are needed.)
c) IBM 1402 Card Read-Punch Model 2.

If storage size is 40K, 60K or 80K, Sort/Merge 11 will use the additional storage, when necessary, to increase the size of its Input/Output Areas and Work Areas.

IBM Application & Systems Programs Library Abstract **File Number** 1410-SM-112

SORT/MERGE 12

Abstract:

Purpose: Sort - Merge 12 is a generalized tape sorting and merging program which employs the processing Overlap and Priority Special Features. It is designed to permit either the sorting or the merging of data so as to produce

(Continued on next column)

ordered output data. Input records can be fixed or variable length, single or blocked. Output can be either in ascending or descending order. Any order of merge up to 5-way may be employed.

Use: A minimum of two control cards must be prepared by the user prior to operating Sort/Merge 12 on the 1410. These cards supply the program with information it needs to make itself specific for the function to be performed, for the data characteristics and for the machine configuration.

Machine Configuration: Sort/Merge 12 requires an IBM 1410 Data Processing System with the following minimum configuration:

a) 20,000 positions of core storage
b) Processing Overlap and Priority Special Features
c) 4 IBM 729 II, 729 IV, and/or 7330 Magnetic Tape Units (may be inter-mixed) if Sort/Merge 12 is to function as a Sort. (To perform a 2-way Merge, only three tapes are needed.)
d) IBM 1402 Card Read-Punch Model 2.

IBM Application & Systems Programs Library Abstract **File Number** 1410-SV-907

1410 SYSTEM SUPERVISOR

Abstract:

Purpose: The System Supervisor has several functions in the operation of the Processor Operating System Tape.

1. In the role of a Supervisor, it picks up information from control cards and, acting upon this information, positions the System Tape, calls in the required phase or program and then turns control over to the program called.

2. The System Supervisor also accomplishes the duplication of new system tapes as well as the maintenance of the system tape.

3. Another part of the System Supervisor is the Library PRINT Program, which prints any desired section of the library that is on the Processor Operating System Tape.

Use of Program: The System Supervisor consists of three programs contained in the system tape. They are self loading, or are called by control cards, and perform the functions listed above as directed by control information.

Machine Configuration: The machine configuration required by the System Supervisor for system maintenance runs is:

1. Minimum of 20 K storage.
2. Two IBM 729 II, IV, or 7330 Magnetic Tape Units.
3. IBM 1402 Card Read Punch.

The machine configuration for the individual programs on the Processor Operating System Tape are specified in the Abstracts of the programs. The 1410 Autocoder has the largest minimum requirement.

IBM Application & Systems Programs Library Abstract File Number 1410-UT-106

1410 UTILITY PROGRAMS

Abstract:

Tape File Generator A. This program prepares unblocked tape files from variable-length card records.

Tape File Generator B. This program generates blocked and unblocked tape files from fixed length card records.

Tape Compare Program. This program compares the contents of two magnetic tapes, each of which can be in odd or even parity, and high or low density. They may have fixed or variable-length records and may be blocked or unblocked. Only one file can be compared on a run, and the comparison may start at any file or record on either tape. If the records are not identical, they will be written out.

Tape Duplicate Program. This program duplicates the contents of one magnetic tape on a second tape. The duplicated tape can be written in high or low density and in odd or even parity, regardless of the density and parity of the original tape. The original tape may contain fixed or variable-length records, and may be blocked or unblocked. Up to nine files of a multi-file reel can be duplicated.

Snapshot Program. The Snapshot Program is a program testing aid. It points out the contents of a specified area of core storage following the execution of any specified instruction in the object program. Following the execution of the Snapshot Program, control is returned to the object program. The Snapshot Program also prints the contents of the Index Registers and the settings of the HIGH-LOW-EQUAL, ARITHMETIC-OVERFLOW, or ZERO RESULT indicators.

Storage Print Program. The Storage Print program prints out the entire contents of 1410 core storage. Substitute characters are used in place of those not available on the user's 1403 Printer. Word marks are represented by the digit "1" printed above the character with which the word mark is associated.

1410-1405 DISK UTILITY PROGRAMS

Abstract:

Clear Disk Program. The Clear Disk Storage Program erases all data in all or selected portions of disk storage by writing blanks. The user also has the option of filling these areas with any one of the other 63 valid characters, and the ability to write a six-digit address in the first six positions of each sector cleared by this program.

Disk-to-Tape Program. The Disk to Tape 'A' Program enables the user to preserve data contained in all or selected portions of a disk file before that data is updated or altered.

Tape-to-Disk Program. The Tape to Disk 'A' Program enables the user to reload into disk storage all or selected portions of the tape records that have been unloaded by the Disk to Tape Program.

Disk-to-Printer Program. The Disk to Printer Program is used to print out on the IBM 1403 Printer data contained in all or portions of a disk file.

Disk File Generator. The Disk File Generator enables the user to load data from punched cards into disk storage.

Use of Programs: The 1410-1405 Disk Utility Programs are used in conjunction with a Machine Specifications Card, and with Area Control Card(s). The programs will allow the user to clear all of disk storage or selected areas of it to blanks or any other allowable character, generate data in all or selected areas of disk storage, write the contents of all or selected areas of disk storage on tape or on the printer, and reload areas of disk storage that were previously written on tape. The smallest area that may be acted upon, however, is a single track of ten sectors.

Machine Configuration

Basic Requirements for all programs.

Each program requires a minimum of:

10,000 positions of core storage
1 IBM 1405 Disk Storage Unit, Model 1 or 2
1 IBM 1402 Card Reader Punch

Additional requirements:

1410-1405 Disk-to-Printer Program
1 IBM 1403 Printer, Model 1 or 2

1410-1405 Disk-to-Tape Program
1 IBM 729 II, 729 IV, or 7330 Magnetic Tape Unit

1410-1405 Tape-to-Disk Program
1 IBM 729 II, 729 IV, or 7330 Magnetic Tape Unit

IBM Application & Systems Programs Library Abstract **File Number** 1410-UT-117

1410-1405 DISK FILE PROTECTION PROGRAMS

Abstract:

Disk-to-Tape with Overlap. The Disk-to-Tape File Protection Program enables the user to preserve data contained in all or specified portions of a disk file before that data is updated or altered. Because of the utilization of the Overlap special feature this program is considerably faster (approximately 35%) than the DISK-TO-TAPE utility program. This program is primarily written to be used in conjunction with the users production programs.

Tape-to-Disk with Overlap. The Tape-to-Disk File Protection Program enables the user to reload into disk storage all or specified portions of the tape records that have been unloaded by the TAPE-TO-DISK File Protection Program. Because of the utilization of the Overlap special feature this program is considerably faster (approximately 20%) than the DISK-TO-TAPE utility program. This program is primarily written to be used in conjunction with the users production programs.

Use of Programs

These File Protection Programs can only be used on a machine that has the Processing Overlap special feature, and only full tracks are written and loaded. The programs are used in conjunction with a Machine Specifications Card, and with Area Control Card(s). The user can unload onto tape or reload from tape either a complete disk file or selected areas of the file. Either the Move mode or the Load mode may be used.

IBM Application & Systems Programs Library Abstract **File Number** 1620-AT-013

1620 FLOW TRACE PROGRAM

Abstract:

Purpose: To enable the programmer to check that the path (flow) of his program is correct. Should the program deviate from the expected, the trace helps localize the trouble.

Method: The trace program detects every branch that actually occurs in the object program, types the address of the branch instructor and the address to which it branched.

Restrictions, Range: Cannot discontinue the trace in the middle of the subroutine linked to the main program by a BT or a BTM and a BB instruction.

Storage Requirements: 631 positions of core storage. Program is relocatable.

Equipment Specifications: 1620 with paper-tape reader. No restriction on 1620 core storage (20K, 40K, 60K). Trace output is via typewriter. Cannot be used on machines with Indirect Addressing feature.

IBM Application & Systems Programs Library Abstract **File Number** 1620-AT-014

1620 SELECTIVE TRACE PROGRAM

Abstract:

Purpose: To provide more detailed checking than the FLOW TRACE PROGRAM. To help pinpoint the exact location of the trouble. To enable the programmer to check each instruction as it appears in memory and the data fields as they are manipulated.

Method: Not applicable.

Restriction, Range: If instruction contains a record mark, only that part of the instruction up to, but not including the record mark, will be typed. Cannot terminate the trace during the execution of a subroutine linked to the program with a BT or BTM and a BB instruction.

Storage Requirements: Program requires 2443 core locations. The small parameter table (containing start trace & stop trace addresses) is located at the end of the program and the additional storage required by the table will vary depending upon the number of parameters specified. The program is completely relocatable.

IBM Application & Systems Programs Library Abstract **File Number** 1620-FO-001

1620 FORTRAN (Tape)

Abstract:

Purpose: Program converts source program written in FORTRAN language into machine language instructions.

Method: Not given.

Restrictions, Range: Permissible FORTRAN language is a subset of 704/709/7090 FORTRAN language. Number of symbols is limited to 300.

Storage Requirements: Requires 20,000 storage positions 1620.

Equipment Specifications:
1620 CPU
1621 Paper Tape Reader
961 Tape Punch
1623 Core Storage Unit may be added, at the user's option.

IBM Application & Systems Programs Library Abstract **File Number** 1620-FO-002

1620 FORTRAN (Card)

Abstract:

Purpose: Program converts source program written in FORTRAN language into machine language instructions.

Method: Not given.

Restrictions, Range: Permissible FORTRAN language is a subset of 704/709/7090 FORTRAN language. Number of symbols is limited to 300.

Storage Requirements: Requires 20,000 storage positions 1620.

Equipment Specifications:
1620 CPU
1622 Card Read-Punch Unit
1623 Core Storage Unit may be added, at the user's option.

IBM Application & Systems Programs Library Abstract **File Number** 1620-FO-003

FORTRAN with FORMAT FOR PAPER TAPE

Abstract:

Purpose: Program converts source program written in FORTRAN language into machine language instructions.

Method: Not given.

Restrictions, Range: Permissible FORTRAN language is a subset of 704/709/7090 FORTRAN language. Number of symbols is limited to 300. The program will process FORMAT statements.

Storage Requirements: Requires 20,000 storage positions 1620.

Equipment Specifications:
1620 CPU
1622 Card Read-Punch Unit
1623 Core Storage Unit may be added, at the user's option.

IBM Application & Systems Programs Library Abstract **File Number** 1620-FO-004

FORTRAN With FORMAT

Abstract:

Purpose: Program converts source program written in FORTRAN language into machine language instructions.

Method: Not given.

Restrictions, Range: Permissible FORTRAN language is a subset of 704/709/7090 FORTRAN language. Number of symbols is limited to 300. The program will process FORMAT statements.

Storage Requirements: Requires 20,000 storage positions 1620.

Equipment Specifications:
1620 CPU
1621 Paper Tape Reader
961 Tape Punch
1623 Core Storage Unit may be added, at the user's option.

IBM Application & Systems Programs Library Abstract **File Number** 1620-FO-005

FORTRAN PRE-COMPILE FOR PAPER TAPE

Abstract:

Purpose: This program detects and permits correction of errors in a FORTRAN source program before the object program is compiled. The Pre-Compile detects many of the more common programming errors in individual source statements, and indicates possible logical errors in the source program as a whole.

Storage Requirements: 20,000 positions.

Equipment Specifications:
1620 CPU
1621 Paper Tape Reader

IBM Application & Systems Programs Library Abstract **File Number** 1620-FO-006

FORTRAN PRE-COMPILE FOR CARD

Abstract:

Purpose: This program detects and permits correction of errors in a FORTRAN source program before the object program is compiled. The Pre-Compile detects many of the more common programming errors in individual source statements, and indicates possible logical errors in the source program as a whole.

Storage Requirements: 20,000 positions.

Equipment Specifications:
1620 CPU
1622 Card Reader Punch

IBM Application & Systems Programs Library Abstract **File Number** 1620-LM-017

TRANSPORTATION PROBLEM

Abstract:

Purpose: This program solves the transpotation problem. That is, it minimizes the total cost of shipping from M warehouses to N retailers.

Method: A logical search technique applied to the stepping-stone method.

Restrictions: Problem sizes are indicated by the formula:

6,000 + (M) (N) (MODC) + (M + N) (MODS + MODC + 23) + M(MODS + 12) + MODS = CORES

where M = number of warehouses MAX of 99
N = number of retailers MAX of 900
MODS = maximum number of digits used to specify units.
MODC = maximum number of digits used to specify cost.
CORES = number of positions of core memory.

Typical sizes are 40 x 50 with both MODS and MODC equal to 5 digit fields, 40 x 80 with MODS and MODC reduced to 3 digit fields, or if 40K additional memory is available, a 48 x 300 problem may be solved using 3 digit fields.

Equipment Specifications: Card or tape I/O, indirect addressing.

Additional Remarks:

Results of a 40 x 50 Problem

Calculation time for a 40 x 50 test problem varied from 3 min. using 3 digit cost and unit fields to 3 3/4 min. using 8 digit fields. The variation of core storage used was from about 15,000 to over 26,000. The total card input required approximately 2 1/2 additional min. while the output added another 1/2 min., for a total running time of less than 7 minutes.

Other 40 x 50 test problems have required as much as 8 minutes of calculation time, using 8 digit fields and occupying over 26,000 core locations.

IBM Application & Systems Programs Library Abstract **File Number** 1620-LM-018

Production Line Balancing

Abstract

Purpose: This routine assigns operators to jobs on an assembly line. The assembly line is divided into zones and the assignment is done in a manner which tends to balance the work load in each zone.

Method: A fast approximation method.

Restrictions: There can be up to 99 zones. The maximum number of jobs per zone is 27 to 98 depending on the average number of precedence jobs per job. The maximum number of can do jobs is 98.

Timing: A problem with 338 input cards and 167 can do jobs took about 3 minutes exclusive of I/O.

Equipment Specifications: Paper tape reader or card reader.

IBM Application & Systems Programs Library Abstract **File Number** 1620-LM-022

1620 FORTRAN with FORMAT - AUTOMATIC FLOATING POINT SUBROUTINES, CARD SYSTEM

Abstract:

Purpose: This subroutine package can be used with 1620 FORTRAN with FORMAT, Card System (Program #1620-FO-004) to realize the advantages of the Automatic Floating Point feature. Storage requirements for the subroutines are reduced and execution time of object programs decreased.

Use of the Program: The subroutines may be incorporated into the object program deck at compilation or may be loaded separately prior to the execution of the object program. Messages are automatically types during compilation and loading, indicating appropriate action by the user. This subroutine deck is fully compatible with the two distributed with the 1620 FORTRAN with FORMAT processor.

Machine Configuration: The subroutine package operates on a 1620 with the card read-punch and the Automatic Floating Point feature.

IBM Application & Systems Programs Library Abstract **File Number** 1620-LM-023

1620 FORTRAN with FORMAT - AUTOMATIC FLOATING POINT SUBROUTINES, TAPE SYSTEM

Abstract:

Purpose: This subroutine package can be used with the 1620 FORTRAN with FORMAT, Tape System (Program #1620-FO-003) to realize the advantages of the Automatic Floating Point feature. Storage requirements for the subroutines are reduced and execution time of object programs decreased.

Use of the Program: The subroutines may be incorporated into the object program tape at compilation or may be loaded separately prior to the execution of the object program. Messages are automatically types during compilation and loading, indicating appropriate action by the user. This subroutine tape is fully compatible with the two distributed with the 1620 FORTRAN with FORMAT processor.

Machine Configuration: The subroutine package operates on a 1620 with punched tape input-output and the Automatic Floating Point feature.

IBM Application & Systems Programs Library Abstract **File Number** 1620-MI-015

1620 HASH TOTAL PROGRAM

Abstract:

Purpose: The purpose of this program is to determine quickly and to a high probability whether a duplicated tape is an exact character for character copy of its original. This is accomplished by taking an arithmetic "hash total" of all the characters on any given tape.

Restrictions, Range: Does not apply.

Method: After each record is read in, it is split into fields of twenty digits and then each of these fields, in turn, is subtracted from an area called the accumulator. At the conclusion of the routine the accumulator is compared with a previously entered check total and a message indicating the result is typed.

Storage Requirements: The program occupies core locations 402 to 1116 and 19980 to 19999. The remainder is available for input records.

Equipment Specifications: This program may be used on a basic IBM 1620 paper tape machine with no optional features.

IBM Application & Systems Programs Library Abstract **File Number** 1620-MI-016

1620 NUMERIC TAPE DUPLICATOR/CORRECTOR

Abstract:

Purpose: To duplicate or correct 1620 tapes consisting only of numeric records, separated by end-of-line characters.

Method: Punching a tape which is an exact copy of the original or punching a second tape incorporating the desired changes.

Restrictions, Range: Maximum permissible record length is 8,850. Also, corrections may not increase or decrease the length of any record.

Storage Requirements: Program is loaded into memory from 00402 to 02300. Each record to be duplicated is loaded from 02301. The program also uses an area of core storage, ending in 19999 and equal to the length of the record, as a dump area.

Equipment Specifications: 1620 with paper tape and 20K memory.

IBM Application & Systems Programs Library Abstract **File Number** 1620-PR-010

1620 GOTRAN (Tape)

Abstract:

Purpose: A relatively fast compiler for programs which will generally be executed only once.

Method: GOTRAN stores the compiled program in memory during computation. The object program is then executed in an interpretive mode. No object tape or deck is produced. After execution of an object program, computation of a new object program is possible without loading the processor.

Restrictions, Range: The language used in GOTRAN is a modified subset of FORTRAN, including the functional subroutines. Arithmetic statements are restricted to one arithmetic operation per statement.

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Data is handled in the form of 10 digit floating point numbers of 3 digit fixed point numbers. Input-output is the same form as FORTRAN with the exception that cards are punched with one item per card.

The maximum number of symbols that may be used is 500 in the tape system and 490 in the card system. The number statements allowed is inversely proportional to the number of symbols used. Approximately 211 statements can be compiled using 200 symbols.

Storage Requirements: Not given.

Equipment Specifications: Basic 1620 Tape.

IBM Application & Systems Programs Library Abstract **File Number** 1620-PR-011

1620 GOTRAN (Card)

Abstract:

Purpose: A relatively fast compiler for programs which will generally be executed only once.

Method: GOTRAN stores the compiled program in memory during computation. The object program is then executed in an interpretive mode. No object tape or deck is produced. After execution of an object program, computation of a new object program is possible without loading the processor.

Restrictions, Range: The language used in GOTRAN is a modified subset of FORTRAN, including the functional subroutines. Arithmetic statements are restricted to one arithmetic operation per statement.

Data is handled in the form of 10 digit floating point numbers or 3 digit fixed point numbers. Input-output is the same form as FORTRAN with the exception that cards are punched with one item per card.

The maximum number of symbols that may be used is 500 in the tape system and 490 in the card system. The number statements allowed is inversely proportional to the number of symbols used. Approximately 211 statements can be compiled using 200 symbols.

Storage Requirements: Not given.

Equipment Specifications: Basic 1620, Card.

IBM Application & Systems Programs Library Abstract **File Number** 1620-SP-007

IBM 1620 SYMBOLIC PROGRAMMING SYSTEM - ONE-PASS PROCESSOR

Abstract:

Purpose: This programming system assembles symbolic instructions into absolute machine language instructions. The source program, consisting of the symbolic instructions, is read only once.

Restrictions, Range: The system can process all of the machine operation codes. It also processes the following declarative operations: DS, DC, DSA, DORG, and DEND. A maximum of one hundred and ninety-nine labels can be handled. Multiplication is not allowed in address arithmetic.

Method: Does not apply.

Storage Requirements: The system occupies memory from position 100 to 19999.

Equipment Specifications: The system is designed to operate on a basic 1620 with tape I/O.

IBM Application & Systems Programs Library Abstract **File Number** 1620-SP-008

IBM 1620 SYMBOLIC PROGRAMMING SYSTEM - TAPE I/O

Abstract:

Purpose: This programming system assembles symbolic instructions into absolute machine language. The source program, consisting of the symbolic instructions, is read twice.

Restrictions, Range: The system occupies memory from position 100 to 19999.

Equipment Specifications: The system is designed to operate on a basic 1620 with tape I/O, and can be modified for the additional storage unit 1623.

IBM Application & Systems Programs Library Abstract **File Number** 1620-SP-009

IBM 1620 SYMBOLIC PROGRAMMING SYSTEM - CARD I/O

Abstract:

Purpose: This program system assembles symbolic instructions into absolute machine language. The source program, consisting of the symbolic instructions, is read twice.

Restrictions, Range: The system can accommodate 312 labels.

Method: Does not apply.

Storage Requirements: The system occupies memory from position 100 to 19999.

Equipment Specifications: The system is designed to operate on a basic 1620 with card I/O and can be modified for the additional storage unit 1623.

IBM Application & Systems Programs Library Abstract **File Number** 1620-SP-020

1620/1710 SPS, CARD SYSTEM

Abstract:

Purpose

SPS is an extension of 1620 SPS, a symbolic programming system in use since late 1960. It provides many additional features in the assembly of source programs, and includes five sets of floating point subroutines for use on 1620 or 1710 systems of a variety of configurations. These are:

a) Fixed length floating point numbers not using the Automatic Divide feature.
b) Fixed length floating point numbers using the Automatic Divide feature.
c) Variable length floating point numbers not using the Automatic Divide feature.
d) Variable length floating point numbers using the Automatic Divide feature.
e) Variable length floating point numbers using the Automatic Floating Point feature.

The range of floating point numbers is:

$$\pm.100000\ldots0 \times 10^{-99} \text{ to } \pm.99999\ldots9 \times 10^{99}.$$

For variable length subroutines the fractional part of the floating point number may vary from 2 to 45 digits.

Use of Program

With the SPS processor loaded in the storage, the source statements may be entered on the typewriter or through the card reader. In the first pass, the statements are scanned, certain errors detected, and label table constructed. In the second pass the source statements are again scanned; additional errors are indicated; and the program assembled in machine language. A listing deck or condensed deck, both self-loading, may be punched. Listing on the typewriter is also possible. A map of storage assignments may be typed. If subroutines are required, the proper subroutine deck will be processed and subroutines selected for inclusion in the object program.

Machine Configuration

For assembly of source programs;

Basic Card 1620 or 1710 with 20,000 digits of storage. The processor can be modified for 40,000 or 60,000 digits of storage to allow an extension of the label table.

For execution of assembled programs:

A 1620 or 1710 system with any optional features.

IBM Application & Systems Programs Library Abstract **File Number** 1620-SP-021

1620/1710 SPS, TAPE SYSTEM

Abstract:

Purpose

(Continued on next page)

SPS is an extension of 1620 SPS, a symbolic programming system in use since late 1960. It provides many additional features in the assembly of source programs, and includes five sets of floating point subroutines for use on 1620 or 1710 systems of a variety of configurations. These are:

a) Fixed length floating point numbers not using the Automatic Divide feature.

b) Fixed length floating point numbers using the Automatic Divide feature.

c) Variable length floating point numbers not using the Automatic Divide feature.

d) Variable length floating point numbers using the Automatic Divide feature.

e) Variable length floating point numbers using the Automatic Floating Point feature.

The range of floating point numbers is:

$$\pm .100000\ldots0 \times 10^{-99} \text{ to } \pm .99999\ldots9 \times 10^{99}$$

For variable length subroutines, the fractional part of the floating point number may vary from 2 to 45 digits.

Use of Program

With the SPS processor loaded in the storage, the source statements may be entered on the typewriter or through the tape reader. In the first pass, the statements are scanned, certain errors detected, and label table constructed. In the second pass the source statements are again scanned; additional errors are indicated; and the program assembled in machine language. A condensed self-loading tape may be punched. Listing on the typewriter is also possible. A map of storage assignments may be typed. If subroutines are required, the proper subroutine tape will be processed and subroutines selected for inclusion in the object program.

Machine Configuration

For assembly of source programs:

Basic tape 1620 or 1710 with 20,000 digits of storage. The processor can be modified for 40,000 or 60,000 digits of storage to allow an extension of the label table.

For execution of assembled programs:

A 1620 or 1710 system with any optional features.

IBM Application & Systems Programs Library Abstract **File Number** 1710-SI-002

1710 Simulator/7090

Abstract

Purpose: The 7090 Simulator of the 1710 Control System provides the ability to perform program checkout:

(1) Prior to the installation of a 1710 System.
(2) Subsequent to the installation but without requiring that the 1710 be removed from its normal task of Data Acquisition, Operator Guide or Closed Loop Control.
(3) Without requiring modification of a physical system to conform to the program requirements, i.e., modifying a 1710 System to have the proper function, and filter and matching cards, at a given 1712 Multiplexer and Terminal Unit Address.

Machine Configuration:
For simulation of the 1710:
7090 with two tape channels (A & B)
4 tapes on channel A
2 tapes on channel B
32,000 words of core storage
On line printer (SHARE II Board)

The simulator will simulate the following 1710 features:
(1) Random & Sequential Addressing
(2) Interrupt (AOC/TAS Complete Indicator #40)
(3) Contact Sense (200 pt/sec)
(4) Contact Operate
(5) Analog Input (20 pt/sec)
(6) Analog Output (set point positioner)
(7) 300 M.T.U. Addresses
(8) 1711 Manual Entry Switches
(9) Process Branch Indicators
(10) Process Interrupt Indicators
(11) 1621-1624 (Paper Tape I/O)
(12) 1622 (Card I/O)
(13) Indirect Addressing
(14) Additional Instruction (TNF-TNS-MF)
(15) Divide
(16) 1623 Additional Core Storage 1 or 2 20,000 Digit Modules

MACHINE CONFIGURATION

For assembly of Source Programs:

709/7090 with two tape channels (A & B)
4 tape units per channel
32,000 words of core storage
on line printer

For execution of assembled program:

A 1620 or 1710 System with either paper tape or card I/O and those optional features required by the Source Language Program, such as the 1620 additional instructions or 1710 Random Addressing Feature.

IBM Application & Systems Programs Library Abstract **File Number** 1710-SP-001

1710 SPS/709-7090 PROCESSOR

Abstract:

PURPOSE

The 709/7090 Processor provides the 1710 user with the ability to assemble programs for a 1710 installation without removing the 1710's capability to perform its normal task of Data Acquisition, Operator Guide or Closed Loop Control. The processor provides the user with all of the features of the 1620/1710 SPS while increasing the assembly speed and the size of the programs that may be assembled.

USE OF PROGRAM

With the SPS Processor loaded into storage under control of the IB SOS Monitor, the source statements are read from Tape A3. In the first pass, the statements are scanned, certain errors detected, and the label table is constructed (capacity 3000 labels). The processor writes the scanned statement on an intermediate tape (B3) along with certain control information to be used during the second pass.

Prior to the second pass of the source language (from tape B3) the label table is examined to determine the number of entries. If there are more than 35 entries, a binary search indices are built up by the processor and a binary search is made when looking up labels during the second pass.

In the second pass, the statements are read from the intermediate tape (B3), assembled, written on the punch output tape (A5) (in the format specified in the control card for this assembly, i.e. condensed card or paper tape format), and written on the print tape (A2).

At the end of Pass II if any subroutines were used, the processor selects the subroutine set specified from the subroutine tape (B7) and assembles and writes the output for listing (A2) and punching (A5). At the end of Pass II, the processor writes the resultant map of 1710 storage on the printer tape. The processor will repeat the assembly process until all source language programs have been assembled.

IBM Application & Systems Programs Library Abstract File Number 7070-AT-082

PAT - PROCEDURE FOR AUTOMATIC TESTING

Abstract:

Purpose: The PAT System has been designed to standardize testing procedures so that they may be just as efficient in a customer installation as they are in a 7070 Data Center with no change in test procedures.

The testing of a program by the PAT System is accomplished in three phases. The first phase is the creation of the data files by the Tape File Generator program. The second phase is the processing of the object program. The third is the recording of the results of the test through the use of Storage Print and Tape Print programs.

PAT testing enables the processing of undebugged programs by remote testing yet under programmer control. The results including the output from the Utility programs would be returned to the programmer for desk debugging.

The PAT System provides for the testing of programs by card or tape processing.

IBM Application & Systems Programs Library Abstract File Number 7070-AT-083

7070 AUTO-TEST GENERATOR SYSTEM

Abstract:

The Auto-Test Generator System provides a highly flexible and efficient method of creating tapes for automatic tape testing. The test tape is created by the ATG System in a one pass generation run.

The minimum system configuration required for a Generation Run is a 7070 capacity of 5K, one tape channel, and three tape drives. If available, a capacity over 5K, 4 tape channels, 40 tape drives, the 7500 Card Reader, the 7501 Console Card Reader, the 7550 Card Punch, and the 7400 On-Line Printer may also be used in generating the test tape. One control card (the ATG Control Card) and the settings of the Console Alteration Switches specify the machine configuration to be used for the generation run.

Testing may be performed with the generated tape on a system even more basic than the minimum needed for generating the test tape or may be done on any combination of the units mentioned above. One control card for each object program packet (the TD Card) specifies the machine configuration to be used for testing that object program.

The configuration of the system which generates the test tape does not have to be the same as the configuration of the system which performs the testing.

IBM Application & Systems Programs Library Abstract File Number 7070-AU-072

7070 BASIC AUTOCODER

Abstract:

The 7070 Basic Autocoder is a symbolic programming system designed to simplify the preparation of programs for the 7070 Data Processing System. With the increased capacity and versatility of data processing systems, machine-language instructions have increased correspondingly in both number and complexity. Coding in machine language today is an extremely tedious and time-consuming task. The 7070 Basic Autocoder is a symbolic programming system designed to permit the programmer to code more easily and with greater meaning than is possible with numerical machine language. Symbolic programming systems also perform automatically many burdensome tasks such as assigning and keeping track of storage locations and checking for errors. Use of these systems will save the programmer a significant amount of valuable programming time and effort.

The 7070 Basic Autocoder is designed specifically for use in 7070 Data Processing installations which contain unit-record input/output equipment only, or a maximum of one or two tape units.

This version includes the addition of the Execute Control Statement, the ability to mix condensed card output on the listing tape, the assignment of relocation indicators, and the typing of the version and level of the Basic Autocoder processor being used.

IBM Application & Systems Programs Library Abstract File Number 7070-AU-074

AUTOCODER 74

Abstract:

Purpose: Autocoder 74 is a symbolic programming system designed to simplify the preparation of programs for the 7070 Data Processing System. With the increased capacity and versatility of data processing systems, machine-language instructions have increased correspondingly in both number and complexity. Coding in machine language today is an extremely tedious and time-consuming task. The 7070 Autocoder 74 is a symbolic programming system designed to permit the programmer to code more easily and with greater meaning than is possible with numerical machine language. Symbolic programming systems also perform automatically many burdensome tasks such as assigning and keeping track of storage locations and checking for errors. Use of these systems will save the programmer a significant amount of valuable programming time and effort.

Autocoder 74 allows the use of IOCS macro-instructions.

Machine Requirements: 4 tape units.

IBM Application & Systems Programs Library Abstract File Number 7070-AU-900

AUTOCODER 7070

Abstract:

Purpose: To translate a program written in the Autocoder language including macro statements and/or one-for-one instructions, into an operative machine language program.

Machine Requirements: (Include machine components, special features, storage requirements, control panels-standard or special)

Minimum

1. 5,000 words of core storage
2. 6 IBM 729 model II, IV, V, VI, or 7330 tape units.
3. Channel 1 or Channels 1 and 2.

Optional

1. IBM 7500 Card Reader (Utility Panel)
2. IBM 7550 Card Punch (Utility Panel)
3. IBM 7400 Printer (Utility Panel)
4. Up to four additional IBM 729 model II, IV, V, VI, or 7330 tape units
5. 10,000 words of core storage

Capabilities and Limitations:
Autocoder can process any program written for Basic Autocoder or 4-Tape Autocoder. If additional tape units are available, it can process stacked input and/or output. Additional macro generators can be added to the system to allow new input statements. There is great flexibility in entering new loads, patching existing loads, and dropping unneeded loads. Only one macro generator can be added or dropped in a single run.

IBM Application & Systems Programs Library Abstract File Number 7070-CB-923

7070 COBOL PROCESSOR

Abstract:

Purpose: The COBOL processor translates a source program written in accordance with the rules specified in the IBM COBOL General Information Manual, form F28-8053-1 into a 7070 or 7074 machine - language program which, when read into the computer, will execute the instructions specified in the source program.

Use of Program: The program is to be used as described in the reference material listed in the accompanying letter with the exception of the following items whose implementation will be deferred:

Procedure Division

1. The CORRESPONDING option of the MOVE verb.
2. The EXAMINE verb (including the TALLY register).
3. Class conditions in conditional statements.
4. Numeric literals as operands of DISPLAY statements.
5. The use of the figurative constant ALL.
6. The ability to optionally round or truncate the results of arithmetic computations. The ROUND OPTION is standard; truncation is deferred.

(Continued on next page)

Data Division

1. The JUSTIFIED clause.
2. The BLANK WHEN ZERO clause as applied to output data.
3. The CHECK PROTECT feature of the editing clause; also, the ZERO SUPPRESS feature if used with FLOAT DOLLAR sign.
4. The use of the figurative constant ALL.
5. The COPY option.
6. The following characters of the PICTURE clause:

   a. preceding ≠ and - signs.
   b. floating ≠ and - signs.
   c. *(i.e., check protect)

   d. Zero and blank as insertion characters.
   e. z if preceded by some other character.
   f. V (i.e., implied decimal point) if in a report item.

Environment Division

1. The COPY option
2. The OPTIONAL clause of the FILE-CONTROL paragraph.
3. Automatic allocation of object machine input/output devices based on configuration given in the OBJECT-COMPUTER paragraph and the ASSIGN clause of the FILE-CONTROL paragraph.

Machine Configuration: The 7070 COBOL processor is designed to operate on a 7070 or 7074 of the following configuration:

1. Memory size - 10K
2. Input/Output requirements. Seven tapes are required by the system. The input medium for the source program may be one of these seven tapes, an eighth tape or a card reader.

IBM Application & Systems Programs Library Abstract File Number 7070-CT-903

7070 COMMERCIAL TRANSLATOR

Abstract:

Purpose: 7070 Commercial Translator makes available to users of the 7070 a problem oriented-language for the formulation of commercial problems.

Use of Program: The program is to be used as described in the Commercial Translator material listed in the accompanying letter.

Machine Configuration: The 7070 Commercial Translator processor is designed to operate on a 7070 or 7074 of the following configurations:

1. 10,000 words of Core Storage.

2. Input/Output requirements - Seven tapes are required by the system. The input medium for the source program may be one of these seven tapes, an eighth tape or a card reader.

IBM Application & Systems Programs Library Abstract File Number 7070-FO-073

BASIC FORTRAN

Abstract:

Purpose: The IBM FORmula TRANslating system, FORTRAN, is an automatic coding system which consists of a source-language (closely resembling the ordinary language of mathematics), and a processor which converts source programs written in the FORTRAN language into machine-language object programs.

Use of Program: FORTRAN is essentially a problem-oriented language designed to facilitate the writing of programs which will perform scientific and engineering type computations. It can also be adopted in the solution of many business problems which can be expressed in a mathematical formula.

Machine Configuration: 5,000 words of core storage
IBM 7500 Card Reader (Utility Panel)
IBM 7550 Card Punch (Utility Panel)

Capabilities and Limitations: Programs may be compiled for any configuration of 7070 equipment. Basic FORTRAN accepts FORTRAN I features in a source program.

IBM Application & Systems Programs Library Abstract File Number 7070-FO-116

7070/2/4 FORTRAN LOADER

Abstract:

Purpose: The 7070/2/4 FORTRAN Loader provides users of 7070/2/4 FORTRAN and users of 7070/2/4 Basic FORTRAN with the principle of relocatability to insure that several routines can be compiled separately but used together at object time.

Use of Program: The 7070/2/4 FORTRAN Loader has been designed specifically to load the FORTRAN object program, the 7070/2/4 FORTRAN Package, and the user's compiled subprograms, and subroutines (written in the FORTRAN or Autocoder language) to produce a relocated program (within storage or on some output medium) available for object time processing.

Machine Configuration: The 7070/2/4 FORTRAN Loader may be utilized with any of the following configurations:

a) IBM 7070, IBM 7072 or IBM 7074
b) Card oriented, Card/Tape or Tape oriented system
c) 5K or 10K Magnetic Core Storage
d) The Floating Decimal Arithmetic device is optional.

The program is adaptable to each user's requirements by changing the control information in the Loader. The 7070/2/4 FORTRAN Loader relocates itself into upper core storage as specified by the user. The Loader zeros itself out once all programs required for a particular object run have been relocated.

Capabilities and Limitations: FORTRAN object programs which are of such size that they overlay the Loader but which do not exceed core storage capacity, as defined by the user, may be executed by writing out the relocated program on some output medium. This is done through the use of an Alteration Switch. The relocated program should be read back into core storage with the IBM 7070/2/4 Condensed Card Load Program which, together with a zero storage program, is written out preceding the relocated program. Storage is zeroed up to the point indicated by the user in the Loader option.

This option is available to any program - regardless of size, but not exceeding core storage capacity. Programs which exceed core storage capacity are not executable and must be rewritten.

Under control of another Alteration Switch, the user has the option to type out a map showing the locations of programs and their data areas.

IBM Application & Systems Programs Library Abstract File Number 7070-FO-901

FORTRAN 7070

Abstract:

Purpose: The IBM FORmula TRANslating system, FORTRAN, is an automatic coding system which consists of a source-language (closely resembling the ordinary language of mathematics), and a processor which, completely or partially, converts source programs written in the FORTRAN language into machine-language object programs.

Use of Program: FORTRAN is essentially a problem-oriented language designed to facilitate the writing of programs which will perform scientific and engineering type computations. It can also be adopted in the solution of many business problems which can be expressed in a mathematical formula.

Machine Configuration:

Minimum
1. 5,000 words of core storage
2. 6 IBM 729 Model II, IV, V, VI or 7330 tape units
3. Channel 1 or Channels 1 and 2

Optional
1. IBM 7500 Card Reader (Utility Panel)
2. IBM 7550 Card Punch (Utility Panel)
3. IBM 7400 Printer (Utility Panel)
4. Up to four additional IBM 729 Model II, IV, V, VI or 7330 tape units.
5. 10,000 words of core storage

Capabilities and Limitations:
Programs may be compiled for any configuration of 7070 equipment. 7070/2/4 FORTRAN accepts all FORTRAN II features in a source program.

IBM Application & Systems Programs Library Abstract File Number 7070-IO-076

SPOOL SYSTEM

Abstract:

Purpose: The SPOOL system provides two programs which may be run simultaneously with the main programs. This system provides tape-to-card, card-to-tape, and tape-to-printer operations. One or two of these operations may take place while the user's main program is running. (Continued on next page)

Restrictions: Operates in conjunction with 7070 IOCS.

Storage Requirements: 400 words + IOCS requirements.

Equipment Specifications: 7500 Card Reader and necessary I/O.

IBM Application & Systems Programs Library Abstract File Number 7070-IO-904

INPUT/OUTPUT CONTROL SYSTEM 7070

Abstract:

Purpose: To provide users of the IBM 7070/2/4 Data Processing Systems with routines for reading and writing card and tape records.

Use of Program: The Input/Output Control System is used in conjunction with other programs to provide standardized routines which perform the input and output functions.

Machine Configuration:

1. Machine requirements at compile time are dictated by the specifications for the program which is being used in conjunction with the Input/Output Control System. Reference should be made to the manual or abstract describing these programs.
2. The storage requirements of the Input/Output Control System vary from 765 to 2100 words depending upon the number of files specified and the parameters in the DIOCS statement.

Capabilities and Limitations:

1. The reading and writing of tape records is controlled by the Input/Output Control System and will occur simultaneously with processing.
2. Macro-instructions are provided for processing which will, when required, block and deblock data records that are to be written on, or read from, tape.
3. A program which uses the Input/Output Control System may be interrupted at any time and continued from that point at another time by the use of these macro-instructions.
4. Macro-instructions are provided for processing unit records.
5. Error routines for both tape and unit records are provided.
6. The Input/Output Control System has been designed to allow the running of SPOOL programs with programs using the Input/Output Control System.

IBM Application & Systems Programs Library Abstract File Number 7070-IO-905

7300 DISK IOCS

Abstract:

Purpose: To provide users of the IBM 7070/2/4 Data Processing Systems with routines for reading and writing 7300 Disk.

Use of Program: The Input/Output Control System is used in conjunction with other programs to provide standardized routines which perform the input and output functions.

Machine Configuration:

1. Machine requirements at compile time are dictated by the specifications for the program which is being used in conjunction with the Input/Output Control System. Reference should be made to the manual or abstract describing these programs.
2. The storage requirements of the Input/Output Control System vary from 765 to 2100 words, depending upon the number of files specified and the parameters in the DIOCS statement.

Capabilities and Limitations:

1. The reading and writing of tape records is controlled by the Input/Output Control System and will occur simultaneously with processing.
2. Macro-instructions are provided for processing which will, when required, block and deblock data records that are to be written on or read from tape.
3. A program which uses the Input/Output Control System may be interrupted at any time and continued from that point at another time by the use of these macro-instructions.
4. Macro-instructions are provided for processing unit records.
5. Error routines for both tape and unit records are provided.
6. The Input/Output Control System has been designed to allow the running of SPOOL programs with programs using the Input/Output Control System.

IBM Application & Systems Programs Library Abstract File Number 7070-MI-084

TAPE FILE GENERATOR FOR TESTING

Abstract:

Purpose: The tape files needed to test programs which read input records from tape can be generated from cards using this utility program. Practically any form of tape file can be created with this program.

Equipment Specifications: 7500 Card Reader
1 729 Tape Drive

IBM Application & Systems Programs Library Abstract File Number 7070-PR-075

COMPILER SYSTEMS TAPE

Abstract:

Purpose: The 7070 compiler system provides Autocoder, Report Program Generator, FORTRAN, COBOL, Commercial Translator, and IOCS on a common systems tape for ease of usage.

Equipment Specifications: 6 magnetic tape units.

IBM Application & Systems Programs Library Abstract File Number 7070-RG-902

REPORT PROGRAM GENERATOR 7070

Abstract:

Purpose: Programs for writing reports from data on magnetic tapes can be created by the programming system through the use of the Report Program Generator.

Use of Program: The Report Program Generator acts as a pre-processor to 7070/2/4 Autocoder. Input consists of the layout of the data tape, the format of the desired report, and the conditions for inclusion of items of the data.

Machine Configuration:

Minimum

1. 5,000 words of core storage
2. 6 IBM 729 Model II, IV, V, VI or 7330 tape units.
3. Channel 1 or Channels 1 and 2.

Optional

1. IBM 7500 Card Reader (Utility Panel)
2. IBM 7550 Card Punch (Utility Panel)
3. IBM 7400 Printer (Utility Panel)
4. Up to four additional IBM 729 Model II, IV, V, VI or 7330 tape units.
5. 10,000 words of core storage

Capabilities and Limitations:
The data file may consist of form 1, 2 or 3 records. The data file records may include no more than 99 fields to be used for the report.
A given variable field to be edited may be no more than 20 characters.

IBM Application & Systems Programs Library Abstract File Number 7070-SI-079

SIMULATE 650 ON 7070

Abstract:

Purpose: Programs written for the 650 (except 650 Model IV) may be run on an IBM 7070 using this program. The machine configuration of the 7070 system must be the same as a 650 system for the program to be simulated. The simulation program was written for standard 650 systems.

IBM Application & Systems Programs Library Abstract File Number 7070-SM-077

SORT 90

Abstract:

Purpose: Tape files containing records from 1 through 999 words in length can be sorted according to a control word that may have from 1 through 160 characters located in from 1 through 10 fields. The tape records may be fixed- or variable-length in single or blocked form. The maximum number of tape records that may be sorted is equal to the number of records which can be contained on 4 full reels of tape.

(Continued on next page)

Equipment Specifications: 4 through 16 magnetic tape units.

Additional Comments: The order of merge of the program depends on the number of tape units available; the order of the merge may be either 2, 3, 4 or 5.

IBM Application & Systems Programs Library Abstract **File Number** 7070-SM-078

MERGE 91

Abstract:

Purpose: Up to 8 tape files may be merged into one file through the use of this program. The record and control word specifications are the same as for Sort 90. There is no limit on the number of reels that may be required for a file.

Equipment Specifications: From 3 through 26 magnetic tape units are required by Merge 91.

IBM Application & Systems Programs Library Abstract **File Number** 7070-UT-080

RAMAC UTILITIES

Abstract:

Purpose: These programs provide frequently needed routines to assist in the use of the 7300 disk files attached to the 7070. The programs are (1) Clear Disk, (2) Disk-to-Tape, (3) Tape-to-Disk.

Storage Requirements: 1500 positions per program.

Equipment Specifications: 7300 Disk Storage Unit
7500 Card Reader
729 Tape Units

IBM Application & Systems Programs Library Abstract **File Number** 7070-UT-081

7070 UTILITIES

Abstract:

Purpose: These utility programs provide frequently needed routines to assist in the testing and operation of the user's 7070 programs. The following are included:

Condensed Card Load Program
Load Program Relocater
Zero Storage Programs
Tape Mark Program
Tape Rewind Program
Tape File Generator Program
SNAPSHOT Program
Storage Print Program
Tape Print Program
Branch Trace Program
Tape Duplication Program
Tape Compare Program
Unload Storage Program

Equipment Specifications: 7500 Card Reader
7400 Printer
7550 Card Punch
Tape drives as needed

IBM Application & Systems Programs Library Abstract **File Number** 7072-UT-085

UTILITY PROGRAMS FOR ADDITIONAL STORAGE

Abstract:

Purpose: This is a collection of 5 commonly used programs. They are:

Condensed Card Load Program for Additional Storage: This program is designed to load a program which has been punched into cards in condensed form. It will load condensed cards with a maximum of five words in each card into specified locations. Execute cards, i.e., cards containing instructions which are to be executed as soon as they are read, may be included among the condensed cards.

Load Program Relocator for Additional Storage: This program will allow the user to move the IBM 7072/7074 Condensed Card Load Program for Additional Storage from its current location to any twenty-five consecutive locations below location 9999. It is not necessary to know the current location of the load program when it is to be relocated.

Zero Storage Program for Additional Storage: This general zeroing program may be used to set core storage to plus zeros regardless of the location of the load program. The Zero Storage Program may be used even though the user does not know the location of the load program.

Tape Mark Program for Additional Storage: This program is used to write a tape mark on a maximum of six tape units connected to any one channel. A separate program, which consists of one card, is required for each channel.

Tape Rewind Program for Additional Storage: This program is used to rewind the tape on a maximum of six tape units connected to any one channel. A separate program, which consists of one card, is required for each channel.

Equipment Specifications: 7072/74 with Additional Storage feature.

IBM Application & Systems Programs Library Abstract File Number 7080-CV-090

INT580

Abstract:

Purpose: INT580 enables a program coded for an IBM 705 I, II or III with serial input/output equipment to operate on the IBM 7080, utilizing communication channels and 729 tape units. The 754, 760 I and II, 777 757, 758, 759 and 734 are simulated in memory. 727, 720A, 730A, 717, 722 and 714 units are simulated on 729 tape units. Restrictions to full simulation are covered in the detailed description of interpretation of each unit, starting at page 10 of the enclosed preliminary manual (as amended by the addenda, also enclosed) and on page 19 of the manual. These restrictions should not affect most object programs.

Use: INT580 may be loaded into memory once, and left there until that memory is needed for another application. Loading of an object program is initiated after INT580 housekeeping has been entered and control cards, if necessary, have been processed for that program. The object program is entered in the normal manner and proceeds until an input/output instruction is encountered. The I/O Interpret feature of the 7080, working with the Nonstop switch causes an automatic interrupt to INT580, where the desired operation is initiated or fully accomplished. Control returns to the object program until the next interrupt. For a detailed description of the various ways to use INT580, see the Addenda for Version 3 referred to above.

Machine Configuration: The minimum 7080 configuration of 80K memory and two communication channels is required. The program as written requires the card reader for one control card per object program, but this is easily modified. Drum simulation will require an additional 80K of memory if many sections are used. Four communication channels are required for efficient simulation of simultaneous PRW-WR operations on two TRC's.

IBM Application & Systems Programs Library Abstract File Number 7080-IO-086

7080 IOCS

Abstract:

Purpose: To provide the user a complete 7080 Input/Output control system for 729 tapes and a means of obtaining two channel and minimal versions of this system.

Use: To use the 7080 IOCS, the first file of the distribution tape should be punched out and a Processor librarian run should be made using these cards. All programs using 7080 IOCS should be assembled from the new system tape.

To obtain the two channel and minimal versions, the third file of the distribution tape should be punched and separated into four decks using the Ident in columns 75 to 80 of the cards.

Using the second file of the distribution tape as the reassembly master and the change deck desired as input, a reassembly should be made to obtain a program deck and listing of the desired version.

The deck with Ident IOCS82 will produce a complete system for two channels.

The deck with Ident IOMS80 will produce a minimal system for four channels. The checkpoint routine may be included by removing the change cards which have a "C" in column 74.

The deck with Ident IOMS82 will produce a minimal system for two channels. The checkpoint routine may be included by removing the change cards which have a "C" in column 74.

The deck with Ident IOCS80 and with a "D" in column 74 will produce an IOCS to run with 729V and VI tapes. This deck may also be collated by index numbers in columns 1 to 5 with any of the three above decks.

The preassembled 7080 IOCS deck may be obtained by punching the fourth file of the distribution tape.

The 7080 IOCS must be in memory at the time of the running of the object program. This may be loaded in one of three ways.

1. The IOCS program deck may be placed in front of the object program deck and loaded as one block.

2. The IOCS Program deck may be loaded first and then the object program loaded.

3. The IOCS program deck may be loaded and left in memory during the running of several programs.

If the program decks for the minimal or two channel systems are used, the 00 card produced by the processor should be discarded.

Machine Configuration: The 7080 IOCS complete version for four channels will occupy memory locations 500 to 20,000 with erasable housekeeping occupying memory locations 20,000 to 24,000. The minimal system for 2 channels will occupy memory locations 500 to approximately 11,500 for the nonerasable portion. The size of the other versions will fall between these two.

The basic program material accompanying this memorandum includes one reel of tape.

1. The first file of this tape is the complete 7080 IOCS Library.

2. The second file is the reassembly master for IOCS80.

3. The third file consists of 4 change decks.

4. The fourth file is the preassembled IOCS80 deck.

5. The fifth file is the IOCS80 Listing.

Each file is preceded by a standard header and a tapemark.

IBM Application & Systems Programs Library Abstract File Number 7080-IO-121

CSMRS

Abstract:

Purpose: CSMRS is a restart program to be used in conjunction with 7080 IOCS. It will restore the machine and tapes to the status at the time of a checkpoint taken during the running of an object program with 7080 IOCS.

Use: The CSMRS program tape must be placed on a program tape, indicated to the 7080 IOCS at the time of the running of the object program. This tape will be rewound and autoloaded by the checkpoint load control record, so provisions should be made to locate and load the restart program from the first record on this tape. CSMRS will be put in the utility section of the SCS80 program tape cards and will be loaded automatically if SCS80 is indicated to 7080 IOCS.

Machine Configuration: All tapes which were being used by the object program at the time of the taking of the checkpoint must be mounted on the proper units. Also a restart program tape must be on-line. CSMRS will use approximately 80,000 memory positions. If the machine is 160K, the memory positions used will be 0 to 40,000 and 120,000 to 160,000.

IBM Application & Systems Programs Library Abstract File Number 7080-SM-114

IBM SORT 80 FOR 7080 UNDER SUPERVISORY CONTROL: S80USC

Abstract:

Sort 80 program specifications and features, operating instructions, etc., are detailed in the reference manual "IBM 705 III/7080 Generalized Sorting Program: Sort 80" form C28-6125. All of the operating and modification features of the basic Sort 80 system can be utilized to full advantage with one exception: Memory positions 75000 through 79999 must be reserved for use by SCS80 and S80USC executive routines.

In accordance with your request, the following Basic Program Material is being forwarded:

1. Two tape files on one reel of Tape at 200 cpi density. The external label reads, "IBM Sort 80 for 7080 Under Supervisory Control: S80USC. Program Number 7080-SM-114, Version 1, Modification Level 6. The first file, preceded by a standard IBM header label, contains the S80USC program deck, including INSER command and DFINE cards. This tape can be used as input (Change Tape) to the SCS Librarian. The second file is a listing of the S80USC executive routines - to be used as a supplement to the basic Sort 80 listings.

2. 7080 Data Processing System Bulletin "IBM Sort 80 for the 7080 Under Supervisory Control: S80USC" form J28-6181.

3. INCL command card to be used on a master program tape for unmodified sort applications.

4. INCL 01 command card and dummy 00 TCD cards to be used on the master program tape for modified sort applications.

5. EXEC command card enabling loading of S80USC from the common program tape.

IBM Application & Systems Programs Library Abstract **File Number** 7080-SU-087

NOSTP

Abstract:

Purpose: The NOSTP macro-instruction and a set of associated subroutines enable 705 and 7080 programs, running on the 7080, to utilize the non-stop operation feature of that machine. The use of these routines, in conjunction with the non-stop operation feature, will permit continuous operation of the 7080 in automatic status.

Additional Remarks: When the 7080 is running in non-stop mode (i. e., interrupt mode with the non-stop switch on) and is not in interrupt program, any condition which would normally cause the 7080 to enter manual status will result in an automatic interrupt to a location specified by interrupt word 250. The conditions which result in this automatic interrupt are:

1. Any halt instruction
2. Any condition which turns on one or more of the 00900-00905 check indicators, provided the corresponding switch for these indicators is set to automatic.
3. Any condition which turns on the automatic restart indicator.

When using the NOSTP routines, the location specified by interrupt word 250 would be the entry to those routines, and the automatic interrupt would transfer program control to them.

Equipment Specifications: 7080

IBM Application & Systems Programs Library Abstract **File Number** 7080-SV-115

7080 SUPERVISORY CONTROL SYSTEM: SCS80

Abstract:

Purpose: To reduce the time and effort required to perform the set-up functions for "production" 7080 runs. SCS80 will, upon command, locate a program on the program tape, load it into memory, verify the console set-up, and transfer control to the object program.

The program tape (s) used at object time will contain a copy of Memory Print (MP7080) at the beginning of each reel. This program has been placed at this location at 7080 users' request to assist them when a production 7080 job encounters trouble.

SCS80 will also assist the 7080 user in holding program file maintenance to a minimum. This is accomplished through the powerful ability to "call in" common programs and/or routines in order to "complete" object programs. Naturally, the common programs and routines need maintenance only on the "source" copy.

Use of Program: SCS80 provides: 1) a program library maintenance facility, 2) ability to select "current" programs, 3) an Object Time Routine.

The data to be handled by SCS80 is normally supplied by the user and constitutes his programs, interspersed with SCS80 command cards. Initially, however, data is being supplied as input to the first run. Input to the maintenance program is converted to a memory image program tape for use by the other two phases of the system.

This system will replace the 7080 Basic Supervisory Control System, Program Number 7080-SV-088. That program is obsolete and will not be distributed or maintained in the future. The Preliminary Reference Manual, IBM 7080 Supervisory Control System SCS80, dated September 1961, is also obsolete.

Machine Configuration:

A. The Library Maintenance Program

Memory Size -80K (minimum)
6 IBM 729 Magnetic Tape Units (minimum)
Console Card Reader

B. The Production of a Current Tape

Memory Size - 80K (minimum)
5 IBM 729 Magnetic Tape Units (minimum)
Console Card Reader

C. SCS80 Object Time Routine

Memory @0 to @159
Plus 2700 characters beginning at a 0 or 5 locations above @499
1 IBM 729 Magnetic Tape Unit (minimum)
Console Card Reader

IBM Application & Systems Programs Library Abstract **File Number** 7080-UT-089

7080 UTILITIES

Abstract:

Purpose: This is a collection of eight commonly used utility programs.

Data Assembler (DA7080): The Data Assembler is capable of creating data files from card image records on tape. There is provision for searching the input tape for the correct data set and then processing through to an "End" card. The files created by DA7080 may be of fixed or variable length, blocked or unblocked, multifile or single file and labeled or unlabeled.

Expanded Load Program (EL 7080): The expanded load program for the 7080 will be capable of locating a program deck on a primary program tape, loading the program, locating a deck of patch cards on a secondary unit, and loading the patch cards. The expanded load program will occupy the upper 3000 positions of memory and the lower 380 positions. If the input is from tape, the processing will be overlapped by the reading of the next program card.

Expanded Load Program (UL7080): UL7080 provides for loading information between memory positions 000240 and 156799 on a 160K 7080 or between 000240 and 076799 on an 80K7080. Otherwise, this program is the same as EL7080.

Load Program (LD7080): The Load Program for the 7080 will provide for the following functions:

1. Clear Memory from 0240 to the end of memory.
2. Clear the contents of Banks 1, 2, 3, and 4.
3. Set up interrupt words 200, 210, 220, 230, 250, 251, 252, and 253 so as to prevent the machine from hanging following the loading operation due to an unanswered interrupt signal.
4. Modify itself to load an object program from any card reader or channel tape.
5. Load an object program into an 80K or a 160K 7080.

Memory Print Program (MP7080): The memory print program for the 7080 will be capable of printing the contents of banks 0 through 3, the settings of the alteration switches, and memory from positions 500 through 159999. Memory areas may be defined as constant, instruction, and/or bit switch areas. The constant and instruction areas will be sorted sequentially so that memory will be printed sequentially by memory position and not by the order of the parameters on the control cards.

Data Print (DP7080): The Data Print program for the 7080 provides for writing records in four output formats. The two options that effect the format are:

1. Indexing - The indexing option provides for breaking each data record into one hundred or fewer character segments and then printing each segment as ten groups of ten characters to the line.
2. Referencing - The referencing option provides for two functions.
   a. Additional output information - When the referencing option is used, a line of print will be printed before each tape record is processed. This line of information indicates the tape record number, the actual length of the tape record, and other information which was indicated by the external modification card and/or indicated by certain fields in the tape record.
   b. Record Length Checking - provides for a length check of each data record and each tape record.

The four formats are:

1. A combination of indexing and referencing.
2. Indexing, but no referencing.
3. Referencing, but no indexing.
4. Neither indexing nor referencing.

Patch Conversion (PC7080): The patch conversion program provides for the use of certain menmonic operations when an expanded patch card is being punched.

Data Conversion (DC7080): The Data Conversion program will allow the user to take records of any format and convert them to any other format. There is provision for labeling unlabeled files, blocking unblocked records, reblocking blocked records, deblocking blocked records and putting IBM standards for variable length records on files containing variable length records. Multifile and/or multi-reel tapes may be created and tapes may be duplicated by DC 7080.

IBM Application & Systems Programs Library Abstract File Number 7090-CT-921

709/7090 COMMERCIAL TRANSLATOR

Abstract:

Purpose: To facilitate the reduction of time and effort required to program commercial problems by permitting a user to compile programs written in the Commercial Translator language, and to load and execute these programs.

Use: Commercial Translator, Version 3, is a subsystem of the IBSYS Processor, #7090-PR-130, operating under the control of the Basic Monitor (IBSYS). All input and output functions are performed through the 7090 IOCS system.

Machine Configuration: The 709/7090 Commercial Translator may be used on a 7090, or on a 709 equipped with the Data Channel Trap.

The following minimum configuration is required:

1. 32768 words of core storage.
2. One on-line printer.
3. A minimum of 5 tapes:
   a) One system tape.
   b) One listing output tape.
   c) Three utility tapes.
4. One additional tape, or a card reader for input.
5. One additional tape, or a punch for punch output.

IBM Application & Systems Programs Library Abstract File Number 7090-IO-094

THE S-PROGRAM FOR THE 7090

Abstract:

Purpose: The S-Program consists of interdependent subroutines for writing I-language string output. Some of these subroutines add I-language elements to the string; others are system subroutines. I-language elements are added to the string without regard to their logical validity. The 7090 Input/Output Control System (IOCS) is used to transmit information from core storage to tape.

IBM Application & Systems Programs Library Abstract File Number 7090-IO-919

7090 IOCS

Abstract:

Purpose: The IOCS Version C is designed to relieve programmers of the necessity of writing input and output routines. A programmer can, if he so chooses, think of each file as a continuous string of words. IOCS will automatically assign tape drives to files giving them the ability to start and stop at any point. Assignment will be on available or reserved tape units as recorded by IBSYS. During processing, IOCS automatically handles label checking and preparation, blocking and deblocking of data words, and overlapping of processing with input and output. Provision is also made for error detection and correction, checkpoint and restart procedures, and tape switching at execution time.

Note that any program which uses IOCS to control input/output functions must use the system for all its I/O functions, and must not use any input/output routines other than those of IOCS.

Use: IOCS Version C is used under the Basic Monitor Operating System. For an example, reference should be made to the 7090 IOCS Reference Manual, #C28-6100-2.

Machine Configuration: IOCS Version C requires at least one tape unit (for the system tape), an on-line printer, and the Data Channel Trap.

IBM Application & Systems Programs Library Abstract File Number 7090-PR-130

7090/7094 IBSYS Processor

Abstract

Purpose: This processor is a system tape which contains the following five programs:

(Continued on next column)

7090-SM-922	SORT
7090-IO-919	IOCS
7090-SV-918	IBSYS
7090-SP-920	IBSFAP
7090-CT-921	Commercial Translator

Reference should be made to these programs for further information.

IBM Application & Systems Programs Library Abstract File Number 7090-SM-922

Sort (729-Fixed Length)

Abstract:

Purpose: To sort and/or merge signed or unsigned binary and BCD files in logical or algebraic sequence.

Use: The 7090/7094 Sort is run under control of the IBSYS operating system. Information is supplied to the program via control card statements. The formats for these statements, details of their preparation, and instructions for loading and operating the system are explained in the 7090/7094 Sort bulletin, J28-6217.

Machine Configuration: The program operates on a 32K machine. It requires a minimum of two channels and five magnetic tape units, two of which must be on the same channel. (The system tape must be on A1.) Additional tape units can be utilized to provide up to a 10 - way merge. An on-line printer is necessary; an on-line card reader is optional.

IBM Application & Systems Programs Library Abstract File Number 7090-SP-920

IBSFAP

Abstract:

Purpose: To facilitate an assembly, including macro-operation compilation, and symbolic tape maintenance under the Basic Monitor (IBSYS). IBSFAP can be called with the Basic Monitor control card ($EXECUTE IBSFAP). This being done, IBSFAP will recognize all cards which are in the format of FAP cards. The exception to this rule is that all IBSFAP control cards must have an asterisk (*) in column seven (7). A special feature of IBSFAP is the pseudo-operation, SST (Save Symbol Table), which provides the symbolic definition entries most commonly needed by IBNUC and IOEX.

Use: IBSFAP is used under the Basic Monitor Operating System. For an example, reference should be made to the Fap Supplement #J28-6186.

Machine Configuration: 7090/7094 IBSYS may be used on a 709 equipped with the Data Channel Trap feature. If the 709 is to be used, the request for the system must state it is going to be used on the 709 and the appropriate system will be sent.

The following minimum configuration is required:

1. 32,768 words of core storage.
2. One on-line printer.
3. One system tape.
4. One tape or a card reader for input.
5. One tape or a card punch for punched output.
6. One tape for printed output.
7. Two tapes for work tapes.

IBSFAP works under IBSYS and thus will obtain its tape units from IBSYS.

IBM Application & Systems Programs Library Abstract File Number 7090-SV-918

7090 BASIC MONITOR, IBSYS

Abstract:

Purpose: To facilitate the reduction of time and effort required to perform the inter-system communication thus allowing continuous processing with a minimum of operator intervention. The Basic Monitor can be equipped with just those programming systems desired at a particular installation. The Basic Monitor can coordinate unit assignments and communicate intermediate information between the desired system facilitating continuous operation and reducing set-up time. This will effect a substantial time saving in computer operation, and will allow greater flexibility in programming.

Use of Program: Basic Monitor, IBSYS, provides:

1. An Editor routine to modify, add, and/or delete programming systems to satisfy the requirements of any users.

(Continued on next page)

2. Machine installation assembly parameters need only be specified for the Basic Monitor. This information will be transmitted to each system as required.

3. A Dump routine to record core when the termination of a system's operation becomes necessary because of an error which makes recovery impossible. IBSYS makes it possible to have system maintenance, assemblies, and selection of current systems each passing information as needed to the next system to be executed. IBSYS control cards are used to obtain the desired results with the minimum of computer time.

A complete set of instructions on the usage of IBSYS is in the IBM 7090 Basic Monitor Manual #J28-8086.

Machine Configuration: The 7090 Basic Monitor may be used on a 7090, or on a 709 equipped with the Data Channel Trap. If the 709 is used, the request for the system must state it is going to be used on the 709 and the appropriate system will be sent.

The following minimum configuration is required:

1. 32,768 words of core storage.
2. One on-line printer.
3. One system tape.
4. One tape or a card reader for input.
5. One tape or a punch for punched output.
6. Any other requirements are determined by the system which is being monitored by Basic Monitor.

The Basic Monitor has been assembled for the following machine configuration:

1. Channel A has ten tape units, a card reader, a punch, and a printer.
2. Channel B has ten tape units.
3. Channel C has five tape units.
4. Channel D has five tape units.

IBSYS is initialized with four tapes, a card reader, a punch and a printer on Channel A, and four tapes on Channel B. Other units may be attached for use by IBSYS control cards as needed.

IBM 305 PROGRAM LIBRARY ABSTRACT File Number 2.0.002

305 RAMACODER

Henry L. Coon

Direct Inquiries to: Henry L. Coon
IBM Corporation
220 Church Street
New York 13, New York

Purpose/Description: The RAMACODER system is comprised of three elements:

1. A general purpose process control panel
2. A symbolic language for preparing 305 programs
3. The assembly program which converts symbolic programs into machine language programs.

Method: N/A

Restrictions/Range: N/A

Storage Requirements: N/A

Equipment Specifications: IBM 305 System - The assembly programs require a basic 305 with no special features but can be used to assemble programs for a broad range of 305 configurations.

IBM 305 PROGRAM LIBRARY ABSTRACT File Number 9.2.001

305 CUT & FILL

Author Unknown

Direct Inquiries to: Author Unknown

Purpose: To perform the calculations involved in the cut and fill problem of highway construction. It may be used to compute either design volumes based on terrain cross sections or payload volumes based on final field slope staking.

Method: Average end areas

Restrictions/Range: Distances - 999.99 feet
Cut and fill volumes - 9,999,999.9 cubic yards

Storage Requirements: Total accumulated cut and fills - 999,999,999

Equipment Specifications: 10 tracks of Dick File uses general Purpose Control Panel

Additional Remarks: Timing - 45-70 seconds per station

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 1.1.002

OPTIMIZING PROGRAM

B. Gordon and A. Dalton
Equitable Life, New York

July 15, 1955

a) Automatically assigns optimum locations to the instructions and data of a program.

b) Does not apply.

c) Does not apply.

d) The program occupies approximately 500 storage locations in addition to 1216 locations for tables. Both input and output are one word per card.

e) Addresses may be left fixed or optimized. Addresses being optimized are 4 digit decimal numbers but are symbolic in the sense that they are assigned new optimum locations. A flow chart is included.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 1.1.003

AN AUTOMATIC METHOD OF OPTIMUM PROGRAMMING

Elmer F. Shepherd
John Hancock, Boston, Mass.

April 8, 1955

a) Automatically assigns optimum locations to the instruction and data of a program.

b) Does not apply.

c) Does not apply.

d) The program occupies approximately 250 storage locations in addition to 1700 locations for tables. Both input and output are one word per card.

e) Addresses being optimized are written as a pseudo address in the 9000 series. Drum locations available to the optimizing program are indicated by manually removing the restricted addresses from a deck of 2000 cards numbered 0000 to 1999 and running those remaining through the 533 as part of the load deck. A flow chart is included.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 1.1.005

SOAPY

Texas Highway Department
Austin, Texas

a) SOAPY is a modification of the original SOAP so that it may be used on a numeric 650.

b) Allows up to 900 symbolic addresses. Includes all the features of original SOAP.

(Continued on next column)

c) Not applicable.

d) Uses most of 2,000 word drum. Can accommodate relocatable subroutines.

e) Reference should be made to original SOAP for details of program's capacity.

f) Minimum 650.

IBM 650 Library Program Abstracts *File no.* 1.1.006 Utility Programs

STANOLINK II

C. E. Stevens
Standard Oil Company (Indiana)
Detroit, Michigan

a. Purpose: This is a symbolic optimal assembly system comparable to SOAP II which uses numeric symbols. There are two 650 programs included in the system. One edits the symbolic coding and punches error cards for invalid conditions. The other assembles the symbolic coding into an optimally coded absolute program.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: Both programs occupy most of the drum.

Speed: The edit program reads at the rate of 180 to 200 cards per minute; punching is intermittent. The assembly program produces single instruction load cards at the rate of 75 to 80 cards per minute at the start and will slow down slightly as assembly proceeds.

Relocatability: Not relocatable.

e. Remarks: This system will accommodate 60 regions and 600 symbolic addresses. Relocatable absolute or symbolic library programs may be incorporated in the program being assembled. The edit program is used to demonstrate all features of STANOLINK II. Block diagrams and listings of the edit program are included to implement the demonstration. This system will work on any 650 installation. On a 650 with one 533, it will assemble programs for the most elaborate installation.

f. IBM 650 System: One 533 required.

Special Devices: None required.

IBM 650 Library Program Abstracts *File no.* 1.1.007 Utility Programs

SOAP-TYPE OPTIMAL ASSEMBLY PROGRAM: STRAP

L. S. Kassel
Universal Oil Products Company
Des Plaines, Illinois

a. Purpose: This program is a modification of SOAP II which permits use of 300 general symbols throughout the program, plus an unlimited number of sets of 100 symbols used only in a particular section.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: Entire drum and immediate access storage.

Speed: Not given.

Relocatability: Not given.

e. Remarks: None

f. IBM 650 System: One 533, IAS, and indexing registers.

Special Devices: Group II special character devices are required.

IBM 650 Library Program Abstracts

File no. 1.1.008
Utility Programs

NO SOAP

G. M. Clemence
R. L. Duncombe
U. S. Naval Observatory
Washington, D. C.

P. Herget
Cincinnati Observatory
Cincinnati, Ohio

a. Purpose: NO SOAP is a Numerically-Operated Symbolic-Ortho-Assembly Program which permits the user of a machine without alphabetic device to do essentially the same things that are done by SOAP II when the alphabetic device is available.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: Uses most of drum.

Speed: Operates at 50-90 cards per minute.

Relocatability: Relocatable.

e. Remarks: NO SOAP is similar to SOAP II in its design and operation; however, only numerical symbolic addresses are used.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 1.1.009
Utility Programs

A MODIFIED SOAP IIA FLOATING POINT PACKAGE FOR THE IBM 650

E. Vernon Griffith
IBM Applied Science
Madison, Wisconsin

a. Purpose: To enable programmers to write programs in SOAP II language as if they had a floating decimal device available, and then assemble them so that they will run on a 650 without the floating decimal device.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: Same as Basic SOAP IIA.

Speed: Same as Basic SOAP IIA.

Relocatability: Same as Basic SOAP IIA.

e. Remarks: Has all the features of Basic SOAP IIA except that on reading a floating point instruction it punches out instructions which automatically create linkages to appropriate subroutines. There are subroutines for each of the seven floating point operation codes. These are relocatable and are automatically assembled into the object program. Note that this is an assembly package and not an interpretive one.

f. IBM 650 System: One 533 equipped with a total of 12 coselectors.

IBM 650 Library Program Abstracts

File no. 1.1.010

STANOSPYCE

Curtis E. Stevens
Standard Oil Company (Indiana)
Regional Accounting Office
Detroit, Michigan

a. Purpose: Using the 650 without the alphabetic device, this routine translates English sentences into a symbolic program language.

(Continued on next column)

The output is coded in STANOLINK II numeric symbols. Using STANOLINK II, the output may be assembled into an object program. (See 650 Program Abstract 1.1.006)

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: This program occupies approximately 1800 drum locations.

Speed: Compiling is at punch speed.

e. Remarks: The use of STANOSPYCE will reduce programming time, lessen the possibility of clerical errors, and provide better communication between the programmer and other interested parties. Programming techniques impossible or awkward using STANOSPYCE language may be coded in a slightly modified version of SOAP. Transitions between STANOSPYCE and SOAP may be made at any time according to the desires of the programmer.

f. IBM 650 System: One 533 required.

Special Devices: The read half time emitter and a full complement of pilot selectors and coselectors are required.

IBM 650 Library Program Abstracts

File no. 1.1.011

SORTING SUBROUTINE

K. Rind
Nevis Cyclotron Labratory
Irvington, New York

a. Purpose: To sort a block of N numbers in decending order.

b. Restrictions, Range: Any fixed point or floating point numbers.

c. Method: Single pass.

d. Storage Requirements: 50 word block.

Speed: Varies from $\frac{N(N+1)}{2200}$ minutes for worst possible order to 0.67 minutes for 1000 numbers as a check.

Relocatability: To any other 50 word block.

e. Remarks: Not really useful for more than 100 numbers (average time approximately 2.2 minutes) except to check pre-sorting.

f. IBM 650 System: Minimum.

IBM 650 Library Program Abstracts

File no. 1.1.012

SOAP-TYPE OPTIMAL ASSEMBLY PROGRAM: STRAP 4000

Louis S. Kassel
Universal Oil Products Company
Des Plaines, Illinois

a. Purpose: This is a 4000-word modification of SOAP II which permits 500 general symbols used throughout the program, plus an unlimited number of sets of 150 symbols used only in a particular section, and which is substantially faster than SOAP II.

b. Restrictions, Range: Does not apply.

c. Method: Does not apply.

d. Storage Requirements: Entire drum and IAS.

Speed: Maintains full punch speed for almost all output even at end of long assemblies with available locations nearly exhausted.

Relocatability: Does not apply.

e. Remarks: None.

f. IBM 650 System: 4000-word drum IAS, index registers, complete alphabetic device, one 533.

IBM 650 Library Program Abstracts *File no.* 1. 1. 013

1401 ASSEMBLY ON THE 650 TAPE SYSTEM

Henry La Badie
U.S. Army Ordinance
Frankford Arsenal
Philadelphia, 37, Pa.

a. Purpose: 1401 S.P.S. Assembly on the 650 Tape System

b. Range: None

c. Mathematical Method: None

d. Storage Required: 2000 Words; 150 CPM Input - 90 CPM Output

e. Remarks:
1. Only mnemonic op codes.
2. Comments, DC and DCW Cards must have 11-X punch in Col. 75.
3. Above cards must have no invalid 650 punches in Cols. 8-23.
4. Sign in Col. 23 may not be used with a constant. The units position of the constant may be signed.
5. All other 1401 S.P.S. Rules must be followed for this program.

f. IBM 650 System:
1. T.L.E.
2. Set Format
3. 1 Tape Unit
4. Index Registers
5. Both Alpha Devices
6. 12 Pilot Selectors
7. 6 Coselectors
8. Rd Side - 2 Digit Selectors (or 1 digit and 1-1/2 time emitter, if extra pilot Sel. available)
9. Pch Side - 1 Digit Selector; 1-1/2 Time Emitter

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650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 1.2.001

FOUR-PER-CARD LOADER

E. C. Kubie and G. R. Trimble, Jr. 11/16/55
IBM, New York

a) Loads one to four words per card into random drum locations specified by control words in the card.

b) Does not apply.

c) Does not apply.

d) Storage required is 5 words, 1995 to 1999. Locations 1951 to 1960 are used as the read band. Cards are loaded at 200 per minute.

e) Self-loading.

f) Minimum 650.

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650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 1.2.002

SEVEN-PER-CARD LOADER

E. C. Kubie and G. R. Trimble, Jr.
IBM, New York

a) Loads one to seven words per card into consecutive drum locations beginning at the location specified by a control word in each card.

b) Does not apply.

c) Does not apply.

d) Storage required is 23 locations, 1977 to 1999. Locations 1951 to 1960 are used as the read band. Cards are loaded at 200 per minute.

e) Self-loading.

f) Minimum 650.

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650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 1.2.003

FIVE-PER-CARD LOADING ROUTINE

J. M. Kibbee 1-1-56
IBM, Houston

a) Loads five words per card into random drum locations specified by control words in the card.

b) Does not apply.

c) Does not apply.

d) Storage required is 30 locations, 1970 to 1999. Locations 1951 to 1960 are used as the read band; 1950 and 1961-1969 are used to load the loading routine. Cards are loaded at 200 per minute.

e) Self-loading.

f) Minimum 650.

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650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 1.2.004

SIX-PER-CARD LOADING ROUTINE

J. M. Kibbee 1-1-56
IBM, Houston

a) Loads six words per card into consecutive drum locations beginning at the location specified by a control word in each card.

b) Does not apply.

c) Does not apply.

d) Storage required is 11 locations, 1950 and 1961 to 1970. Locations 1951-1960 are used as the read band. Cards are loaded at 200 per minute.

e) Self-loading.

f) Minimum 650.

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650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 1.2.006

EIGHT PER CARD LOADING ROUTINE

D. W. Hagelbarger and E. F. Moore June 16, 1956
Bell Telephone Laboratories, Murray Hill, New Jersey

a) Loads eight words per card into consecutive drum locations beginning at the location specified by control punches.

b) Does not apply.

c) Does not apply.

d) Storage required is approximately 25 locations in the lower part of the drum in addition to the read area of the 1950 band. Cards are loaded at 200 per minute.

e) Provision is made for checking the deck being loaded for cards which are missing or out of order. This routine uses a control panel which is a modification of the one used in Bell Lab's interpretive routines.

f) Minimum 650.

IBM 650 Library Program Abstracts

File no. 1.2.007
Utility Programs

LD_1 LOADING ROUTINE

B. T. Wade
Numerical Computation Laboratory
Ohio State University
Columbus, Ohio

a. Purpose: This routine is designed to load either seven words per card or five words per card instruction card formats and is used in the Ohio Department of Highways engineering programs. (See classification 9.2.000.)

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: The routine occupies locations 1900-1999.

Speed: Cards are loaded at maximum speed.

Relocatability: Program is non-relocatable.

e. Remarks: The routine's main feature is its ability to read in and stack modular programming and subroutines. "Links" are set between routines by the loading routine. Key cards indicate the locations of the links. This makes for flexibility in arranging subroutines, replacing subroutines, or adding to the lengths of modular sections of programming.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 1.2.008
Utility Programs

LAB AND LOB

T. S. Gemmell
Ohio Department of Highways
Columbus, Ohio

a. Purpose: These two routines load the seven words per card instruction card format using any band other than the 1900 - 1950 band as the location of the loading routine, and are used in the Ohio Department of Highways engineering programs. (See classification 9.2.000.)

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: Requires 36 locations including the read area.

Speed: Cards are loaded at 200 per minute.

Relocatability: LAB is relocatable by multiples of fifty.

e. Remarks: These routines are loaded by LD_1 (IBM 650 Library Program 1.2.007). Clears memory used by LD_1 to minus zero after being loaded.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 1.2.009
Utility Programs

7/CARD LOADER

L. Zirkle
Computing Center
Oklahoma State University
Stillwater, Oklahoma

a. Purpose: This is a two-card routine which will load into consecutive drum locations up to seven words of data from a standard seven-word load card. Loading begins at the location specified by the control word.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: Storage locations 1987-1999 for the program, and 1951-1960 for read-in area.

Speed: Not given.

Relocatability: Not given.

e. Remarks: The format is the same as most 7/card loaders. This program will load the output of "7/Card Punch," File Number 1.3.010.

f. IBM 650 System: One 533, IAS, and indexing registers are required.

IBM 650 Library Program Abstracts

File no. 1.2.010
Utility Programs

LOAD DECK AUDITOR

C. E. Stevens
Standard Oil Company (Indiana)
Detroit, Michigan

a. Purpose: This routine will audit a single instruction load deck against a program loaded on the drum.

Assume we have two load decks on a program, one being a multiple instruction deck. This routine will audit one against the other and punch error cards for invalid conditions.

It is a useful tool in cleaning up a condition where changes have been made without proper documentation. It can save time in detecting program errors if an audit is made prior to re-assembly.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: This routine always uses read area 1951-1960.

Speed: Reading speed is 200 cards per minute.

Relocatability: Instructions and punch area are relocatable into any band by proper setting of storage entry switches on the console.

e. Remarks: This routine will audit all or any portion of the drum, depending upon control data punched into the last load card. It may also be used as a complete or partial drum dump.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 1.2.012

DUMP AND LOAD ROUTINE FOR IBM 650
(SOSF)

Harold R. Vandenburgh
Princeton University
Princeton, N. J.

a. Purpose: Dump and Load Routine for the IBM 650. "SOSF".

b. Restrictions, Range: Does not apply.

c. Method: Does not apply.

d. Storage Requirements: 100 locations relocated by the symbolic term G. Routine is in SOAP.

e. Remarks: Will clear one read band for unnecessary blanks. Therefore, if two or more read bands are used, they must be free of blanks.

f. IBM 650 System: 650 with Index Registers.

IBM 650 Library Program Abstracts *File no.* 1.2.011

INDEPENDENT TABLE LOADER

T/Sgt. J. D. Fry
Directorate of Statistical Services
Elgin Air Force Base, Florida

a. Purpose: Independent Table Loader - loads tables, permits reorigin of tables, additions and deletions, expansion and contraction without object program assembly or reassembly.

b. Restrictions, Range: Does not apply.

c. Method: Does not apply.

d. Storage Requirements: 29 words, 1963-1991 during program loading.

e. Remarks: Requires specially punched table cards, will sequence check tables as loaded or will not sequence check at discretion of the user.

f. IBM 650 System: Minimum 650.

---

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 1.3.001

SEVEN-PER-CARD PUNCH ROUTINE

D. W. Sweeney 11-16-55
IBM, New York

a) Punches, seven words to a card, the contents of consecutive drum locations between two address limits specified on a control card.

b) Does not apply.

c) Does not apply.

d) Storage required is 27 locations, 1950, 1961 to 1976, and 1985 to 1994. The read and punch areas of band 1950 are used for input - output.

e) The self-loading routine is not included in the listing. Output is in a form loadable by the seven-per-card loader, file number 1.2.002.

f) Minimum 650.

---

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 1.3.007

STORAGE DUMP

R. Haberman January 20, 1956
G. E., Schenectady

a) Punches a specified block of storage, 8 words per card.

b) Does not apply.

c) Does not apply.

d) Storage required is 55 locations, 1900 to 1950, and 1961 to 1964. No speed information given.

e) The upper limit of the block being punched must be less than 1900. The block may be specified by a master card or entry may be programmed. If the number of locations being punched is not an even multiple of 8, additional storages will be punched to fill the last card with 8 words. The first card punched is a master card for use when these cards are loaded with L-2, see Technical Newsletter No. 8, pp. 50-52.

f) Minimum 650.

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650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 1.3.008

MEMORY DUMP AND RELOAD ROUTINE

George A. Rupprecht December 17, 1956
Office of the Chief of Naval Operations, Pentagon Building, Washington 25, D. C.

a) Punches a compact, self-reloading deck of load cards which replace 1990 words of memory.

b) Accurately replaces all except the ten card input words of any band desired.

c) Does not apply.

d) Punching time: 3 1/2 minutes. Reloading time: 1 1/2 minutes.

e) The instruction address and sign on the storage entry switches are necessary as specified despite the fact that only load cards are being read. Illegal information in the 1990 words to be replaced causes validity check stops requiring accurate console corrections for completing operation.

f) Minimum 650.

---

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 1.3.009

AVAILABILITY

James D. Chappell December 31, 1956
IBM, Washington

a) Produces a SOAP Availability Punchout from a deck of load cards that may be single-instruction, four-per-card, seven-per-card, or any mixture of these three types.

b) Does not apply.

c) Does not apply:

d) Entire drum used by program. Running time is approximately read speed when processing single instruction or four-per-card load cards and about 1/2 read speed on seven-per-card load cards.

e) Load routines 1.2.001 and 1.2.002 transfer cards, and blank cards will be processed. The d address of less than 1 % of all constants will improperly be marked as unavailable.

f) Minimum 650.

IBM 650 Library Program Abstracts *File no.* 1.3.010
Utility Programs

7/CARD PUNCH

L. Zirkle
Computing Center
Oklahoma State University
Stillwater, Oklahoma

a. Purpose: This is a flexible, relocatable, 7/card punch routine which uses additional features.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: The program uses storage locations 0000-0051, and punch region 9002-9009.

Speed: Not given.

Relocatability: Relocatable using SOAP II.

(Continued on next page)

e. Remarks: The output of this program may be reloaded with the program, "7/Card Loader," File Number 1.2.009.

f. IBM 650 System: One 533, IAS, and indexing registers.

Special Devices: Alphabetic device required.

IBM 650 Library Program Abstracts — *File no.* 1.3.010 ERRATA

SEVEN/CARD PUNCH BY LARRY ZIRKLE

It was discovered that the program does not perform as indicated in the writeup under program entry.

A corrected relocatable deck and new listing are available upon request.

Listing and decks mailed on or after March 1, 1961 have been corrected.

650 LIBRARY PROGRAM ABSTRACT — FILE NUMBER 1.4.002

FLOW TRACER

S. Poley
IBM, New York

5-15-56

a) A symbolic program to be assembled by SOAP which will trace designated locations only, called "bus stops."

b) Does not apply.

c) Does not apply.

d) Storage required is 60 locations and two successive bands should be designated as an assembly area for the routine. The symbolic deck contains 52 cards.

e) A maximum of 27 bus stops are allowable. When a bus stop is reached a single card is punched giving the location of the bus stop along with the contents of the distributor and accumulator. A SOAP symbolic deck listing with a sample absolute listing is included.

f) Alphabetic device if the SOAP symbolic version is used.

650 LIBRARY PROGRAM ABSTRACT — FILE NUMBER 1.4.003

TRACING ROUTINE

D. W. Hagelbarger
Bell Telephone Laboratories, Murray Hill, New Jersey

July 27, 1956

a) A tracing routine for use with machine language programs.

b) Does not apply.

c) Does not apply.

d) Storage required is 150 locations, 1800 to 1949 (or 0800 to 0949). Tracing is at 100 card per minute.

e) Traces any program that the computer can execute. For each instruction traced the following information is punched: card number, location of instruction, the instruction, and contents of upper and lower accumulator and distributor (before execution of the instruction). Entry to, exit from and tracing of branch orders only is under control of console switches. Designed for use with the general purpose control panel used by the Bell Interpretive System, Technical Newsletter No. 11.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT — FILE NUMBER 1.4.005

SELECTIVE TRACING ROUTINE

Barry Gordon
Equitable Life Assurance Society
New York, N. Y.

a) Traces all instructions, or only those instructions with a minus sign.

b) Does not apply.

c) Does not apply.

d) Uses one band of 50 locations; is relocatable.

e) This program was previously published in IBM Principles of Operation Bulletin #135 (Form 22-7135-0) and is reprinted here to bring it within the scope of the 650 Program Library.

f) Minimum 650

IBM 650 Library Program Abstracts — *File no.* 1.4.007 Utility Programs

SYMBOLIC TRACING ROUTINE FOR A 650 SYSTEM WITH INDEXING REGISTERS

D. J. Hall
Research Computing Center
Indiana University
Bloomington, Indiana

a. Purpose: This routine is designed to be assembled by SOAP II, along with an untested main program, in anticipation of utilizing tracing as an aid in debugging.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: 60 locations in addition to eight successive words of any punch area.

Speed: Tracing proceeds at 100 instructions per minute.

Relocatability: Not given.

e. Remarks: For each instruction traced a card is punched with the location of the instruction, the instruction itself, the contents of the distributor, upper and lower accumulators, and the contents of the three indexing registers. The location of the first instruction to be traced is set in the storage entry switches. A SOAP II symbolic deck listing with a sample absolute deck listing is included in the write-up.

f. 650 System: One 533 and indexing registers required.

Special Devices: Alphabetic device if SOAP II symbolic version is used.

IBM 650 Library Program Abstracts — *File no.* 1.4.010 Utility Programs

GENERAL TRACING ROUTINE

J. W. Burgeson
IBM, Akron, Ohio

a. Purpose: This routine traces all instructions, or only those with a minus sign.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: This program uses 50 storage locations.

Speed: Not given.

Relocatability: Relocatable.

e. Remarks: This program is very nearly identical with File Number 1.4.005. The only difference is that the one deck (45 cards) can be used for any band of 50 locations, excluding the 1950 band. The user specifies the band to be used by means of the instruction address in the console switches when reading in the program deck.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 1.4.011
Utility Programs

MODIFIED SYMBOLIC TRACING ROUTINE

J. May
Hudson Laboratories
Columbia University
Dobbs Ferry, New York

a. Purpose: This program is to be assembled by SOAP II, along with an untested program, for use in tracing as a method of debugging. This routine is a modification of "Symbolic Tracing Routine," File Number 1.4.001.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: This routine requires 57 storage locations, including eight successive words of any punch band.

Speed: Tracing proceeds at the rate of 100 instructions per minute.

Relocatability: Not given.

e. Remarks: For each instruction traced, a card is punched with the location of the instruction, the instruction itself, the contents of the distributor and accumulators, and the contents of the indexing registers. The location of the first instruction to be traced is set in the Storage Entry switches.

f. IBM 650 System: One 533 and indexing registers.

Special Devices: Alphabetic device required.

IBM 650 Library Program Abstracts

File no. 1.5.003
Utility Programs

AUTOSET

M. F. Row
Federal Bureau of Investigation
Washington 25, D. C.

a. Purpose: This program will set tapes (either "read" or "write") to a predetermined position. Can be used to set tapes to the position where a partially completed job was halted on a previous run.

b. Range: Will preset one to six tapes.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: Programmed for locations 1950 - 1999.

Speed: Approximately that of tape reading.

Relocatability: May be relocated to any band.

e. Remarks: Identification of predetermined position on tape may be a tape mark, record number, or any word in a record which is peculiar to that specific record.

f. 650 System: One 533, tape units, and indexing registers required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 1.5.004
Utility Programs

MULTIPLE PROGRAM DUMP AND LOADER

G. M. Stace
Office Methods & Procedures
Owens-Illinois Glass Co.
Toledo 1, Ohio

a. Purpose: These routines write any number of programs on a single tape. Any required program can be reloaded onto the drum by means of a single load card. A program may be added to the program tape without specifying the last program number on the tape.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: All routines are fixed.

c. Mathematical Method: Does not apply.

d. Storage Required: The maximum storage requirement for any routine is 0000-0049 plus the first ten locations of IAS and a read band.

Speed: Not given.

Relocatability: Not given.

e. Remarks: These routines will destroy instructions located in IAS and indexing registers.

f. 650 System: One 533, tape units and indexing registers are required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 1.5.006
Utility Programs

CROWN LIFE INSURANCE COMPANY SORTING PROGRAM

J. Ballantyne
Crown Life Insurance Company
Toronto, Ontario

a. Purpose: Program to sort ungrouped 650 tape records. Record size and position of the index in the record are located symbolically so that the SOAP program may be assembled to sort any size record from one to fifty words in length. The program retains the sequence of equal indices from the input to the sorted output.

b. Range: Sorts on a single word index only. Program has two phases. Phase I block sorts thirty records and Phase II merges these blocks in multiple passes to complete the sort.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: Requires bands 0450 to 1950 for the internal block sorting in Phase I, and there are seventy-seven free locations between 0000 and 0449.

Speed: Not given.

Relocatability: Not given.

e. Remarks: None.

f. 650 System: One 533, six 727 Magnetic Tape Units, and indexing registers are required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 1.5.009
Utility Programs

SORT II, DESCENDING

C. E. Perkins
J. R. Casalaspi
National Biscuit Company
New York, New York

a. Purpose: This routine sorts records in descending order rather than ascending order.

(Continued on next page)

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: Not given.

Speed: Not quite as well optimized as SORT II.

Relocatability: Not given.

e. Remarks: The methods are covered in the SORT II Reference Manual (form 328-0415). The "High" and "Low" exits of the original comparison blocks have been interchanged.

f. IBM 650 System: An IBM 650 system with four tape units.

Special Devices: None.

IBM 650 Library Program Abstracts *File no.* 1.5.011

TAPE PROGRAM FINDER, WRITER, AND SALVAGE

Mr. Charles Sampson
Kentucky Department of Highways
State Office Building
Frankfort, Kentucky

a. Purpose: These programs are for the purpose of writing any program(that is in single or 7-per card) on tape, finding the program after it is written on tape and loading it on to the 650, and then transferring the program from one tape to another.

b. Restrictions, Range: Does not apply.

c. Method: Does not apply.

d. Storage Requirements: One band used for Finder Program, four bands used for each of the other. These bands are used momentarily and there is no need for relocation.

e. Remarks: Follow instructions submitted in write-up.

f. IBM 650 System: With IAS and tapes.

650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 1.6.006

CLEAR BLOCK TO ZERO

S. Fleming
G. E., Schenectady

3-30-56

a) Clears a specified block of storage to zero.

b) Does not apply.

c) Does not apply.

d) Storage required is 8 locations, 1951 - 1958.

e) Self-loading. The block limits are punched in the one card deck.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 1.6.007

FIVE-PER-CARD CONDENSING ROUTINE

G. E. Mitchell
IBM, Houston

1-1-56

a) Condenses a one-word-per-card deck to a five-word-per-card deck and places a loading routine, file number 1.2.003, ahead of the condensed deck.

(Continued on next column)

b) Does not apply.

c) Does not apply.

d) The deck contains 47 cards. Output is 100 cards per minute.

e) Self-loading. A trailer card placed at the end of the condensed deck makes it self-transferring.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 1.6.009

ONE TO SEVEN CONVERTER

P. S. Herwitz
IBM, Washington

3-20-1956

a) Converts single-word load cards to seven-per-card load cards which may be used with the seven-per-card loader, file number 1.2.002.

b) Does not apply.

c) Does not apply.

d) Storage required is 37 locations, 0000 to 0035 and 1950. In addition, 25 locations are used in the 1900 and 1950 bands for reading, punching, and loading. Cards read at 200 per minute and punch at approximately 28 per minute.

e) Loading routine not included in listing.

f) Minimum 650.

ERRATA **650 Library Program - File No. 1.6.009**

"One to Seven Converter," by P. S. Herwitz

In the one-page listing appended to the detailed write-up for 1.6.009, instruction number 29 (location 0029) should read:

	65	**0028**	**0030**
instead of	**65**	**0028**	**0039**

This is a typographical error in the preparation of the listing; the program deck is not affected.

April 1958, Bulletin 18 - 37

650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 1.6.011

SEVEN TO ONE CONVERTER

P. S. Herwitz
IBM, Washington

a) Converts seven-per-card load cards to single instruction load cards.

b) Does not apply.

c) Does not apply.

d) Storage required is 8 locations 1961 to 1967 and 1986. The 1950 band is used for a read area, punch area, and self-loading routine. Cards are punched at 100 per minute.

e) Self-loading.

f) Minimum 650

650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 1.6.012

A PROCEDURE FOR USING SOAP WITH A NUMERIC 650

Jack N. Graham
USAF, Directorate of Intelligence
Mathematical Analysis Branch
Washington, D. C.

a) Enables SOAP to be used with a minimum 650 provided a 407 with summary punch is available.

b) Does not apply.

c) Does not apply.

d) Approximately 850 storage locations are required.

e) A SOAP deck is partially converted to 650 alphabetic code using the 407 and summary punch. This routine completes the conversion at which time the regular SOAP program performs the assembly. No special characters may be used for any part of symbolic addresses.

f) Minimum 650 and 407 with summary punch.

650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 1.6.014

SOAP TO SEVEN

James D. Chappell
IBM, Washington
December 31, 1956

a) Will convert single instruction load cards to seven-per-card load cards. SOAP output cards may be converted immediately without removing special type cards. Only those locations from the FWA to the LWA are punched with the further provision that no output card shall begin with an unused location.

b) Does not apply.

c) Does not apply.

d) Uses entire 1950 band. Running time is approximately read and punch speed.

e) The 1.2.002 loader is punched along with the 1.6.001 stop number routine prior to punching the converted program deck. A 1.2.002 transfer card is the last card punched. No single instruction load cards can be processed for loading into the area used by the 1.2.002 loader.

f) Minimum 650.

IBM 650 Library Program *File no.* 1.6.014 ERRATA

"SOAP to Seven," by J. D. Chappell

Under INPUT on page 1 of the write-up, the statement should read as follows:

". . . , the location in columns 23-26, and the word to be loaded in columns 31-40."

650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 1.6.016

SOAP I TO SOAP II TRANSLATOR

S. Poley
IBM, New York
December 1, 1956

a) Translates symbolic cards prepared for SOAP I into symbolic cards acceptable to SOAP II.

b) Does not apply.

c) Does not apply.

(Continued on next column)

d) Storage required including tables is approximately 220 locations. Timing is approximately 100 cards per minute.

e) It is assumed that errors detectable by SOAP I have been corrected and that relocatable addresses are in the range 0000 - 1999. Only the first ten columns of the remarks field will be retained. A SOAP II symbolic deck listing and a four-per-card absolute deck listing are included.

f) Alphabetic device is necessary.

650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 1.6.017

AN INTERPRETIVE OPERATION FOR THE CONVERSION OF NUMBERS FROM FIXED POINT REPRESENTATION TO FLOATING POINT REPRESENTATION AND VICE VERSA

R. W. Klopfenstein
RCA Laboratories
Princeton, New Jersey

a) Designed as an adjunct to the interpretive system developed at Bell Telephone Laboratories and described in IBM Technical Newsletter No. 11.

b) Floats a fixed point number or fixes a floating point number. Rounds in the last place in both floating and fixing.

c) Not applicable.

d) Programmed for locations 001-049. (Note: Interpretive system proper occupies locations 1000-1999).

Running Time: Approximately 60 milliseconds.

Relocatable to any 49 consecutive locations in lower memory (excepting 0000) by means of the Bell Telephone Laboratories translation routine. Preferably relocated by multiples of 50 locations.

e) Programmed stop with 8888 in the address lights occurs if an overflow would result upon fixing a given floating point number.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 1.6.020

INTERPRETIVE FLOATING DECIMAL ROUTINE

R. R. Haefner
E. I. du Pont de Nemours & Co., Inc.
Savannah River Laboratory
Aiken, South Carolina

a) This routine is a modification of the Trimble interpretive floating decimal system described in IBM Technical Newsletter No. 8. It is designed for the 650 installation equipped with the automatic floating decimal device to provide a compromise between rewriting infrequently used programs which incorporate the Trimble routine and inefficient machine utilization while running such programs.

b) Floating arithmetic.

c) Modification of methods in Trimble routine.

d) Uses 243 storage locations in a block of 390 locations. The routine is 75% faster than the Trimble routine with no recoding required.

e) None

f) 650 with automatic floating decimal device.

IBM 650 Library Program Abstracts

File no. 1.6.021
Utility Programs

DAYS BETWEEN DATES

R. Strauss
IBM, Jacksonville, Florida

a. Purpose: Subroutine to determine the number of days between two dates.

b. Range: Up to the limit of the upper accumulator.

Accuracy: Inaccurate one day for each leap year.

Floating/Fixed: Computation is in fixed point.

c. Mathematical Method: Does not apply.

d. Storage Required: 69 words plus 10 words for each time the subroutine is used in the program.

Speed: Variable.

Relocatability: Not given.

e. Remarks: The earliest date must be used as the first date and the most current date as the last date. The date must be six digits and read into the 650 in year, month, and day order. To compute the days between dates in different centuries, the dates must be eight digits and read in the 650 in century, year, month, and day order.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 1.6.022
Utility Programs

FIVE-PER-CARD CONDENSING ROUTINE

J. H. Cooper
R. P. Fraser
T. H. Green
Shell Oil Company
P. O. Box 2527
Houston 1, Texas

a. Purpose: Condenses one-per-card instructions of either SOAP I or SOAP II form.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: About 400 drum locations are required for program and storage.

Speed: Card reader operates at maximum speed.

Relocatability: Not given.

e. Remarks: The entire drum is available to object program since object program instructions, which overlay locations used by the 5/card loader, are automatically saved until last and punched in self-loading 2/card form. The condensed cards are counted when punched and this count is punched in the last card, thus each time the condensed deck is loaded the count is compared with the original count.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 1.6.023
Utility Programs

MISCELLANEOUS UTILITY ROUTINES

a. Purpose: Six of the seven short utility routines originally published in IBM 650 Bulletin 12 and three contributed routines of a similar nature have been assembled to provide a convenient "package" for installations with an expanded IBM 650 system. The routines included are:

Clear Drum to Zeros between Limits
Clear IAS to Zeros between Limits

(Continued on next column)

Clear Drum and IAS to Minus Zeros
Dump IAS and Drum onto Tape
Load IAS and Drum from Tape
Print IAS and/or Drum
Universal Tape Print
Determine Footage of a Reel of Tape
"SNIP" - Measure Off Predetermined Footage of Tape

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: Varies from eight locations to twenty-four depending upon routine used.

Speed: Varies depending upon routine and job to be done.

Relocatability: Not in relocatable form.

e. Remarks: None.

f. IBM 650 System: Most of these routines require one 533 and indexing registers in addition to the equipment specified in the title.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 1.6.025
Utility Programs

RELOCON

E. D. Mounts
National Homes Acceptance Corp.
Lafayette, Indiana

a. Purpose: This program converts single-instruction load cards to four-per-card load cards where other than the 1950 band is used for read-in and relocates the "Four-Per-Card Loader," File Number 1.2.001, automatically. It will also convert the 1950 band.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: The program uses 170 storage locations from location 1800 to location 1999, excluding the read-in locations 1951 to 1960, punch locations 1977 to 1986, the self-loader locations 1995 to 1999, and the trailer load card location.

Speed: The input speed is 200 cards per minute and the output is approximately 50 cards per minute.

Relocatability: Does not apply.

e. Remarks: All routines to be converted must reserve locations 45, 46, 47, 48, and 49 (or their equivalents) in the desired read-in band, for self-loader instructions. The routine could be easily altered for other locations. Output is complete and ready for subsequent loading. It is assumed that any program being converted has been used and proved in single instruction load card form. SOAP output decks may be used without disturbing their sequence. The relocated self-loader is punched out in front of the output deck.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 1.6.026
Utility Programs

LOAD DECK GENERATOR

C. E. Stevens
Standard Oil Company (Indiana)
Detroit, Michigan

a. Purpose: This program produces a seven-per-card load deck preceded by a zero clearing routine and a seven-per-card loading routine, for any band of the drum. The program to be punched must first be loaded on the drum. The Load Deck Generator generates the necessary variable instructions so that the zero clearing routine and the seven-per-card loading routine will read into any band specified by the programmer. Many zero locations are not punched, thus reducing the multiple-instruction-per-card deck to minimum size.

(Continued on next page)

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: There are two sections to the subject program. The first section is read into the last band and punches seven words per card for locations 0000-1950. The second section, if used, requires a second loading of the program to be punched. This section is read into the first two bands and punches two instructions per card for locations 1951-1999.

Speed: Punching speed for both sections of the program is 100 cards per minute. Loading speed of the seven-per-card deck output is 200 cards per minute.

Relocatability: Not given.

e. Remarks: This program is self-zero clearing with self-loading output.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 1.6.027
Utility Programs

STOP NUMBER DRUM AND IAS

J. B. Reid
Trans-Canada Air Lines
Montreal Airport
Quebec, Canada

a. Purpose: This program loads all drum locations (except 1951-1960) and IAS locations with: 01 aaaa 8888, where aaaa is the address of the location.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: Storage locations 1951-1960 and IAS locations 9000-9007.

Speed: Total of 5.7 seconds for drum and IAS loading with stop codes.

Relocatability: Not given.

e. Remarks: None.

f. IBM 650 System: One 533, IAS, and indexing registers.

IBM 650 Library Program Abstracts

File no. 1.6.027
Errata

"Stop Number Drum and IAS" by J. B. Reid

The following corrections have been submitted for the abstract for the above program published in Distribution No. 6 of IBM Library Program Abstracts:

In paragraph (a) delete "(except 1951-1960)".

In paragraph (d) Storage Required should read "Does not apply."
Relocatability should read "Does not apply."

IBM 650 Library Program Abstracts

File no. 1.6.028
Utility Programs

UNIVERSAL MEMORY DUMP AND CONDENSING ROUTINE

B. M. Taylor, Jr.
North Carolina State College
Raleigh, North Carolina

a. Purpose: This program dumps entire contents of drum, accumulator, and distributor as a numbered, self-reloading, self-starting, condensed re-entry deck of not more than 360 cards. Any operating program may be interrupted and dumped at any point; reloading the output automatically restarts the operating program at the point of interruption. An operating program beset with a validity error may be dumped and repaired for re-entry and restarted at the point of interruption. A program being debugged and beset with anomalies may be dumped and listed for inspection. A debugged ready-to-operate program may be condensed for permanent use, without reserving any special area on the drum for the condensing routine itself. The dump program is read into any single available read band of ten words, and does not disturb any other locations.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: Any read band - ten words.

Speed: Not given.

Relocatability: Relocatable.

e. Remarks: If operating program is stopped following division without reset (14), the upper accumulator will be restored with the sign of the lower. If invalid information (blank bits, etc.) is present on the drum, special steps may be taken.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 1.6.029
Utility Programs

CDCSB

D. A. D'Esopo
P. H. Butterfield
Stanford Research Institute
Menlo Park, California

a. Purpose: This program permits the use of the command difference method of address modification in the SOAP language. This command difference coding technique can save initialization and modification instructions when it is used on a series of variable commands which have a common modification increment and which are modified as a group.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: This program requires 23 storage locations plus that needed for parameters.

Speed: Not given.

Relocatability: Not given.

e. Remarks: The 23-card symbolic deck can be punched from the listing included in the write-up.

f. IBM 650 System: One 533 required.

Special Devices: Alphabetic device required.

IBM 650 Library Program Abstracts

File no. 1.6.030
Utility Programs

ON-LINE STORAGE DUMP

H.R. Vandenburgh
Princeton University
Princeton, New Jersey

a. Purpose: This program causes a print-out of the contents of the indexing registers, distributor, accumulators, and drum storage.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: Locations 1951-1960, 8001-8003, and 8005-8007.

Speed: Not given.

(Continued on next page)

Relocatability: Not given.

e. Remarks: The labeled contents of 1951-1960 and 1963-1972 are meaningless.

f. IBM 650 System: One 533, indexing registers, and an on-line 407 are required.

Special Devices: None required.

IBM 650 Library Program Abstracts

File no. 1.6.031
Utility Programs

MATRIX TRANSLATION A/O TRANSPOSITION

R. L. Freeman
Portsmouth Naval Shipyard
Portsmouth, New Hampshire

a. Purpose: This program is designed to separate, translate, or transpose matrices. The matrix to be manipulated may be stored on the drum or in a form to be loaded by the standard four-per-card loader or the n-per-card loader (IBM 650 Library Programs number 1.2.001 or 1.2.002). The repositioned matrix is stored in cards in a form to be reloaded by the n-per-card loader. This program is written to prepare data output of one routine in forms suitable for uses in other routines.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: The program and subroutines use all the drum storage locations.

Speed: Governed by the input-output speeds.

Relocatability: Relocatable by modifying type cards and re-assembling.

e. Remarks: The following restrictions apply:

when $\alpha = 8$, $q \leq 6 \leq n$
when $\alpha = 9$, $q \leq 6 \leq m$

q = number of words per card output
n = number of columns of input matrix
m = number of rows of input matrix
α = code; 8 means non-transpose; 9 means transpose matrix

f. IBM 650 System: One 533 required.

Special Devices: For SOAP version of the deck, the alphabetic device is required; however, for the condensed deck, the alphabetic device is not required.

IBM 650 Library Program Abstracts

File no. 1.6.033
Utility Programs

SELF-CHECKING LOAD DECK GENERATOR

C. E. Stevens
Standard Oil Company (Indiana)
Detroit, Michigan

a. Purpose: With the 650 doing all the work, this program will produce, for any read area of the drum, a condensed load deck consisting of the following sections:

1. Drum zeroing routine
2. Seven-per-card, self-checking load routine
3. Seven instructions per card, 0000-1950
4. Self-checking card, 0000-1950
5. Load routine erasing card
6. Two instructions per card, 1951-1999
7. Self-checking card, 1951-1999

Many zero locations are bypassed in producing the seven-per-card and two-per-card sections, reducing the size of the load deck. The entire output is loaded in the same order as punched with one console setting.

If loading stops with 01 2345 6789 in the program register, something is wrong with the load deck; cards are missing, or have been added or altered.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

(Continued on next column)

c. Mathematical Method: Does not apply.

d. Storage Required: The last band is used by the program to handle locations 0000-1950, and the first two bands to handle 1951-1999.

Speed: Punching of the condensed deck proceeds at the rate of 100 cards per minute; loading of the output is at the rate of 200 cards per minute.

e. Remarks: The program is self-zero-clearing, self-loading and self-checking.

f. IBM 650 System: One 533 required.

Special Devices: None required.

IBM 650 Library Program Abstracts

File no. 1.6.034
Utility Programs

RELOCATABLE TO REGIONAL SOAP II

G. J. Porter
Project Matterhorn
Princeton, New Jersey

a. Purpose: This program converts subroutines written in relocatable SOAP II into normal SOAP II by making the relocatable addresses into regional addresses. These subroutines are acceptable to either 650 FORTRAN or FOR TRANSIT.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: The program including the loader occupies locations 1800-1999.

Speed: Not given.

Relocatability: Not given.

e. Remarks: Requires minor modifications to SOAP II board.

f. IBM 650 System: One 533 required.

Special Devices: Alphabetic device required.

IBM 650 Library Program Abstracts

File no. 1.6.035
Utility Programs

ERL GENERAL UTILITY PROGRAM

Judy Psygoda
Electronics Research Laboratories
New York, New York

a. Purpose: This program was designed to facilitate the comparison and assimilation of sets of data output from mathematical programs. It is useful for the interpretation of output data and the preparation of data for plotting by hand or machine. For sets of data in 8 words-per-card format, by means of control cards, it can be used for conversion between number systems, finding the range of data, conversion to logarithms to the base 10, normalization of data, and rearrangement of output card formats.

b. Range: Not given.

Accuracy: Not given.

Floating/Fixed: Either floating or fixed decimal input and output may be utilized.

c. Mathematical Method: Not given.

d. Storage Required: The entire drum is used.

Speed: Part I, the rangefinder, runs 4 seconds per data card input, when all 8 words of the data card are processed. Part 2 runs 3.5 seconds per data card input, for processing of 8 words.

Relocatability: Not relocatable.

e. Remarks: All auxiliary routines used are included in the seven-per-card listings and program decks.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 1.6.036
Utility Programs

MATRIX PACKAGE

V. Kahan
W.D. Thorpe
V. Sears
V. Soots
L.S. Green
Computation Centre, University of Toronto
Toronto, Canada

a. Purpose: The matrix package is an interpretive system designed to reduce a sequence of matrix operations to a sequence of pseudo-instructions.

b. Range: Maximum size of matrices handled is 37 rows X 50 columns.

Accuracy: Dependent on matrices being processed by matrix operation.

Floating/Fixed: Both can be used.

c. Mathematical Method: The inversion subroutine uses Jordan's Elimination Method.

d. Storage Required: Dependent on size of matrices used.

Speed: Not given.

Relocatability: Not given.

e. Remarks: The package contains the following operations:

70 Input	39 Multiplication
71 Output	20 Transpose multiplications
90 Fixed point output	33 Add Transpose
99 Fixed to floating	35 Column augmentation
32 Linear combination	36 Row augmentation
22 Transfer	37 Partition
34 Inversion	78 Checksum output

f. IBM 650 System: Tape system consisting of one 533, indexing registers, one 727 magnetic tape unit.

IBM 650 Library Program Abstracts

File no. 1.6.038
Utility Programs

650 FORTRAN SYMBOL EQUIVALENCE TABLE

W. M. Compton
Arabian American Oil Company
New York 22, N. Y.

a. Purpose: This program automatically prepares SOAP II "EQU" cards defining the storage locations of each non-subscripted variable and the location of the first 650 instruction compiled for each statement in a 650 FORTRAN source program. This symbol table aids in program error-detection operations.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: Not given.

Speed: Symbol table punched at the rate of 100 symbols per minute.

Relocatability: Not given.

e. Remarks: None.

f. IBM 650 System: One 533 and indexing registers.

Special Devices: Group II special character device required.

IBM 650 Library Program Abstracts

File no. 1.6.039
Utility Programs

LADPAC UTILITY ROUTINES

Los Angeles Data Processing Center
Los Angeles, California

a. Purpose: These programs are a compatible set of utility routines for many different configurations of 650 systems. They use standard console settings throughout. The routines range from those useful with basic machines through those which may be

(Continued on next column)

used with systems (e.g. RAMAC). They are useful both as program error-detection aids and utility programs. The routines included, and the LADPAC number for each are:

Number	Routine	Number	Routine
1153	LADPAC SOAP	1422	I. R. Print Trace (high)
1215	Library Checkmate	1423	Set Format Trace (high)
1232	Standard 3/cd Loader	1431	Basic Print Trace (relocatable)
1251	5/cd Loader (high)	1432	I. R. Print Trace (relocatable)
1252	5/cd Sequencing Loader (high)	1433	Load Card Trace (high)
1261	6/cd Loader (high)	1442	I. R. Punch Trace (low)
1262	6/cd Sequencing Loader (high)	1452	I. R. Punch Trace (high)
1272	7/cd Sequencing Loader (high)	1472	I. R. Print Punch Trace (core)
1281	1/cd Translating Loader (high)	1485	I. R. Trace to Tape (high)
1282	1/cd Sequencing Translating Loader (high)	1495	Snapshot Print Trace (high)
		1496	Snapshot Print Trace (high)
1312	1/cd Punchout (high)	1541	Copy Tape
1313	1/cd Punchout (core)	1551	Memory to Tape
1317	1/cd Punchout (low)	1552	Tape to Memory
1332	3/cd Punchout (high)	1553	Read Check Tape
1337	3/cd Punchout (low)	1561	Tape to Printer
1352	5/cd Punchout (high)	1571	Memory and Arithmetic Units to Tape
1356	5/cd Punchout (low)		
1362	6/cd Punchout (high)	1582	Recall Memory and Arithmeti Units from Tape
1372	7/cd Punchout (high)		
1391	Drum Print	1651	Clear Memory to Zero
1392	Band Print (high)	1652	Set Memory to Stop Codes
1393	Core Print	1654	Partial Drum Clear
1394	Band Print (low)	1655	Drum Clear to Zero
1395	Band Print (core)	1656	Set Drum to Stop Codes
1401	Basic Punch Trace (low)	1658	Clear Drum Between Limits
1402	Basic Punch Trace (high)	1666	Drum Search
1403	Basic Punch Trace (relocatable)	1701	Zero RAMAC Between Limits
1411	Basic Print Trace (low)	1702	Zero Disk File
1412	I. R. Print Trace (low)	1711	RAMAC to Tape
1413	Set Format Trace (low)	1712	Tape to RAMAC
1421	Basic Print Trace (high)	1731	Selective RAMAC Print

Number	Routine	Number	Routine
1732	Selective RAMAC Zero	1789	Recall Memory and Arithmetic Units from RAMAC
1733	Selective RAMAC Change		
1777	Memory and Arithmetic Units to RAMAC	1841	Tape Quality Preparation
		1842	Tape Quality Analysis
		1892	Deck Numbering Routine

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: See the program writeup.

c. Mathematical Method: Does not apply.

d. Storage Required: See the program writeup. Some routines operate from core.

Speed: See the program writeup.

Relocatability: Some routines are relocatable.

e. Remarks: All routines have been tested and put to use at the Los Angeles Data Processing Center. In addition to the routines, an extensive commentary is included to fully explain the standard procedures employed. A trace table is included to assist the customer in choosing the proper trace. Descriptions in detail of the LADPAC Utility Read/Punch panel (largely 80-80) and the LADPAC 407 On-line Print panel are included. Most routines will operate with only a load hub wired to column 1, or with a ten word print panel. Standard card formats are described. Floating point mathematical routines for the basic functions are included in both SOAP relocatable and SOAP symbolic. An explanation of the numbering system used in identification of these routines is included, together with symbolic and absolute listings.

Punchout routines always include, as the first cards of the output, a routine to load that deck. This loader will operate from the same storage locations as the punchout. Most of the punchout and loader routines are written for the basic machine.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 1.6.040
Utility Programs

FOR TRANSIT SUBROUTINE PACKAGE

C. W. Zahler
United States Steel Corporation
Pittsburgh, Pennsylvania

W. J. Lee
IBM Corporation
Pittsburgh, Pennsylvania

(Continued on next page)

a. Purpose: This package includes subroutines for ABSF, COSF, SINF, ATANF, SQRTF, EXPF, LGNF, ANTLF, CLOGF.

b. Range: Maximum.

Accuracy: Maximum.

Floating/Fixed: Floating decimal arithmetic is used.

c. Mathematical Method: Standard iterative techniques are employed.

d. Storage Required: Not given.

Speed: Not given.

Relocatability: Not given.

e. Remarks: All subroutines are in 5/card format.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 1.6.041

AUTOMATIC PERSONAL IDENTIFICATION CODE
(AUTO PIC)

Jack Melnick
IBM - Trenton
215 West State Street
Trenton 8, New Jersey

a. Purpose: To numerically code alphabetic names of individuals and assign unique identifying data to each individual.

b. Range: Not applicable.

Accuracy: Expected accuracy of 85-95% alphabetic sequence with an expectancy of .01-.02% duplications.

Fixed

c. Mathematical Method: Not applicable.

d. Storage Required: 1727 words for tables; 267 words for program, constants, and input-output areas; 6 words available.

Speed: 100 cards per minute.

Relocatability: Non-relocatable.

e. Remarks: Limits of tables: 768 first names; 9590 last names broken into 10 phases of 959 words each.

f. 650 System: Minimum 650 with alphabetic device.

IBM 650 Library Program Abstracts

File no. 1.6.042

SWCHF SUBROUTINE FOR 650 FORTRAN

David L. Grobstein
Concepts and Applications Laboratory
Picatinny Arsenal
Dover, New Jersey

a. Purpose: This subroutine makes available to 650 FORTRAN a statement resembling the IF (SENSE SWITCH i) n_1, n_2 instruction available in 704-709 FORTRAN.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply

c. Mathematical Method: Does not apply.

d. Storage Required: 28 drum locations

Speed: Varies from 10 to 60 milliseconds depending on the degree of optimization.

(Continued on next column)

Relocatability: SWCHF is written in SOAP II and is used in symbolic form during 650 FORTRAN PASS II assembly. Available locations are assigned by the FORTRAN PASS II deck, and may be anywhere on the drum.

e. Remarks: The subroutine uses the rightmost three Storage Entry Switches on the 650 console to simulate sense switches, and control program branching.

f. IBM 650 System: Same as needed for 650 FORTRAN.

IBM 650 Library Program Abstracts

File no. 1.6.043

UTILITY SUBROUTINES

George Radin
Daniel Salkoff
New York University College of Engineering
University Heights
New York, N. Y.

a. Purpose: The package has the advantage of offering a system with uniform linkage, 4-character local addresses, and index-register preserving routines.

Routines included:

1. Float X
2. Fix X
3. $\sqrt{X}$
4. Arctan X
5. Ln/X/
6. Exp X, 10^X, Sinh X, Cosh X
7. Sin X, Cos X
8. n-Pt Gaussain Integral
9. Gamma X

b. Restrictions, Range: Floating decimal.

c. Method: Does not apply.

d. Storage Requirements: Does not apply.

e. Remarks: Does not apply.

f. IBM 650 System: 650 with Floating Decimal and Index Register.

IBM 650 Library Program Abstracts

File no. 1.6.044

GOUTY II A

A. Wachowski
J. L. Overbey
Research Department
Automatic Electric Laboratories, Inc.
400 North Wolf Row
Northlake, Illinois

a. Purpose: This program with associated 533 and 407 control panels form a unified system of programmed input and output both in numeric and alphabetic form for the scientific use of the IBM 650.

b. Range, Accuracy, Floating/Fixed: Not applicable.

c. Mathematical Method: Not applicable

d. Storage Required: 177 locations.

Speed: Maximum read and punch speed.

Relocatability: Not relocatable.

e. Remarks: The 533 Control Panel may also be used as a General Utility Board with 80-80 Read and Punch, as Load or Non-Load cards.

f. Equipment Specifications: 650 with Alphabetic Device and an off-line 407 accounting machine.

IBM 650 Library Program Abstracts

File no. 1.6.045

AUTOMATIC SOAP CONVERSION UTILITY PROGRAM (ASCUP)

T/Sgt. Robert D. Drury
5755 Hickam Drive
Dayton 31, Ohio

(Continued on next page)

a. Purpose: Program automatically converts sequentially coded 650 programs to Soap IIA input for optimization.

b. Restrictions, Range: Does not apply.

c. Method: Does not apply.

d. Storage Requirements: Load deck contains 164 cards - 100 card per minute output.

e. Remarks: Program must be reloaded for each program being converted.

f. IBM 650 System: Alphabetic device necessary.

IBM 650 Library Program Abstracts

File no. 1.6.046

BLOCK CORRELATION - COR_2

Numerical Computation Laboratory
Ohio State University Research Center
Columbus 12, Ohio

a. Purpose: COR_2 will produce all the correlations for a block of variables which are to be correlated with themselves or with another block of variables. Results include sums, sums of squares, sums of crossproducts, means, standard deviation, variance, covariance, correlation coefficient, and its square.

b. Range: Not given.

Accuracy: Not given.

Floating/Fixed: Fixed point data (see write-up for various data forms).

c. Mathematical Method: COR_2 uses the following formula in the computations.

$$r_{12} = \frac{N\left(\sum x_1 x_2\right) - \left(\sum x_1\right)\left(\sum x_2\right)}{\sqrt{N\left(\sum x_2^2\right) - \left(\sum x_2\right)^2} \cdot \sqrt{N\left(\sum x_1^2\right) - \left(\sum x_1\right)^2}}$$

d. Storage Requirements: Permanent locations: 0000 and 1067 thru 1999. Unused locations: 1995, 1996, 1998. Reserved for sums: 0001 thru 1066.

Speed: Time required for accumulation of sums is approximately (in minutes) $\frac{1}{625}(2.5a + b)c$ where a = number of variables, b = number of correlations, c = number of observations.

Correlation requires approximately (in seconds): 1.5n, where n is number of correlations.

Relocatability: Not relocatable.

e. Remarks: COR_2 has attached to the front of the 7/card deck the loading routine used by the program.

f. 650 System: Basic 650; no special equipment necessary.

IBM 650 Library Program Abstracts

File no. 1.6.047

SHIFF

Richard E. Chandler
Research Computing Center
Florida State University
Tallahassee, Florida

a. Purpose: SHIFF is a FORTRANSIT I (s) subroutine designed to shift a fixed point number a desired number of places right or left (or both).

b. Restrictions, Range: Fixed point.

c. Method: Does not apply.

d. Storage Requirements: 17 locations plus 1454 and 1951-1952.

e. Remarks: SHIFF operates with the argument (number to be shifted) in the lower. Since the first shift performed is to the right, all digits shifted "off" will be lost.

f. IBM 650 System: Minimum 650 with alphabetic and special character devices.

IBM 650 Library Program Abstracts

File no. 1.6.048

TRANSLATOR - OTHER FORMATS TO SOAP RELOCATABLE (TYPE 2) DECKS

W. H. Lewellen
D. L. Weimer
Ohio Department of Highways
Columbus 15, Ohio

(Continued on next column)

a. Purpose: A program to translate routines written in post-SOAP (one-word per card), four-word per card, five-word per card (6-10 format), and seven-word per card into SOAP relocatable (type 2) form.

b. Restrictions, Range: Does not apply.

c. Method: Does not apply.

d. Storage Requirements: The program occupies locations 0000 through 1036 inclusive. Program speed is punch limited.

e. Remarks: The five-word per card (6-10 format) routines are always translated correctly and every address referred to, but not used as a location, will be reserved when assembling. Other formats require hand checking in order to ascertain that they have been treated as intended.

If it is desired, a group of constants may be held fixed by preceding them with a load card containing all nines in the first word.

A post-SOAP and seven word per card listing is included.

f. IBM 650 System: Minimum 650 equipped with alphabetic device.

IBM 650 Library Program Abstracts

File no. 1.6.049

FIRSIR

Fred G. Gross
IBM - Los Angeles
3424 Wilshire Blvd.
Beverly Hills, California

a. Purpose: To simulate index registers on a basic 650.

b. Restrictions, Range: Fixed decimal.

c. Method: Does not apply.

d. Storage Requirements: Approximately 300 locations are required. Speed varies with type of problem run.

e. Remarks: Trace is included.

f. IBM 650 System: Minimum 650.

IBM 650 Library Program Abstracts

File no. 1.6.050

FLOATING POINT AND INDEXING REGISTER SIMULATOR WITH TRACE (FIRST)

Peter W. Pakeltis
Computing Center
Northwestern University
Evanston, Illinois

a. Purpose: To make available to programmers of the basic 650 all the operation codes, addresses, automation and apparent behavior of a 650 equipped with automatic floating decimal device and three indexing registers.

Programs existing or intended for the above augmented machine are immediately compatible with any 650 provided drum space is available for this simulator. Entrance and exit procedures are quite simple and the simulator can be used as a subroutine in the main program or as a general interpretive program by entering from the console switches once per program.

The write-up includes detailed flow charts and listings so that less general versions of the simulator can be assembled as special subroutines requiring less storage if desired.

This simulator is especially intended for training programmers in the use of the automatic devices and their operation codes when only a basic 650 is available.

b. Range, Accuracy, fixed or floating point are as for augmented 650.

c. Mathematical Methods: Not pertinent.

d. Storage Requirements: 394 adjacent drum locations are required for the full simulator. The speed of the main program being interpreted is roughly ten 650 operations per second. Relocation is possible in multiples of 50 locations by changing SOAP II pseudo-operations as explained in write-up for re-assembly.

e. Remarks: Program is available on single or double word self-loading cards assembled for locations 1500 thru 1894. To enter: RAL first command of main program to be interpreted and go to 1500. To leave: Address control to a negative command, read a load hub card, or attempt an invalid command.

f. Equipment: Minimum 650. No special wiring.

IBM 650 Library Program Abstracts

File no. 1.6.051

537 SIMULATOR GENERATOR

Q. J. Maltby
North American Life Assurance Co.
Toronto, Ontario, Canada

a. Purpose: Generates on SOAP II input card format a subroutine for use within a program. The subroutine generated, after assembly within a program will simulate in the 533 the operation of a 537 input-output unit to the extent of punching the output on the input cards. Misfilings between reading and punching are detected.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required (re the generated subroutine): The results storage area used by the subroutine is defined by the input prepared for the generator. (This area should be as large as possible for easy card handling). The subroutine programme is contained with 100 consecutive locations (with a few spaces in the middle).

Speed: Unknown. However the subroutine was hand optimized.

Relocatability: The subroutine is fully relocatable. The translation desired is specified in the input prepared for the generator.

e. Remarks: The input to the generator must specify the number of "answer" words needed and the punch words from which they will be available for output. Thus there is considerable flexibility in programme design, as the generator analyses the variables and puts out a complete subroutine which is ready to use.

f. 650 System: One 533 required.

Special Devices: Alphabetic device required.

IBM 650 Library Program Abstracts

File no. 1.6.052

650 DIAGNOSTIC

T. L. Yates
Oregon State Highway Department
Salem, Oregon

a. Purpose: A program to detect irregularities in IBM 650 routines.

b. Range: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: Operates at full read-punch speed. Uses approximately 500 words of drum storage. Non-relocatable.

e. Remarks: Input to this program consists of load cards in the SOAP output format. Output consists of 30 columns of alphabetic from punch words 1-6.

f. IBM 650 System: Minimum 650 with alphabetic device.

IBM 650 Library Program Abstracts

File no. 1.6.053

650 FORTRAN EDITOR

Jon Pegg
S. Togasaki
IBM Advanced Systems Development
Monterey & Cattle Roads
San Jose, California

a. Purpose: 650 FORTRAN Editor: A method of detecting many errors in 650 FORTRAN statements.

b. Range: Does not catch all errors.

c. Mathematical Method: Does not apply.

d. Storage Required: Speed about 100 cards per minute.

e. Remarks: None.

f. IBM 650 System: IAS, 407, Indexing registers, alphabetic device.

IBM 650 Library Program Abstracts

File no. 1.6.054

FORSCAN

AN IBM 650 COMPUTER ROUTINE FOR
MACHINE EDITING OF FORTRAN PROGRAMS

C. A. Irvine
Monte G. Smith

Continental Oil Company
P. O. Drawer #1267
Ponca City, Oklahoma

a. Purpose: This routine will scan a program written in the "650 FORTRAN" language and will examine the program for forty-seven types of errors. These errors fall into three major categories: (a) transcribing and keypunching, (b) violations of system restrictions, (c) logical flow errors.

b. Range: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: 1849 locations.

Speed: Approximately 16 cards per minute.

Relocatability: Non-relocatable.

e. Remarks: Since the "650 FORTRAN" system contains virtually no diagnostic features, the use of FORSCAN should greatly reduce the number of unsuccessful compilations. Machine editing with FORSCAN is considerably faster than the 650 FORTRAN to SOAP phase of the compiling process.

f. 650 System: Minimum 650.

Special Devices: Indexing accumulators, special character device, and alphabetic device.

IBM 650 Library Program Abstracts

File no. 1.6.055

FORTRANSIT SCANNING ROUTINE

George Brooks
Applied Science Representative
IBM - Tulsa,
1307 S. Boulder Avenue
Tulsa 19, Oklahoma

a. Purpose: This routine is designed to scan FORTRANSIT Statements for most of the common errors that occur in the writing of the statements and also check the flow of logic of the program. If errors are detected, an card is punched and the program continues to scan.

b. Range: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: 650 Set up for FORTRANSIT, reads at 40-50 cards per minute.

e. Remarks: This diagnostic will not check all possible errors (i.e. misspelling) but will provide a fairly thorough check for the most common errors. The program is open ended and future plans include checking for misspelling and other possible errors not included in this system.

f. IBM 650 System: FSR I will take care of the FORTRANSIT I and II while FSR (S) will take care of the FORTRANSIT I (s) and II (s) systems.

IBM 650 Library Program Abstracts

File no. 1.6.056

GENERAL PURPOSE 407 CONTROL PANEL

Robert C. Hessing
Cities Service Research and Development Company
920 East Third Street
Tulsa 20, Oklahoma

a. Purpose: This control panel allows the 407 user to list all card formats which arise in normal 650 programming and data processing: FORTRAN,

(Continued on next page)

SOAP, and machine language processing (see (e) below). FORTRAN statement cards, data cards, answer cards, SOAP instruction cards, machine language cards, and five per card condensed decks are examples of formats which may be printed. In addition to the above, any title of 32 characters (or less) may be stored and subsequently printed on the first line of each form.

b. Range, Accuracy, Floating/Fixed: Does not apply.

c. Mathematical methods: Does not apply.

d. Storage: Does not apply.

e. Remarks: Standard 407 accounting machines cannot be programmed to print FORTRAN statement cards or to bring information out of storage on the first line of the first form.

Cards must contain identifying punches where necessary.

f. Equipment specifications:
1) Standard 407 accounting machines (16 co-selectors, 15 pilot selectors, and 2 digit selectors) allow printing of all card formats mentioned above except FORTRAN statement cards.

2) 407 accounting machines equipped with 16 additional co-selectors, 5 additional pilot selectors, and 1 additional digit selector allow printing of all card formats mentioned above including FORTRAN statement cards.

IBM 650 Library Program Abstracts

File no. 2.0.001
Programming Systems

SIR: SOAP INTERPRETIVE ROUTINE*

B. G. Oldfield
W. Hemmerle
IBM, New York

a. Purpose: A relocatable library program which is used with the SOAP system to handle floating decimal interpretive operations.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: The program is separated into 9 sections and only those required for a particular problem need be assembled. Storage for individual sections varies from 31 to 184 locations.

Speed: Timing is a function of the operation being performed.

Relocatability: Relocatable SOAP program cards are available.

e. Remarks: Included, in addition to the arithmetic operations, are trace, float, fix, square root, sin-cos, ln, exp, and arctan. Entry and exit from the interpretive routine are at the discretion of the programmer.

The program is available from the Program Library in 3 forms:

an absolute 7-per-card condensed deck
a symbolic deck in SOAP I format
a symbolic deck in SOAP II format

Modified SOAP I and SOAP II decks are also available from the Library and must be used in assembling the SIR symbolic decks. If possible, use of the condensed deck is advised.

f. 650 System: One 533 required.

Special Devices: Alphabetic device necessary.

*This abstract, which has been revised to reflect the current status of the system, should be substituted for the existing abstract for 2.0.001.

IBM 650 Library Program Abstracts

File no. 2.0.001
ADDENDA

"SIR: SOAP Interpretive Routine," by B. G. Oldfield and W. Hemmerle

The original SIR write-up has been rewritten by Dr. J. A. Kearns and Mrs. Helga Shareshian, IBM Education Center, New York, to conform to SOAP II. The new report, known as "SIR II" is written as a textbook rather than as a reference manual and is being added to the original write-up as an addendum. (Continued on next column)

Copies of the new write-up are available (either separately or combined with the original report) from the IBM 650 Program Librarian.

IBM 650 Library Program

File no. 2.1.001
ERRATA

"Internal Translator (IT), A Compiler for the 650," by A. J. Perlis, J. W. Smith, and H. R. Van Zoeren.

In the SOAP listing of the compiler the following changes should be made:

Card No.	Should read:							
1. 0341		SUP	A0001		1065	11	0383	1137
2. A0341		STU	NEWAB		1137	21	0845	0887
3. 0603	BS	LDD		DROPU	0987	69	0690	0893
4. A0603		RAL	NEWAB		0690	65	0845	0298
5. B0603		NZA	BSA		0298	45	0786	0640
6. 0606		STL	A0001	BSA	1485	20	0383	0786
7. 0607	BSA	RAU	N	BN1	0786	60	0484	1039
8. 0650		LDD		LDSR	1413	69	1377	1038
9. Delete cards 651, 652, 653, and 1692.								

The above changes are corrections to the compiler and do not represent misprints in the listing. Changes 1 - 7 are necessary since the compiler, as distributed, would incorrectly erase an entry in the abcon table every time a floating point constant with a negative exponent was compiled, regardless of whether the exponent had previously been stored as a constant. Changes 8 and 9 are necessary to make room for the insertions.

The above changes have been made in all decks supplied on or after June 1, 1958.

650 LIBRARY PROGRAM ABSTRACT — FILE NUMBER 2.0.002

MITILAC

R. H. Battin, R. S. O'Keefe, M. B. Petrick
MIT, Boston
September, 1955

a) A general purpose multiple address interpretive routine for floating point numbers.

b) Does not apply.

c) Does not apply.

d) The complete routine requires all but 390 locations 0010 to 0399. This amount may be increased to approximately 850 by not using all the features of MITILAC. Timing is a function of the operation being performed.

e) Included, in addition to the arithmetic operations, are sin, cos, arctan, square root, exp, ln, log as a special case, absolute value, solutions for simultaneous differential equations, 10 index registers, read, punch, and various branch operations.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT — FILE NUMBER 2.0.003

COMPLEX ARITHMETIC INTERPRETIVE ROUTINE

Tsai H. Lee
Detroit Edison, Detroit

a) Interprets and executes multiple address complex arithmetic instructions in addition to performing the normal 650 instructions.

b) All complex numbers are assumed to be of the form .xxxxx xxxxx + j .xxxxx xxxxx.

c) Does not apply.

(Continued on next page)

d) The interpretive routine occupies 284 locations, 0000 to 0283. Timing is a function of the operation being performed.

e) Twelve instructions may be interpreted: add, subtract, multiply, divide, shift left, shift round, store complex accumulator, transfer complex number from memory to memory, sum a block of complex numbers, square of absolute value, vector-vector multiplication, and unconditional transfer. Negative instructions are interpreted; positive instructions are executed normally.

f) Minimum 650.

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650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 2.0.005

SPEED CODING SYSTEM

H. M. Sassenfeld
Redstone Arsenal, Huntsville, Alabama

a) A three address interpretive routine for both fixed and floating-point decimal arithmetic.

b) Does not apply.

c) Does not apply.

d) Storage required is from 600 to 855 locations depending upon how many of the function subroutines are needed.

e) There are 45 possible instructions including mathematical functions, memory, dump, restart procedure, three index registers, and optional use of normal 650 operations. Programs coded in the Speed Coding System may be simulated on the 704 by use of the 650 simulator program prepared by Redstone Arsenal.

f) Minimum 650.

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650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 2.0.006

NINE OPERATION SPLIT INSTRUCTION ROUTINE: NOSIR

L. M. Harvey and J. C. White
G. E., Schenectady
August 3, 1956

a) A floating-point interpretive routine using 5 digit instructions so that problems with a large number of instructions may be solved with a single program loading.

b) The interpreted operations use the built-in floating-point operations.

c) Does not apply.

d) Storage required is 94 locations 0000 to 0093.

e) Instructions consist of a one-digit operation code and a four-digit data address. Operations include the arithmetic operations, store, branch minus, branch zero, and exit. Interpreted instructions are stored two to a word and are executed in sequence; the two instructions in a word are performed before proceeding to the next word. Subroutines and normal 650 instructions may be used as needed.

f) Floating decimal device is required.

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650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 2.0.007

ERCO SPACE SAVER

W. G. Rouleau and E. H. Weiss
ERCO Division, ACF Industries, Inc., Riverdale, Maryland

(Continued on next column)

a) This routine is designed to save programming space by executing two instructions per line. The floating decimal point instructions are add, subtract, multiply, negative multiply, divide and add absolute as well as reset add, reset subtract, store and branch minus.

b) Range: $-10^{50} < x < 10^{50}$. Accuracy: 8 places. Number system: floating arithmetic.

c) Does not apply.

d) Storage required is 150 locations.

e) This routine embellishes the 650 computer, but all ordinary 650 instructions can be used in conjunction with this system. A tracing routine has been developed and can be put into any punch band.

f) Minimum 650.

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650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 2 0 008

GENERAL PURPOSE SYSTEM FOR THE 650: L_2

R. W. Hamming and Miss R. A. Weiss
Bell Telephone Laboratories, Inc., Murray Hill, N. J.
August 24, 1956

a) A general purpose three address floating point interpretive system designed to be easy to learn and use. The orders are not assigned definite locations so that program changes are very easy to make.

b) The 8 place floating point system of numbers with exponent range of -50 to + 49. A fixed point addition is also included.

c) Does not apply.

d) Storage required for the interpretive system is 1100 locations, 0900 to 1999 System is not relocatable but library routines are relocatable. The main program of a problem automatically relocates itself as required.

e) In addition to the standard arithmetic operations there are: square root, e^x, $\log_e x$, 10^x, $\log_{10} x$; sin x, cos x, arctan x (both degrees and radians) all with full range of arguments and 8 place accuracy; block read in, punch out, and move; five index registers; transfers on minus, zero, and exponent; transfer to library and subroutines; and tracing orders. Conditional error stops for division by zero, square root of negative numbers, etc., for which error cards are automatically punched. Calculations can be continued after these stops by pushing the program start button.

f) Minimum 650.

(File numbers 2.0.008 and 2.0.008R refer to the same item, i.e., this General Purpose System.)

ERRATA **650 Library Program - File No. 2.0.008**

"General Purpose System for the 650: L_2," by R. W. Hamming and Miss R. A. Weiss

An error has been discovered in certain copies of the L_2 program deck furnished to 650 users. In the main deck, column 18 of card 30 should contain a zero punch; in the incorrect copies, this column is blank.

It is recommended that all copies of this deck be examined and, if necessary, corrected. L_2 decks furnished by the 650 Program Library on or after March 3, 1958, have been corrected.

650 LIBRARY PROGRAM ABSTRACT	FILE NUMBER	2.0.009

ERCO FLOATING DECIMAL POINT SUBROUTINES

J. K. Carl and E. H. Weiss
ERCO Division, ACF Industries, Inc., Riverdale, Maryland

a) Performs eight floating decimal point instructions, namely: add, multiply, divide, subtract, negative multiply, negative divide, add absolute and subtract absolute.

b) Range: $-10^{50} < X < 10^{50}$. Accuracy: 8 places. Number system: floating decimal point.

c) Does not apply.

d) This routine uses only memory locations 1900-1999.

e) Does not apply.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT	FILE NUMBER	2.0.010

DOPSIR: DOUBLE PRECISION FLOATING POINT SOAP INTERPRETIVE ROUTINE

Hebron E. Adams
IBM, Washington

January 2, 1957

a) DOPSIR is both a system of coding (uses a set of mnemonic operation codes in which all arithmetic operations are performed with double precision floating decimal numbers) and a relocatable library program, which interprets the said system.

b) Range of variables: 10^{-49} to 10^{+50}. Accuracy: 18 places. Floating point.

c) Conventional floating point methods.

d) Storage required· 670 locations maximum. Speed: interpretation-execution time averages 60 milliseconds. Relocatable library program.

e) DOPSIR is, in most ways, analagous to SIR, and all SIR operations are included in DOPSIR. In addition, such features as interpretive floating decimal to fixed decimal and fixed decimal to floating decimal commands, an improved interpretive tracing system, and an addressable pseudo-accumulator have been included. Inasmuch as DOPSIR is a somewhat extensive system, the text of the report should be referred to for precautions and restrictions.

f) Alphabetic device is necessary.

650 LIBRARY PROGRAM ABSTRACT	FILE NUMBER	2.0.012

COMPLEX ARITHMETIC OPERATIONS IN THE BELL LABORATORIES INTERPRETIVE SYSTEM

P. M. Marcus
Carnegie Institute of Technology
Pittsburgh, Pa.

D. L. Blackhurst
Mellon Bank
Pittsburgh, Pa.

a) Complex Arithmetic Operations in the Bell Laboratories Interpretive System provides the five arithmetic operations - addition, subtraction, multiplication, division and negative multiplication - with the same code structure as for real operations. The 650 must be sent into a complex mode of operation by a special command; however, previous results and looped operations are preserved, and there is also a complex move; all other operations send the 650 back to the usual mode. Complex numbers are stored in two floating decimal parts in successive registers.

(Continued on next column)

b) Floating point numbers between 10^{-50} and 10^{+49} with eight significant figures (for both real and imaginary parts).

c) Not relevant.

d) Uses 1000-1999; and 0002-0004 erasable storage, 0000-0001 for previous result. Sacrifices arctangent, but provides supplementary (slower) program to evaluate arctangent, using 950-999. Operation times much slower than for real floating decimal operations.

e) Special functions are not available for complex arguments.

The Bell Laboratories Interpretive System is described in IBM Technical Newsletter No. 11.

f) Minimum 650.

IBM 650 Library Program Abstracts

File no. 2.0.013
Programming Systems

AUTOFLIN

H. L. Pickering
W. C. Lake
Pan American Petroleum Corporation
Research Department
Tulsa, Oklahoma

a. Purpose: Autoflin is a general purpose, interpretive system which combines some of the features of the IBM Technical Newsletter No. 8 Floating Point System with the Bell Telephone Laboratories System. In addition, looping codes with many of the properties of the FORTRAN DO statements are provided. An auxiliary input-output system may also be used.

b. Range: Depends on the operation being performed.

Accuracy: Depends on the operation being performed.

Floating/Fixed: The internal system uses automatic floating point. The auxiliary input-output system provides for fixed decimal input-output.

c. Mathematical Method: Function routines for sine, cosine, logarithm and exponentiation similar to those used in the Bell system are provided. An arctangent routine is provided based on D. W. Sweeney's routine described in Abstract 3.1.017.

d. Storage Required: The interpretive system itself is divided into four parts as follows:

Part	Function	Drum Locations
I	Basic Arithmetic	0000-0220
II	Logarithm-Exponential	0221-0376
III	Sine-Cosine	0377-0491
IV	Arctangent	0492-0563

Part I may be used alone. Any one or more of the remaining parts may be added if needed, but may not be used without Part I. The complete auxiliary input-output system uses drum locations 1785-1999.

Speed: Operating speeds are two to three times faster than those for the Bell system, depending somewhat on the problem type.

Relocatability: Not given.

e. Remarks: The AUTOFLIN system allows the programmer to write programs which use the computer effectively with only a superficial knowledge of the 650. No assembly machine pass is required.

f. 650 System: One 533, indexing registers, and automatic floating decimal arithmetic are required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 2.0.015
Programming Systems

REVISED BELL LAB INTERPRETIVE SYSTEM; REVISED BELL LAB TAPE SYSTEM

D. J. Hall
Research Computing Center
Indiana University
Bloomington, Indiana

(Continued on next page)

a. Purpose: "Revised Bell Lab Interpretive System": This program is a revision of the Bell Lab Interpretive System (see Technical Newsletter No. 11) to extend its principles to include the use of indexing registers, IAS, and automatic floating decimal arithmetic feature.

"Revised Bell Lab Tape System": This program is a supplement to "Revised Bell Lab Interpretive System." Both systems were assembled separately; thus the program decks are not the same in similar parts. The tape commands were added to permit the user of the Bell Lab System to have access to tape storage.

b. Range: Will vary depending upon the function being executed.

Accuracy: Will vary depending upon the function being executed.

Floating/Fixed: Floating decimal.

c. Mathematical Method: See the program write-up.

d. Storage Required: "Revised Bell Lab Interpretive System": 819 drum storage locations and 60 IAS locations are required. "Revised Bell Lab Tape System": 998 drum storage locations and 60 IAS locations are required.

Speed: Will vary, depending upon the function being executed.

Relocatability: Not given.

e. Remarks: The unused drum storage locations could be used to add more codes to the revised systems.

f. IBM 650 System: "Revised Bell Lab Interpretive System": One 533, indexing registers, IAS, and automatic floating decimal arithmetic feature are required. "Revised Bell Lab Tape System": Same as above plus at least two 727 tape units.

Special Devices: Alphabetic device required if reassembly is desired.

IBM 650 Library Program Abstracts

File no. 2.0.016
Programming Systems

SIMULATION OF AN INDEXING REGISTER IN SIR

B. Leavenworth
American Machine & Foundry Company
Greenwich, Connecticut

a. Purpose: This program is a modification in SIR ("SOAP Interpretive Routine," File Number 2.0.001) to simulate an indexing register.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: Requires the modification of 14 SIR instructions. If the function subroutines (SIN-COS, LOG, EXP, ARCTAN) are not used, this program requires the reservation of only seven storage locations in addition to MAIN SIR.

Speed: Not given.

Relocatability: See File Number 2.0.001.

e. Remarks: The simulation of an indexing register in SIR is accomplished by providing for two new pseudo-operation and tagging instructions with a negative sign for address modification. The only sacrifice made is the trace negative SIR instructions feature. Otherwise, the system is unchanged.

f. IBM 650 System: One 533 required.

Special Devices: Alphabetic device required.

IBM 650 Library Program Abstracts

File no. 2.0.017
Programming Systems

UNIVERSITY OF HOUSTON ASSEMBLER FOR THE PROCESS ENGINEERING INTERPRETIVE CODING SYSTEM

V. Schorre
E.I. Organick
University of Houston
Houston, Texas

a. Purpose: This program combines the functions of symbolic assembly with those of the executive routine. For many applications this system possesses greater advantages than either function utilized separately.

(Continued on next column)

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: Not given.

Speed: Not given.

Relocatability: Not given.

e. Remarks: This program can be modified to perform symbolic assembly on programs in all known one, two and three address sequential interpretive systems for the IBM 650.

f. IBM 650 System: One 533 required.

Special Devices: Alphabetic device required.

IBM 650 Library Program Abstracts

File no. 2.0.018
Programming Systems

SIR PLUS

B. Kallick
R. W. Floyd
Armour Research Foundation
Illinois Institute of Technology
Chicago, Illinois

a. Purpose: This program augments the SOAP Interpretive Routine with three ten-digit indexing registers permitting address modifications while in the interpretive mode.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: This program requires 47 storage locations.

Speed: Not given.

Relocatability: Relocatable.

e. Remarks: Must be loaded after the SIR deck. Should be used with non-standard SOAP II deck.

f. IBM 650 System: One 533 required.

Special Devices: Alphabetic device required.

IBM 650 Library Program Abstracts

File no. 2.0.019

WOLONITS INTERNAL TRANSLATOR
(WIT)

Barry J. Mitchel
Carnegie Institute of Technology
Pittsburgh, Penna.

a. Purpose: This system permits the programmer to code problems in the three-address language of the Wolontis Interpretive System, developed in 1956 at Bell Telephone Laboratories, and described in IBM Technical Newsletter No. 11.

b. Restrictions, Range: The WIT compiler, which will operate on any 650, translates the Wolontis program into 650 machine code, and prepares a permanent program utilizing automatic floating-decimal arithmetic, magnetic core storage, and (if desired) the indexing accumulators and RAMAC disk storage unit.

c. Method: Not given.

d. Storage Requirements: This translation results in an operating speed increase of about five to one.

e. Remarks: The card formats for a WIT program and its associated data and output are identical to those specified for the corresponding Wolontis program. For this reason it is possible to check out programs using the TRACE mode of the interpretive system before translation by WIT.

(Continued on next page)

The result of translation is a machine code program on four-per-card load cards. The operating program deck is prepared by prefixing to this the WIT basic package, and appending the subroutine card packages called for by the program. Drum memory is cleared at the initiation of loading of the operating program.

f. IBM 650 System: IBM 650.

IBM 650 Library Program Abstracts

File no. 2.0.020

FLICOR: FLOATING INTERPRETIVE COMPATIBLE OPERATION ROUTINE

S. I. Schlesinger
L. Sashkin
Aeronutronic Systems Incorporated

a. Purpose: This routine was designed to simulate floating decimal arithmetic and indexing register operations using the IBM 650 basic card machines. Programs written for use with this interpretive routine are compatible with programs intended for use with the IBM 650 equipped with floating decimal device and indexing registers, and may be run on such machines by changing only two instructions. In addition to the main routine, a tracing routine for debugging is included, as are a set of certain basic arithmetic subroutines.

b. Range: Does not apply to the main routine. See the program writeup for the range of the subroutines.

Accuracy: Does not apply to the main routine. See the program writeup for the accuracy of the subroutines.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply to the main routine. See the program writeup for the methods used in the subroutines.

d. Storage Required: The main routine requires 475 storage locations. The following subroutines require the number of storage locations indicated:

$\log_e X$ - 49; SIN X - 84; COS X - 84;

$\sqrt{X}$ - 72; e^x - 82; ARCTAN X - 87.

Speed: For the main routine, the following approximate speeds are given:

Arithmetic operations - 45 to 52ms.
Store, reset, index register operations - 18 to 30 ms.

For the following subroutines, the approximate speeds are as follows:

$\log_e X$ - 205 ms.; SIN X - 200ms.; COS X - 205ms.;

$\sqrt{X}$ - 205 ms.; e^x - 210 ms.; ARCTAN X - 240 ms.

Relocatability: The main routine is relocatable, with some restrictions.

e. Remarks: Tagging for address modification is interpreted for the data address portion only of the instruction word. The subroutines (arithmetic) mentioned are independent of the main routine in operation, and may be assembled separately.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 2.0.021

A COMPLETE FLOATING-DECIMAL INTERPRETIVE SYSTEM FOR THE IBM 650 MAGNETIC DRUM CALCULATOR AND IBM IMMEDIATE ACCESS STORAGE UNIT (BELL III)

Robert L. Farrow, Ph.D.
Biophysics Division
Department of Physiology
Ohio State University
Columbus 10, Ohio

a. Purpose: This program is a general purpose scientific and engineering interpretive program. It is designed to replace the original Bell Interpretive System Program when running Bell language programs on the IBM 650 equipped with an auxiliary 653 unit.

b. Restrictions, Range: The range of this program is identical to the original Bell I program as written by Dr. Wolontis (viz: IBM Technical Newsletter No. 11, 1956). The accuracy of the floating-decimal subroutines is generally plus or minus one in the eighth place except for LOG and the SIN-COS subroutines which contain optional machine stops to indicate loss of accuracy. Externally, this systems program is identical to Bell I with three necessary exceptions noted under "precautions", below.

c. Method: Subroutines for the transcendental functions are based upon the eight digit Rand approximations for digital computers, and in fact are the same as those found in Bell I except for the calculations of the floating-decimal characteristic.

d. Storage Requirements: The systems program uses core addresses 9000 to 9049 and addresses 9050 to 9059 for erasable storage as well as drum locations 1000 to 1999. (Note: A separate subroutine is provided to locate some 200 plus unused registers).

(Continued on next column)

Bell III will operate, for a given problem, at least 35 percent faster than Bell I while even greater operating speeds are attainable with extensive programmed use of the Previous Numerical Result. It consists of a Systems Load Program (6 cards), a Systems Deck (177 cards) and Drum Clear (3 cards) in that order.

e. Remarks: Precautions:
1. There is no error stop for zero before floating divide operations. A new interpretive command TR ZERO (transfer on zero in PR) has been provided. Floating-decimal overflow and underflow modulo 100 is possible.

2. For greatest advantages the Systems program uses the automatic floating-decimal arithmetic feature of the auxiliary 653 unit. Consequently, the FD

IBM 650 Library Program Abstracts

File no. 2.0.022

ID-3 INTERPRETIVE SYSTEM

Bonner and Moore Engineering Associates
Houston, Texas

a. Purpose: This routine is a special interpretive system designed for use in the process industry.

b. Restrictions, Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Fixed point.

c. Method: Does not apply.

d. Storage Requirements: 1350 drum locations are available for interpretive instructions.

e. Remarks: The ID-3 system is used to write the executive program for the Unit Operations Simulator. Operation codes of ID-3 are of the type that greatly reduce the programming time for the Process engineer.

f. IBM 650 System: Basic 650 is required.

650 LIBRARY PROGRAM ABSTRACT	FILE NUMBER	2.1.001

INTERNAL TRANSLATOR (IT)
A COMPILER FOR THE 650

A. J. Perlis
J. W. Smith
H. R. Van Zoeren
Carnegie Institute of Technology, Pittsburgh 13, Pa.

a) Programs written as a sequence of statements in a general algebraic language (roughly similar to that of FORTRAN) are translated into programs in symbolic, i.e., SOAP I form.

b) Programs employing both fixed and floating point constants and variables may be translated.

c) Does not apply.

d) The translator requires the entire drum. Output is approximately 50 SOAP I cards/minute.

e) The SOAP I type programs produced are assembled by a modified SOAP I deck whose output is a machine language program punched 5 words/card. These machine language programs require, during operation, an auxiliary package of subroutines which include floating point, input-output, and optional logarithm, power and exponential routines. Depending on the option, these packages require from 270 to 500 locations. The remainder of the drum is available for program and data. A general technique may be used to incorporate additional subroutines.

The system includes a programming manual, 533 wiring diagram, the translation program, the modified SOAP I program, reservation and subroutine packages, and sine, cosine, and square root floating point subroutines.

f) Alphabetic device is required.

650 LIBRARY PROGRAM ABSTRACT	FILE NUMBER	2.1.002

MODIFICATIONS OF THE INTERNAL TRANSLATOR* (IT) COMPILER FOR USE OF SPECIAL CHARACTERS

J. N. Rogers
C. M. White
GE Vallecitos Atomic Laboratory
Pleasanton, California

a) These revisions are to take advantage of some of the FORTRAN symbols in writing IT statements for the compiler. The following table gives the correspondence between the revised symbols and the representation for the computer.

Symbol Name	Representation
Left Parenthesis	(
Right Parenthesis	)
Decimal Point	.
Equality (substitution sense)	=
Comma	,
Addition	+
Division	/
Negation	-

A sample statement would appear as below:

Y2 = (CI3 x Y5) - (2.85 + C (I2 + I4)) / 5.82

b) Does not apply.

c) Does not apply.

d) All other aspects of the IT system remain the same. The card deck and the listing appended to the write-up include only the change cards for the IT deck.

e) Alphabetic device and Group II special character device are required.

* 650 Library Program Abstract Number 2.1.001, Internal Translator (IT) A Compiler for the 650, A. J. Perlis, J. W. Smith, H. R. Van Zoeren, Carnegie Institute of Technology, Pittsburgh 13, Pa.

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650 LIBRARY PROGRAM ABSTRACT	FILE NUMBER	2.1.003

IT - 2

H. R. Van Zoeren
Computation Center
Carnegie Institute of Technology
Pittsburgh 13, Pa.

a) Programs written as a sequence of statements in IT language (see 650 Abstract 2.1.001) are translated directly into machine language represented in standard 5 instructions/card form.

b) Same as 2.1.001.

c) Does not apply.

d) The translator requires the entire drum. Output is approximately 20 cards per minute (100 instructions per minute).

e) The machine language programs produced require, during operation, an auxiliary package of subroutines which include floating point, input-output, and optional logarithm, power and exponential routines. Depending on the option, these packages require from 270 to 500 locations. The remainder of the drum is available for program and data. A general technique may be used to incorporate additional subroutines.

The system includes the translation program, relocation routine and subroutine packages, and associated function subroutines.

f) Alphabetic device is required.

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IBM 650 Library Program Abstracts — *File no.* 2.1.004 Programming Systems

SPYCE

J.M. McKeever
IBM, Los Angeles, California

a. Purpose: This routine translates English sentences into symbolic program language. The output of this routine may then be assembled using an assembly program of the user's choice.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: This routine requires all of drum storage except six locations.

Speed: This routine compiles at punch speed.

Relocatability: Not relocatable.

e. Remarks: By using SPYCE, programming time is greatly reduced and much of the detail effort is eliminated. At any time the programmer may switch from sentence to SOAP mode. SPYCE is applicable to both those commercial and engineering problems which require large volumes of input/output data.

f. IBM 650 System: One 533 required.

Special Devices: Alphabetic device and read half-time emitter are required.

IBM 650 Library Program Abstracts — *File no.* 2.1.006 Programming Systems

BUMP, BOSTON UNIVERSITY MATRIX PROGRAM

L. E. Belsky
Boston University
Boston, Massachusetts

a. Purpose: This is an interpretive program which will perform matrix-vector operations automatically, including: add, subtract, multiply, invert, transpose, trace, scale, scalar multiply, as well as internal operations: read, punch, move, stop, go, etc.

b. Range: Maximum size matrix is 10 X 10, without partitioning.

Accuracy: Not given.

Floating/Fixed: Floating decimal arithmetic is used.

c. Mathematical Method: Does not apply.

d. Storage Required: Entire drum is used. 750 locations allocated for instructions, data.

Speed: Not given.

Relocatability: Not relocatable.

e. Remarks: Use of larger systems outlined by method of matrix partitioning. Example of 20 X 20 inversion included.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts — *File no.* 2.1.007 Programming Systems

GENERALIZED ALGEBRAIC TRANSLATOR (GAT)

B. Arden
R. Graham
University of Michigan
Ann Arbor, Michigan

a. Purpose: This routine translates programs written as conventionally parenthesized algebraic statements into optimized IBM 650 instructions.

b. Range: Does not apply.

(Continued on next page)

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: Not given.

Speed: Not given.

Relocatability: Not given.

e. Remarks: The translation is accomplished in a single pass and the resulting program is produced on five-per-card load cards. Subroutines called for by the source program are selected by means of a symbolic linkage and relocated at the time of execution.

f. IBM 650 Systems: One 533, automatic floating decimal arithmetic feature and indexing registers are required.

Special Devices: Group II special character device is required.

IBM 650 Library Program Abstracts

File no. 2.1.008
Programming Systems

650 FORTRAN MODIFIED FOR THE 4000 WORD 650

Dr. H. Klein
Mrs. Ann Miller
Lycoming Division
AVCO Corporation
Stratford, Conn.

a. Purpose: To provide a FORTRAN system for the 4000 word 650. The system consists of two major parts:

1. The compiler, 650 FORTRAN, which accepts FORTRAN statements and compiles 650 instructions in symbolic SOAP II language.

2. The assembler, a modified version of SOAP IIA-4000, which produces an optimized machine language program from the symbolic instructions.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Both where applicable.

c. Mathematical Method: Does not apply.

d. Storage Required: The compiler occupies most of the drum; the assembler utilizes the entire drum.

Speed: Compiler: varies with complexity of source statement.
Assembler: Approximately 75-80 cards per minute.

Relocatability: Not relocatable.

e. Remarks: IAS is used by the package subroutine deck supplied with the system.

f. IBM 650 System: One 533, indexing registers, and 4000 word drum are required.

Special Devices: The machine on which the object program is to be run requires the automatic floating decimal arithmetic feature.

IBM 650 Library Program Abstracts

File no. 2.1.009

FLATRAN

Frank Dow Vickers
University of Florida
Tallahasse, Florida

a. Purpose: An automatic coding system using a FORTRAN - like language and a modified FORTRANSIT I control panel.

b. Restrictions, Range: Interpretive floating point routines with 8 digit mantissa and 2 digit exponent.

c. Method: Does not apply.

d. Storage Requirements: One or two passes, depending on optimization desired.

e. Remarks: The source program must be correct in every detail.

f. IBM 650 Program: 2000 or 4000 word 650 with or without immediate access storage.

IBM 650 Library Program Abstracts

File no. 2.1.010

MODIFIED 650 FORTRAN-SCRUB PROGRAMMING SYSTEM

John D. Janicek
Cities Service Research and Development Company
Production and Exploration Laboratories
920 East Third Street
Tulsa 20, Oklahoma

a. Purpose: The IBM 650 FORTRAN programming system has been modified to incorporate the following advantages:

1) The SCRUB routine (Soap Condenser Removing Unnecessary Bulk) may be used as an optional pass in the system to reduce the number of instructions in the final object program, especially where subscripting is extensively used. The SCRUB routine takes the SOAP output of the FORTRAN compiler as input and produces as output an equivalent SOAP program for specific, commonly occurring redundant sequences and rearranges them into shorter, equivalent sequences.

2) The output of SOAP assembly may now be obtained in a one instruction per card format (or in a five instruction per card format). A condensing routine is provided which will accept the entire object program in l/card form as input (including the package subroutines) and produce an equivalent program in 5/card form.

3) Corrected FORTRAN statements can be reprocessed without recompiling the entire FORTRAN program. This is made possible in the modified system by punching out reloadable availability and symbol tables after SOAP assembly.

4) When the input-output format is sufficiently simple, the SCRUB routine also permits the reading and punching of data by means of FORTRAN statements using an 11 instruction subroutine instead of the 119 instruction READ-PUNCH subroutine built into the system.

b. Programs employing both fixed point and floating point variables and constants may be translated.

c. Mathematical Methods: Does not apply.

d. Storage: The SCRUB routine utilizes the entire 2000 word drum.

e. Remarks: The efficiency and speed of the SCRUB routine drops off sharply if a FORTRAN statement cannot be SCRUBBED down to less than about 34 SOAP instructions. The SCRUBBING pass cannot be bypassed if the optional input-output system is utilized.

f. Equipment Specifications: Same as for 650 FORTRAN - Translation,

IBM 650 Library Program Abstracts

File no. 2.1.010

Scrubbing, and Assembly require a basic 650 with Index Registers and Special Character Device. To run the object program the machine must also have a Floating Point Arithmetic Device. The 650 FORTRAN 533 panel must be modified to obtain the 1/card object program. The modified panel may be used with the unmodified 650 FORTRAN system decks and with the FORSCAN routine (for checking 650 FORTRAN programs for logical and clerical errors). By sacrificing some of the efficiency in using index registers to improve the compiled program, the SCRUB routine can be used with the unmodified 650 FORTRAN system decks and 533 panel.

IBM 650 Library Program Abstracts

File no. 2.1.011

MODIFIED BELL TRANSLATION PROGRAM FOR THE
IBM 650-653 MAGNETIC DRUM CORE STORAGE COMPUTER

Robert L. Farrow, Ph.D.
Biophysics Division
Dept. of Physiology
Ohio State University
Columbus 10, Ohio

a. Purpose: This program, "Modified Bell Translation Program for the IBM 650-653 Magnetic Drum-Core Storage Computer" is an extension of the existing Bell Translation Program for the IBM 650. The purpose of the Program is to permit the user to translate basic machine language subroutines occuring as part of a Bell Interpretive program. The program will properly translate basic machine language instructions that have been "tagged" for the Index Accumulators if they are in the Bell user's region, while leaving untranslated "tagged" instructions referring to the Systems area.

b. Restrictions, Range: The program is contained on fifty-two cards of 6 words each, and is placed immediately behind the Bell Translation Program for the IBM 650, written by Miss Dolores C. Leagus of the Bell Laboratories. It is punched as Deck 2. Translation is restricted to the range of 0000 to 0999 and there are error-stops provided for overflow and underflow outside of this area during translation. Two additional control cards are provided for options in translating instructions referring to Index Accumulators (i.e. op codes 50's and 80's). The program functions with the existing Bell program, not separate from it.

c. Method: Translation is accomplished by splitting the instruction off into the Indexing accumulators and branching to 1400+OP. From there to various subroutines to determine if the data address and instruction address should

(Continued on next page)

be translated or not. Error stops are branches to 9999, and a display and restart procedure is given.

d. Storage Requirements: Not given.

e. Remarks: Precautions: Instructions to be translated must be in the range 0000 to 0999. The program is for use with the Bell III Interpretive Program as it checks for 3 return addresses to Bell I and translates then to the corresponding Bell III Systems locations. There are no provisions for RAMAC or tape instructions.

f. Equipment Specifications: Basic IBM 650 and 533 card input-output device, and the 653 Auxiliary IAS unit with 60 words or core storage and 3 Index Accumulators.

IBM 650 Library Program Abstracts File no. 2.1.012

THREACS

S. Nakai
Applied Science Dept.
IBM - Japan, Ltd.
Tokyo, Japan

a. Purpose: This system is a compiler, which accepts THREACS instructions which are in three address form and produces 650 instructions in symbolic language. These symbolic instructions can be assembled by the standard SOAP II. This system has two main advantages. One is that the SOAP symbolic codes also can be directly written in the source program together with THREACS instructions for higher efficiency and flexibility than other compilers. The other is that it is possible to translate a program written in the L_2 interpretive form into a SOAP program.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Both fixed and floating point operations are contained.

c. Mathematical method: Does not apply.

d. Storage required: This system requires all of drum storage.

Speed: Unknown.

Relocatability: Not relocatable.

e. Remarks: None.

f. 650 System: One 533, indexing registers and the floating arithmetic device are required.

Special device: Alphabetic device.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 3.1.001

SQUARE ROOT SUBROUTINE

G. E. Collins
IBM, New York 3-22-56

a) Computes the square root of a single-precision fixed-point number.

b) The argument must be such that at least one of the two highest order digits is non-zero and that the decimal point must be an even number of places from the extreme left. All 10 digits of $\sqrt{x}$ are significant.

c) The method is a table look-up operation followed by two modified Newtonian iterations.

d) LWA is 0064 in the relocatable version with 8 words open. Average execution time is approximately 72.9 ms.

e) Both absolute and SOAP relocatable deck listings are included.

f) Alphabetic device if relocatable version is used.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 3.1.002

SQUARE ROOT SUBROUTINE

G. R. Trimble, Jr.
IBM, Houston 1-30-55

a) Computes the square root of a single-precision fixed-point number.

b) Range: $0 \leq A \leq .9999999989$. Maximum error is $3 \cdot 10^{-10}$

c) Newton's method is used.

d) LWA is 0039 with 16 words open in the relocatable version. For a random argument 120 ms. are required.

e) Both absolute and SOAP relocatable deck listings are included.

f) Alphabetic device if relocatable version is used.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 3.1.003

CUBE ROOT

W. K. Pence June 24, 1955

a) Computes the cube root of a single-precision fixed-point number.

b) Range $0 \leq A \leq .999999999$. Accuracy information not given.

c) The method is to make first approximation followed by an iterative formula.

d) Storage required is 22 locations, 0000 to 0021; the routine may be translated an even number of locations. Requires approximately 14.4 + 24n ms., where n is the number of iterations.

e) None.

f) Minimum 650

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 3.1.004

EXPONENTIAL

S. Fleming
G. E., Schenectady March 28, 1956

a) Computes e^x for a single-precision fixed-point number.

b) Range: $-16.11 < X \leq 23.02585092$.

c) Method not given.

d) Storage required is 50 locations, 0000 to 0049; the routine may be translated by an even number of locations. Not more than 6 iterations are required.

e) None.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 3.1.005

EXPONENTIAL

S. Fleming March 28, 1956
G. E., Schenectady

a) Computes e^X for single-precision fixed-point number.

b) Range: $-20.5 < X \leqq 23.02585092$. Accuracy: error is less than one in the eighth significant digit.

c) Method not given.

d) Storage required is 49 locations, 0000 to 0048; the routine may be translated by an even number of locations.

e) None.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 3.1.009

SINH X AND COSH X

Barbara Martin August 8, 1955
Detroit Edison, Detroit

a) Computes sinh X or cosh X for a single-precision fixed-point number.

b) Range: $0 < X < 2$. Accuracy information not given.

c) Method is to calculate e^X from the subroutine given in Technical Newsletter No. 9, page 50, and then determine sinh or cosh from the standard formulas.

d) Storage required is 62 locations, 0000 to 0061, including the e^X subroutine. The routine may be translated an even number of locations.

e) The e^X subroutine is not included in the deck listing.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 3.1.010

SIN-COS SUBROUTINE

G. R. Trimble, Jr. 1-30-55
IBM, Houston

a) Calculates sin X or cos X for a single-precision fixed-point number.

b) Range: For sin X, $-7.2 \leqq X \leqq 7.2$; for cos X, $-8.8 \leqq X \leqq 8.4$. Maximum error is $3 \cdot 10^{-9}$.

c) Method: 12th power in Taylor series. Reference: Technical Newsletter No. 9, p. 34.

d) LWA is 0099 with one word open in the relocatable version. Running time is 123 ms.

e) Both absolute and SOAP relocatable deck listings are included.

f) Alphabetic device if relocatable version is used.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 3.1.013

$LOG_{10}A$, Ln_eA

E. B. West and A. O. Garder 2-30-56
IBM, Houston

a) Computes $\log_{10}A$ or $\ln_eA$ for single-precision fixed-point numbers.

b) Range $10^{-5} \leqq A < 10^5$. Accuracy: maximum error is $2 \cdot 10^{-7}$.

c) Method: polynomial approximation by Hastings.

d) LWA is 0099 with 34 words open in the relocatable version. Running time is 130 ms.

e) Both absolute and SOAP relocatable deck listings are included.

f) Alphabetic device if relocatable version is used.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 3.1.014

NATURAL LOGARITHM

S. Fleming 3-28-56
G. E., Schenectady

a) Computes ln X for a single-precision fixed-point number.

b) Range: $10^{-9} \leqq X < 10^{10}$. Accuracy: error is less than 2 in the 7th decimal.

c) Method not given.

d) Storage required is 54 locations, 0000 to 0053.

e) None.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 3.1.015

POLAR TO CARTESIAN COORDINATES

Barbara Martin 7-27-55
Detroit Edison, Detroit

a) Converts single-precision fixed-point polar coordinates to single-precision fixed-point cartesian coordinates.

b) Range: $r < 100$, $0 < \theta < 2\pi$.

c) Method is to use the sin-cos subroutine in Technical Newsletter No. 9, page 39 and then to use the standard conversion formulas.

d) Storage required is 67 locations, 0000 to 0066, including the sin-cos subroutine. The routine may be translated by an even number of locations.

e) The sin-cos subroutine is not included in the deck listing.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 3.1.019

FLOATING POINT LOG |A| AND LN |A|

Prepared by IBM 650 Applied Programming

G. J. Porter
IBM, New York

a) This subroutine computes $\text{Log}_{10}A$ and Ln A utilizing the floating decimal arithmetic device and indexing register A. This routine has maximum range and accuracy with running time minimized as much as possible.

b) Range: $|A| > 0$
Accuracy: Error $< 10^{-8}$
Floating Point

c) Method: $A = M \times 10^P$, where P is an integer
Multipliers A_i are found such that $m = M \prod_i^k A_i$

The A_i are chosen so that $1 < m < 1.1$

$\text{Log}_{10}m$ is computed by use of a relaxed Taylor series for

$$\text{Log}_{10}(1 + x),\ 0 < x < .1$$

Finally, $\text{Log}_{10}M = \text{Log}_{10}m - \sum \text{Log}_{10}A_i$

Ln A is secured by multiplying Log A by Ln 10

This subroutine uses multipliers in which the sum of the digits is minimized thus taking advantage of the variable multiplication time of the 650.

d) Storage requirements: 100 locations with 15 open.
Speed: Log: 130 m. s. Ln: 140 m. s.
Relocatable SOAP II cards.

e) Indexing Registers: Indexing register A (8005) is used in this subroutine, thus the information in A before entrance into the subroutine is destroyed.

f) 650 equipped with floating point device and indexing registers. The alphabetic device is also required because of the relocatable (SOAP II) feature.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 3.1.020

FLOATING POINT e^A, 10^A, SINH A, COSH A

Prepared by IBM 650 Applied Programming

G. J. Porter
IBM, New York

a) Subroutine for e^A, 10^A, Sinh A and Cosh A utilizing the floating decimal arithmetic device and indexing register A. Maximum accuracy and range have been secured with reasonable running time and storage requirements.

b) Range: e^A: $A < 100$; 10^A: $A \leq 43.4$; Sinh A and Cosh A: $|A| < 100$
Accuracy: Relative accuracy of 10^{-8}
Floating Point

c) Mathematical methods:

e^A: By several reductions A is reduced to the range $|A| < .054$. A relaxed Taylor series is then used.
10^A: A is multiplied by Ln 10 converting to an exponential function. The method used in e^A is then used.
Sinh A, Cosh A: These are simply extensions of the e^A method. For more detail refer to the program write-up.

d) Speed: e^A: 180 m. s.; 10^A: 185 m. s.; Sinh A and Cosh A: 240 m. s.
Storage: 150 Locations for the entire routine. If only e^A and 10^A are desired, 25 Locations can be omitted. For convenience these 25 are located at the end of the program.
Input: Relocatable SOAP II cards.

e) Indexing register A is used in the program and is not restored to its original state. If it is necessary to save the contents of this register changes can be made in the program to accomplish this. These changes are listed in the program write-up.

f) 650 equipped with floating decimal arithmetic device and indexing registers is required. The alphabetic device is also required because of the relocatable (SOAP II) feature.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 3.1.026

FRATS
(Fast, Relocatable, Arithmetic and Transcendental Subroutines)

W. E. Stewart
Department of Chemical Engineering
University of Wisconsin
Madison, Wisconsin

a) Provides general utility routines for floating point calculation. The operations are listed below.

b) The routines deal with floating point numbers in the form

$\pm$ (xxXXXXXXXX) = $\pm$ (X. XXXXXXX) (10^{xx-50})
Digits in the 650 Scientific notation

The range of the exponent, xx, is therefore $0 \leq xx \leq 99$. Unnormalized numbers may be used as input to any of the routines. Results are normalized, except in FIX and unnormalized ADD. Given exact, normalized input, the maximum result error is about $\pm$ 0.56 units of the last result digit, except for logarithms of numbers near unity, which are correct within $\pm 3 \times 10^{-10}$ before normalization and rounding. Unnormalized input is handled with equal precision, except when added or used as numerator in division.

c) Square root is computed by the Newton iteration method, using three iterations. The exponential function, e^x or a^x ($a \leq 10$), is evaluated using a table of $y = 10^w$ at interval $\Delta w = 0.1$, and a fifth-degree polynomial for interpolation; the 650 table lookup operation is not used. The logarithmic function, ln Z, is evaluated using a seventh-degree expansion in odd powers of $\frac{Z - y}{Z + y}$. Values of y and $\log_{10} y$ are obtained, by table lookup, from the same table used for the exponential function.

d) The complete set of routines occupies 398 locations including temporary storage, and can be loaded in locations 0001 - 0399 or any 8 consecutive bands on the drum. The routines are relocatable by SOAP II to any higher region on the drum, except that the address increment for Natural Logarithm must be evenly divisible by 50. Any block of routines may be omitted without affecting the others, except that Multiply-Add requires Blocks 1 and 2.

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Block	Operation	Drum Locations Used, Unrelocated: Lowest	Highest	Total Number	Execution Time, Milli-seconds
1	ADD (normalized or unnormalized)			76	29
1	FLOAT, and set ADD to normalize			8*	20
1	FIX, and set ADD to not normalize			8*	39
2	MULTIPLY			59	31
1, 2	MULTIPLY-ADD, link and execute			6*	64
1, 2	MULTIPLY-ADD, execute only				59
3	Divide by 8002			42	37
3	Divide 8002 by (k)				32
4	Square Root			55	103
5	Exponential, e^x or a^x	0000	0099	75	108 for e^x
6	Natural Logarithm	0063	0149	90	126
1-3		0001	0199	196	
1-4		0001	0249	248	
5, 6		0000	0149	150	

* In addition to parent operations.

The above execution times do not include access time for factors and exit instructions. Access time ranges from 0 to 20 milliseconds for random access, depending on the number of new factors.

e) The invalid-address stops use addresses above 9990, and are effective for any combination of accessories now available. Programs which will utilize these subroutines may be written in symbolic form for SOAP assembly, or coded directly in machine language.

f) Minimum 650.

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IBM 650 Library Program Abstracts

File no. 3. 1. 028
Mathematical Functions

ARCSIN X, ARCCOS X, SQUARE ROOT X

V. E. Kohman
Curtiss-Wright Corporation
Propeller Division
Caldwell, New Jersey

a. Purpose: Computes arcsin X, arccos X, square root X for a single-precision floating point number.

b. Range: Arcsin / Arccos: $-1 \le X \le 1$.
Square root: Any positive floating point argument.

Accuracy: Maximum error $< 1.5 \times 10^{-7}$

Floating/Fixed: Floating.

c. Mathematical Method: Arcsin / Arccos: Polynomial approximation by Hastings.
Square Root: First approximation involving a table look-up followed by three iterations with Newton's formula.

d. Storage Required: 140 locations are required.

Speed: Approximate running time is 310 ms. for arcsin or arccos, or 165 ms. for square root.

Relocatability: As written, the 0000, 0050 and 0100 bands are used but may be relocated an even amount.

e. Remarks: SOAP II symbolic and relocatable decks are included. Error stops are provided for a negative argument for square root routine or an argument greater than ± 1 for arcsin / arccos routine.

f. 650 System: One 533, automatic floating decimal arithmetic, and indexing registers are required.

Special Devices: Alphabetic device for SOAP II assembly.

IBM 650 Library Program Abstracts

File no. 3. 1. 029
Mathematical Functions

CUBE ROOT X

A. R. Barton, Jr.
Curtiss-Wright Corporation
Propeller Division
Caldwell, New Jersey

a. Purpose: Computes the cube root of any single-precision normalized floating-point number.

b. Range: Any floating-point argument.

Accuracy: Maximum error of one in seventh digit.

Floating/Fixed: Floating.

c. Mathematical Method: First approximation is followed by an iterative formula.

d. Storage Required: 61 locations are required.

Speed: Average running time is 950 ms.

Relocatability: As written, the 0000 and 0050 bands are used but relocation may be made by an even amount. (Program is in relocatable SOAP II form.)

e. Remarks: None.

f. 650 System: One 533, automatic floating decimal arithmetic, and indexing registers are required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 3. 1. 030
Mathematical Functions

PARABOLIC INTERPOLATION

A. R. Barton, Jr.
J. H. Schenck
Curtiss-Wright Corporation
Propeller Division
Caldwell, New Jersey

a. Purpose: To interpolate the f(x) value corresponding to a given x value by fitting a parabola through 3 given points which define the curve on which f(x) lies. All values must be in normalized floating point form.

b. Range: The routine will use any set of numbers supplied.

Accuracy: The region of the curve under consideration must be parabolic, and the axis of symmetry of the assumed parabola must be perpendicular to the x-axis for most accurate results.

Floating/Fixed: Floating.

c. Mathematical Method: The three given points are used to set up 3 simultaneous linear equations. Solution of these equations yields the equation of the parabola from which f(x) is calculated.

d. Storage Required: 80 locations in 2 adjacent bands plus a previously defined region K of 6 words are required.

Speed: Not given.

Relocatability: Not given.

e. Remarks: There are no error stops. It is left to the programmer to determine if a curve of the form $f(x) = a\,x^2 + b\,x + c$ is applicable and if the unknown f(x) will lie on the curve defined by the 3 given points before using this routine.

f. 650 System: One 533, automatic floating decimal arithmetic, and indexing registers are required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 3. 1. 032
Mathematical Functions

WISCONSIN FUNDAMENTAL FLOATING - DECIMAL FUNCTION SUBROUTINES

G. W. Struble
Department of Mathematics
Numerical Analysis Laboratory
University of Wisconsin
Madison 6, Wisconsin

a. Purpose: This program consists of five subroutines designed to evaluate the following functions: e^x, ln x, arctan x, sin x or cos x and $\sqrt{x}$, where x is expressed in normalized floating decimal form.

b. Range: For subroutines given in (a) above, respectively:

$|x| < 111.675$, $x > 0$, no restriction, $|x| < (2\pi)(10^7)$, $x \ge 0$.

Accuracy: Variable, but in general the result has seven significant figures.

Floating/Fixed: Floating decimal.

c. Mathematical Method: The square root subroutine uses a Newton-Raphson iteration. All others use relaxed polynomial approximations. The methods were chosen primarily to yield subroutines taking little space and yet maintaining suitable accuracy and speed.

d. Storage Required: For the subroutines given in (a) above, the number of storage locations required is, respectively: 41, 57, 48, 56 and 23.

Speed: For the subroutines given in (a) above, the average computation times are, respectively: 158, 147, 175, 156, 130 and 188 milliseconds.

Relocatability: The program decks are in relocatable SOAP II form, and should be relocated an even number of locations to preserve optimization.

e. Remarks: Indexing register A is used for e^x and arctan x only, but is reset by the subroutine to its contents upon entry.

f. IBM 650 System: One 533, indexing registers, and automatic floating decimal arithmetic feature are required.

Special Devices: Alphabetic device is required.

IBM 650 Library Program Abstracts

File no. 3.1.033
Mathematical Functions

PRIME NUMBER GENERATOR

J. J. Di Giorgio
New York Test Center
New York City

a. Purpose: To generate prime numbers within a given range.

b. Range: 1-324,000,000.

Accuracy: Does not apply.

Floating/Fixed: Not given.

c. Mathematical Method: A number is tested for primeness by dividing by all prime numbers up to the square root of the number tested.

d. Storage Required: The program is stored in the first 200 drum locations. A table is created from 0200 upwards, depending on the range of numbers desired.

Speed: Is a function of the range. For example, program execution time for the range 30,000 to 31,000 is ten minutes.

Relocatability: Not given.

e. Remarks: None.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 3.1.034

STANDARDIZED UTILITY DECK OF SUBROUTINES (SUDS)

T. A. Weil
Raytheon Company
Wayland, Mass.

a. Purpose: Computes Sine, Cosine, Tangent, Arcsine, Arctangent, Square Root, Log, Natural Log, Anti-Log, Anti-Natural-Log, Hyperbolic Sine, Hyperbolic Cosine, Arcosine, and x-to-the-y.

b. Restrictions, Range: Floating point throughout, angels in radians.

Accuracy generally 7 significant digits or better.

Range:		
	Sine Cosine, Tangent	$\|x\| < 2\pi \times 10^7$
	Arcsine, Arcosine	$\|x\| \leq 1.0$
	Arctangent, Square Root	any
	Log, Natural Log, x-to-the-y	$\|x\| > 0$
	Anti-Log	$x < 49$
	Anti-Natural-Log	$x < 112.82667$
	Hyperbolic Sine, Hyperbolic Cosine	$\|x\| < 112.82667$

c. Method: Square root uses 3 iterations of Newton's method. All others use standard truncated expansions.

d. Storage Requirements: Speed is from 125 to 350 ms. depending upon the function selected. The SUDS deck is 41 cards that are self-loading by the utility panel as if they were 1-word-per-card load cards. The SUDS deck loads 8 word per card at 200 cards per minute. When loaded, SUDS occupies 299 locations, 1651 through 1949. Read-in band 1951-1960 is used only during loading. SUDS is added to the SOAP II output deck, which saves SOAP'ing time, but is therefore not relocatable. A 7-word-per-card format deck is also included.

e. Remarks: All entries, exits, and stops are standardized. Although execution times are slightly longer than separate relocatable subroutines, time is saved overall through reduced card handling. All of the functions have been thoroughly tested. The Library Program lists SUDS in absolute and as if it had been programmed in SOAP II format.

f. IBM 650 System: 650 with floating point. SUDS uses no index registers. Since SUDS is in absolute, the alphabetic device is not required.

650 LIBRARY PROGRAM ABSTRACT — FILE NUMBER 3.2.001

CIRCULAR AND HYPERBOLIC FUNCTIONS: REGULAR BESSEL FUNCTIONS

W. V. Baxter
Savannah River Laboratory, duPont, Augusta, Georgia
July, 1955

a) Computes sin x, cos x, sinh x, cosh x, $J_n(x)$, and $I_n(x)$ for n = 0, 1, 2, or 3.

(Continued on next column)

b) Arguments are fixed-point in the form xx.xxxxxxxx; answers are given in both fixed and floating-point form. Range for sin x and cos x is $|x| < 100$; for sinh x and cosh x, $|x| < 5.29$; $I_0(x)$, $x < 6.32$; $I_1(x)$, $x < 6.52$; $I_2(x)$, $x < 6.77$; $I_3(x)$, $x < 7.15$; $J_0(x)$ and $J_3(x)$, $x < 7.82$, $J_1(x)$, $x < 9.62$; $J_2(x)$, $x < 8.94$. The series is summed until the new term is $< 10^{-8}$.

c) Series expansions are used.

d) Storage required is 150 locations, 0000 to 0149, and may be translated by an even amount.

e) None.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT — FILE NUMBER 3.2.002

IRREGULAR BESSEL FUNCTIONS

Julius C. English
Savannah River Laboratory, duPont, Augusta, Georgia
May, 1956

a) Computes ln x, $Y_n(x)$, and $K_n(x)$ for n = 0, 1, 2, or 3.

b) Arguments are fixed-point in the form xx.xxxx xxxx; answers are given in both fixed and floating-point form. Range for ln x is $.0086 \leq x < 100$; $Y_0(x)$, $.021 \leq x \leq 6.30$; $Y_1(x)$, $.021 \leq x \leq 6.46$; $Y_2(x)$, $.21 \leq x \leq 6.64$; $Y_3(x)$, $.55 \leq x \leq 6.98$; $K_0(x)$, $.021 \leq x \leq 5.20$; $K_1(x)$, $.021 \leq x \leq 5.30$; $K_2(x)$, $.21 \leq x \leq 5.57$; $K_3(x)$, $.55 \leq x \leq 5.98$. The series is summed until the new term is $< 10^{-8}$.

c) Series expansions are used.

d) Storage required is 449 locations, 0000 to 0448, and may be translated by an even amount.

e) This program includes W. V. Baxter's routine for sin, cos, sinh, cosh, $J_n(x)$, and $I_n(x)$, file number 3.2.001.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT — FILE NUMBER 3.2.003

AN INTERPRETIVE SUBROUTINE FOR THE ERROR FUNCTION AND THE COMPLEMENTARY ERROR FUNCTION

R. W. Klopfenstein
RCA Laboratories,
Princeton, N. J.

a) This subroutine computes the error function, or, alternately its complement. It is designed for use with the interpretive system developed at Bell Telephone Laboratories and described in IBM Technical Newsletter No. 11.

b) Floating point input and output. Accepts any argument (positive and negative) accepted by the interpretive system, viz.,

$$10^{-50} \leq |x| < 10^{+50}, \text{ and } x = 0.$$

Maximum error of 3 units in the eighth significant figure for Erf (x) and 3 units in the seventh significant figure for Erfc (x).

c) Power series for small values of argument. Laplace continued fraction for large values of argument.

d) Programmed for locations 900-999 (Note: Interpretive system occupies locations 1000-1999.) Addition of 5 cards to Erf (x) deck converts it to Erfc (x) deck preserving constant significant figure accuracy but not changing storage requirements. Maximum running time: 2.58 seconds.

Relocatable to any 100 consecutive storage locations in lower memory (excepting location 0000) by means of Bell Telephone Laboratories translation subroutine. Preferably relocated by multiples of 50 locations, however, in order to preserve optimization in basic language portion of the program.

(Continued on next page)

e) See write-up for explanation of programmed CONDITIONAL STOP and means for eliminating it if it is not desired.

f) Minimum 650.

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650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 3.2.004

AN INTERPRETIVE SUBROUTINE FOR THE SINE INTEGRAL AND COSINE INTEGRAL FUNCTIONS

R. W. Klopfenstein
RCA Laboratories,
Princeton, N. J.

a) This subroutine computes the sine integral and cosine integral functions. It is designed for use with the interpretive system developed at Bell Telephone Laboratories and described in IBM Technical Newsletter No. 11.

b) Floating point input and output. Accepts any argument (positive and negative) accepted by the interpretive system, viz.,

$$10^{-50} \leq |x| < 10^{+50}, \text{ and } x = 0.$$

Maximum error of 1 unit in the eighth significant figure for Si (x) and 5 units in the eighth decimal for Ci (x).

c) Power series for small values of argument. Legendre continued fraction for large values of argument.

d) Programmed for locations 800-999. (Note: Interpretive system occupies locations 1000-1999.)

Running time: Average running time - 3.0 seconds.
Maximum running time - 4.18 seconds.

Relocatable to any 200 consecutive storage locations in lower memory (excepting location 0000) by means of the Bell Telephone Laboratories translation subroutine. Preferably relocated by multiples of 50 locations.

e) Ci (x) has singularity at $x = 0$. Subroutine stores - 99999999 99 (-10^{50}) in the Ci (x) output for $|x| < 10^{-49}$ as an approximation to minus infinity.

f) Minimum 650.

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650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 3.2.005

BESSEL FUNCTIONS SUBROUTINE

R. R. Haefner
E. I. du Pont de Nemours & Co., Inc.
Savannah River Laboratory
Aiken, South Carolina

a) Computes e^x, $\ln x$, $\sqrt{x}$; $I_n(x)$, $K_n(x)$, $J_n(x)$, and $Y_n(x)$ for $n = 0, 1, 2,$ and 3

b) Automatic floating decimal; range and accuracy are discussed in the write-up.

c) Various mathematical methods are used; they are described in the write-up.

d) 490 storage locations are required - SOAP II relocatable or fixed in locations 0500-0989.

e) None.

f) 650 with automatic floating decimal device and indexing registers.

April 1958, Bulletin 18 - 19

IBM 650 Library Program Abstracts *File no.* 3.2.005 ERRATA

BESSEL FUNCTIONS SUBROUTINE

An error in the Bessel Functions Subroutine, File Number 3.2.005 has been noted. The error is such that a K_o or Y_o function is calculated incorrectly if the subroutine is relocated an amount NN, nodulo 100, where NN is greater than 40. If the relocation is less than 40, modulo 100, all functions are calculated correctly. This error may be corrected by removing card No. 245 and replacing it with two cards:

TYPE	LOC	OP	DA	IA
2	0391	AUP	0153	0484
2	0484	SUP	F8003	F8001

In the original deck, the upper accumulator was not cleared following the execution of the instruction in 0391. For the K_o and Y_o functions, the succeeding instruction was a FAD instruction. The amount of relocation NN, modulo 100, was then treated as the exponent of the number remaining in the accumulator. Thus, when NN was greater than about 40, a significant error was introduced.

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650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 3.2.006

MATHIEU AND MODIFIED MATHIEU FUNCTIONS SUBROUTINE

E. T. Kirkpatrick
Mechanical Engineering Department
Carnegie Institute of Technology
Pittsburgh 13, Pa.

a) Computes Mathieu and modified Mathieu Functions

using canonical forms $y'' + (a - 2q \cos 2u)\, y = 0$

$$y'' - (a - 2q \cosh 2u)\, y = 0$$

and solutions of the form $y = \sum_{r=0}^{\infty} A_{2r}^{2n} \cos 2r\,u$

$$y = \sum_{r=0}^{\infty} A_{2r}^{2n} \cosh 2r\,u$$

b) Range: $n = 0(1)\,3$ $\quad 0 \leq q \leq 25$ $\quad 0 \leq u < 1.0$
Accuracy: 5 significant figures.
Floating point interpretive system of Dr. V. M. Wolontis of Bell Laboratories is used (IBM Technical Newsletter No. 11).

c) The characteristic numbers and Fourier coefficients are found by evaluating the continued fraction and recurrence relations which are found as a consequence of assuming a solution in the form of an infinite trigonometric or hyperbolic series.

d) The Mathieu Function subroutine requires locations 50 to 549, not relocatable. Since the program is written in the Bell Laboratories interpretive mode, locations 1000 to 1999 are also unavailable. Given n, q, u and an approximation to a, the time required to compute y varies from 30 to 90 seconds.

e) The normalization used is that of Goldstein-Ince.

f) Minimum 650.

April 1958, Bulletin 18 - 21

IBM 650 Library Program Abstracts *File no.* 3.2.007 Mathematical Functions

A SET OF INTERPRETIVE SUBROUTINES FOR CYLINDRICAL AND SPHERICAL BESSEL FUNCTIONS OF THE FIRST AND SECOND KINDS AND THEIR DERIVATIVES

H. E. Kulsrud
RCA Laboratories
Princeton, New Jersey

a. Purpose: Subroutines compute any or all of the Bessel functions $J_m(x)$, $Y_m(x)$, $J_m'(x)$ and $Y_m'(x)$ or $j_m(x)$, $y_m(x)$, $j_m'(x)$ and $y_m'(x)$. These

(Continued on next page)

routines are particularly applicable when Bessel functions of different orders for the same argument are required. To be used with the Bell Interpretive System as described in IBM Newsletter No. 11.

b. Range: Range in argument and order is limited by available machine storage.

Accuracy: Cylindrical Bessel functions are accurate to at least six decimal places; spherical Bessel functions are accurate to at least seven decimal places.

Floating/Fixed: Input and output in floating point.

c. Mathematical Method: Based on a recursion method suggested by Stegun and Abramowitz.

d. Storage Required: Programs are stored beginning at 0001 and occupy from 150 to 360 locations. (Note: The Bell system occupies locations 0000 and 1000-1999.)

Speed: A single Bessel function requires 1.5 secs. but program write-up should be studied on this question.

Relocatability: Programs can be relocated.

e. Remarks: Input argument may be positive or negative if only Bessel functions of the first kind are desired, but must be positive if Bessel functions of the second kind are called for.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 3.2.008
Mathematical Functions

RACA

Miss Marjory Simmons
University of California
Radiation Laboratory
Berkeley 4, California

a. Purpose: This is a subroutine to compute Clebsch-Gordan coefficients, $C^{A,B,C}_{\alpha,\beta,\gamma}$.

b. Range: $0 \leq A + B + C + 1 \leq 25$.

Accuracy: Eight significant figures.

Floating/Fixed: Floating decimal.

c. Mathematical Method: Not given.

d. Storage Required: Program requires 324 storage locations.

Speed: Not given.

Relocatability: Relocatable, in multiples of 50 locations.

e. Remarks: A standard square root subroutine is used by the program.

f. IBM 650 System: One 533, indexing registers, and automatic floating decimal arithmetic feature are required.

IBM 650 Library Program Abstracts

File no. 3.2.010

FORBCOLEIT

Arthur Wachowski
Automatic Electric Laboratories, Inc.
400 North Wolf Road
Northlake, Illinois

a. Purpose: FORBOOLEIT is a modification of Fortransit I(S) at the object program level, which evaluates Boolean Expressions for construction of truth tables or expansion of Boolean functions into cannonical form. This is accomplished by reinterpreting + and * as the Boolean binary operations of "inclusive or" and "and".

b. Range, Accuracy, Floating/Fixed: Same as Fortransit I(S)

c. Mathematical Method: Same as Fortransit I(S) or as described in program write-up.

d. Storage Required: 81 locations.

Speed: Not applicable.

(Continued on next column)

Relocatability: Not applicable.

e. Remarks: No modification of the compiler is made, only the object program is changed. Operations may be switched at any time from boolean operation to regular Fortransit I(S).

f. Equipment Specifications: Same as Fortransit I(S).

650 LIBRARY PROGRAM ABSTRACT — FILE NUMBER 4.0.002

MULTIPLE NUMERICAL INTEGRATION

F. Edelman
RCA, David Sarnoff Research Center, Princeton

a) This subroutine uses the floating-point interpretive system developed by Dr. V. M. Wolontis, Technical Newsletter No. 11, and performs up to a triple integration.

b) The upper limits of integration may be finite or infinite.

c) Methods used are the Trapezoidal Rule, Simpson's Rule, or Newton's 3, 4, or 5 point formulas.

d) Storage required is practically the entire drum. Machine time is measured for the integration of a basic block of five points, excluding computation time of the integrands. The time is 5 seconds, 28 seconds, or 168 seconds for a single, double, or triple integration respectively.

e) Only programming of the integrands and specification of the integration limits are required. The integration increment can be varied to a certain extent during any one integration. Program decks are available upon request from the author.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT — FILE NUMBER 4.0.004

LAPLACE TRANSFORMATION

J. A. Painter
IBM, Endicott

a) Solves linear differential equations by evaluating the Laplace Transform of the equation. Input is $X(S) = A(S)/B(S)$ which is obtained by taking the transform and solving for $X(S)$. $A(S) = \sum_{i=0}^{n} A_i S^i$, $B(S) = \sum_{i=0}^{m} b_i S^i$.

b) Floating-point arithmetic is used. $1 \leq m \leq 6$.

c) $B(S)$ is factored using Lin's method and $X(S)$ split into partial fractions. The inverse transformations are evaluated using a RAND polynomial for e^x.

d) The entire drum is used. Timing information is not given.

e) Final output is in complex form. This routine may also be used to solve algebraic equations.

f) Minimum 650

ADDENDA — **650 Library Program - File No. 4.0.004**

"Laplace Transformation," by J. A. Painter

The following supplement to the program write-up has been submitted:

This program solves the algebraic equation entered on data card #1 prior to returning control to the console to read the second data card. Therefore, it has been found useful at times to replace the second data card with a self-loading program to read out or operate upon the coefficients without performing the transformation.

(Continued on next page)

In addition, this program is capable of extracting roots of equations of the degree M, where $6 < M \le 25$, when the degree and coefficients are properly loaded. To accomplish this, punch 0000XX0000 where XX is the degree of the equation, into a standard one-per-card load format to load at 1901. The coefficients are then punched one-per-card to load at 1902, 1903.... The transfer card is replaced by these single "instruction" load cards with a new transfer to 1048 following.

In either event, the roots are stored at 1851, 1852,... as complex numbers.

Restriction: This program will not solve an equation with a numerator of 1.

NOTE: Unless the special procedure for extracting roots of equations (described above) is being used, the last card of the load deck should transfer to 1000 rather than to 1048, i.e., the first word of the final card of the load deck should be punched $\overset{+}{0}00000100\overset{+}{0}$ instead of $\overset{+}{0}00000104\overset{+}{8}$.

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650 LIBRARY PROGRAM ABSTRACT	FILE NUMBER	4.0.005

AN INTERPRETIVE SUBROUTINE FOR THE SOLUTION OF SYSTEMS OF FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS

Franz Edelman
RCA, David Sarnoff Research Center, Princeton

a) Solves systems of first order ordinary differential equations.

b) Systems of up to 30 equations may be solved. Floating decimal arithmetic is used. Precision is specified by the programmer.

c) The programmer has a choice between the Runge-Kutta-Gill and the Milne methods.

d) The interpretive routine occupies locations 0600 to 0999. Execution time per point is about 6 + 3N seconds for the RKG method and about 2.5 + 1.5N seconds for the Milne method where N is the number of equations to be solved.

e) The programmer need specify only initial conditions, the equations to be solved and their number, and the precision. The program is written for the Wolontis Interpretive Routine described in Technical Newsletter No. 11. Program decks are available upon request from the author.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT	FILE NUMBER	4.0.006

ELLIPTIC INTEGRALS

R. Pexton
R. Carpenter
University of California Radiation Laboratory
Livermore, California

a) Computes complete and incomplete elliptic integrals of the first and second kinds.

b) The elliptic integrals contain two parameters whose ranges are: $0 \le k \le 1{\cdot}0$; $0 \le Q \le \pi/2$. k is defined as the modulus and Q is defined as the amplitude of the elliptic integrals.

Magnitudes of parameters are expressed in floating point notation. The two high order digits determine the location of the decimal point: XXYYYYYYYY.
i.e. 5010000000 = 1·0 Q is measured in radians.

The results are accurate to seven decimal digits when the parameters are in the following ranges: $0 \le k \le {\cdot}8$ and $0 \le Q \le 1{\cdot}4$ ($\sim 80^{\circ}$). Outside this range, the accuracy decreases, particularly when both parameters are close to their upper bounds.

c) Repeated application of Landen's transformation permits one to replace a numerical integration process with an algebraic expression whose members are easily produced. The magnitudes of the algebraic members rapidly converge to a constant value (0 or 1.0) and hence only a few terms are required for the desired accuracy.

(Continued on next column)

d) The total program occupies cells 0000 through 1045. The IBM Basic Floating Point Routine plus the transcendental subroutines sin, cos, ln, and arctan are located in cells 0000 through 0772.

The following commands in the IBM Basic Floating Point Routine are not used: 04, 11, 12, 13, 15, 17, 18.

Four values are computed for a specified set of parameters in 15 seconds, on the average.

The program may be relocated by a multiple of 50.

e) Locate k in cell 0877, Q in cell 0878.
Incomplete elliptic integral of the first kind will be stored in 0879.
Complete elliptic integral of the first kind will be stored in 0880.
Incomplete elliptic integral of the second kind will be stored in 0881.
Complete elliptic integral of the second kind will be stored in 0882.
First instruction is in 1025.
Insert exit command in 0865.
Load and Punch routines are not included.

f) Minimum 650.

IBM 650 Library Program Abstracts — *File no.* 4.0.007 — Differential and Integral Equations

RELAXATION PROGRAM: LAPLACE'S EQUATION IN RECTANGULAR COORDINATES

D. Dorfman
Lycoming Division of AVCO Mfg. Corp.
Gas Turbine Department
Stratford, Connecticut

a. Purpose: Solves problems for systems that can be represented by the Laplace partial differential equation in rectangular coordinates.

b. Range: An effective field of up to 1500 points can be represented with a limitation of 900 interior points distributed as follows:

1. Up to 50 vertical distances, including boundaries.
2. Up to 30 horizontal distances excluding boundaries.
3. Up to 30 interior points along any of the vertical coordinate strips (32 including the boundaries).

Accuracy: Can be controlled up to 8 significant digits.

Floating/Fixed: Floating.

c. Mathematical Method: Finite difference method for unequal spacing, allowing both over-relaxation and under-relaxation.

d. Storage Required: Full drum storage required.

Speed: Speed is approximately .35 seconds per interior point per iteration.

Relocatability: Not relocatable.

e. Remarks: Program must be reloaded for each new case.

f. 650 System: One 533, indexing registers, and automatic floating decimal arithmetic are required.

Special Devices: None.

IBM 650 Library Program Abstracts — *File no.* 4.0.007 — ERRATA/ADDENDA

"Relaxation Program: Laplace's Equation in Rectangular Coordinates," by D. Dorfman.

The following changes in the deck and listings should be made:

Location	Is	Should Be
0440	24 1958 0490	24 1958 0194
1853	24 1954 1857	24 1955 1857
1903	24 1955 1808	24 1954 1808

The following additions should be made to the program write-up:

Restrictions on types of parabolic points:

Experience in using the relaxation programs dictates that parabolic points should be avoided wherever possible, because account is not taken about points in the neighboring strips, or the proximity of the boundary.

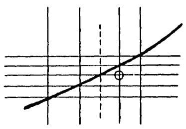
If parabolic points cannot be avoided:

(Continued on next page)

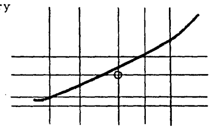
There is a further restriction on a parabolic point near the upper boundary: If a parabolic point occurs near the upper boundary, the point following the parabolic point cannot have as neighbors any points, either to the right or left, that fall on the boundary.

For Example:

upper boundary



Not allowed as a parabolic point. This can be eliminated by adding the dotted vertical grid or by removing the horizontal grid on which this point lies.



This is allowed as a parabolic point because the following point has all interior points as neighbors.

IBM 650 Library Program Abstracts

File no. 4.0.008

Differential and Integral Equations

RELAXATION PROGRAM: LAPLACE'S EQUATION IN THE CYLINDRICAL COORDINATE SYSTEM

D. Dorfman
Lycoming Division of AVCO Mfg. Corp.
Gas Turbine Department
Stratford, Connecticut

a. Purpose: Solves axisymmetric incompressible flow problems with variables r (radial distances), and h (axial distances) only.

b. Range: An effective field of up to 1500 points can be represented with a limitation of 900 interior points distributed as follows:

1. Up to 50 radial distances, including boundaries.
2. Up to 30 axial distances excluding boundaries.
3. Up to 30 interior points along any radial coordinate strip (32 including the boundaries).

Accuracy: Can be controlled to up to 8 significant digits.

Floating/Fixed: Floating.

c. Mathematical Method: Finite difference method for unequal spacing, allowing both over-relaxation and under-relaxation.

d. Storage Required: Full drum storage required.

Speed: Speed is .45 seconds per interior point per iteration.

Relocatability: Not relocatable.

e. Remarks: Program must be reloaded for each new case.

f. 650 System: One 533, indexing registers, and automatic floating decimal arithmetic are required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 4.0.008

ERRATA/ ADDENDA

"Relaxation Program: Laplace's Equation in the Cylindrical Coordinate System," by D. Dorfman.

The following changes in the deck and listings should be made:

Location	Is	Should Be
1290	24 1958 1340	24 1958 0194
1853	24 1954 1807	24 1955 1807
1903	24 1955 1808	24 1954 1808

The following additions should be made to the program write-up:

Restrictions on types of parabolic points:

Experience in using the relaxation programs dictates that parabolic points should be avoided wherever possible, because account is not taken about points in the neighboring strips, or the proximity of the boundary.

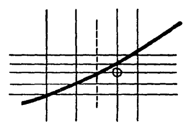
If parabolic points cannot be avoided:

There is a further restriction on a parabolic point near the upper boundary: If a parabolic point occurs near the upper boundary, the point following the parabolic point cannot have as neighbors any points, either to the right or left, that fall on the boundary.

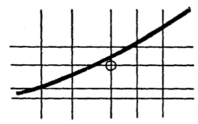
(Continued on next column)

For Example:

upper boundary



Not allowed as a parabolic point. This can be eliminated by adding the dotted vertical grid or by removing the horizontal grid on which this point lies.



This is allowed as a parabolic point because the following point has all interior points as neighbors.

The development of the finite difference equations in the write-up, equation 3 on top of page 2, holds for radially decreasing ψ values, but since this is not the case, the equation is actually programmed as:

$$\psi_0 = \frac{d(\Delta h_2\psi_1 + \Delta h_1\psi_3) + a\Delta r_2\psi_2(1 - k\Delta_2) + a\Delta r_1\psi_4(1 + k\Delta r_1)}{ac + bd - ak(\Delta r_2^2 - \Delta r_1^2)}$$

which is correct in the general application.

IBM 650 Library Program Abstracts

File no. 4.0.009

Differential and Integral Equations

RELAXATION PROGRAM: POISSON'S EQUATION IN RECTANGULAR COORDINATES

D. Dorfman
Lycoming Division of AVCO Mfg. Corp.
Gas Turbine Department
Stratford, Connecticut

a. Purpose: Solves problems for systems that can be represented by the Poisson partial differential equation in rectangular coordinates.

b. Range: An effective field of up to 1500 points can be represented with a limitation of 900 interior points distributed as follows:

1. Up to 50 vertical distances, including boundaries.
2. Up to 30 horizontal distances excluding boundaries.
3. Up to 30 interior points along any of the vertical coordinate strips (32 including the boundaries).

Accuracy: Can be controlled up to 8 significant digits.

Floating/Fixed: Floating.

c. Mathematical Method: Finite difference method for unequal spacing, allowing both over-relaxation and under-relaxation.

d. Storage Required: Full drum storage required.

Speed: Speed is approximately .35 seconds per interior point per iteration.

Relocatability: Not relocatable.

e. Remarks: Program must be reloaded for each new case.

f. 650 System: One 533, indexing registers, and automatic floating decimal arithmetic are required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 4.0.009

ERRATA/ADDENDA

"Relaxation Program: Poisson's Equation in Rectangular Coordinates," by D. Dorfman.

The following changes in the deck and listings should be made:

Location	Is	Should Be
0540	24 1958 0590	24 1958 0194
1853	24 1954 1857	24 1955 1857
1903	24 1955 1808	24 1954 1808

(Continued on next page)

The following additions should be made to the program write-up:

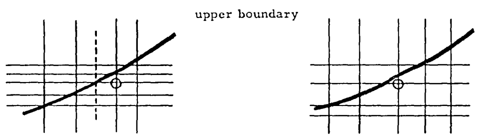
Restrictions on types of parabolic points:

Experience in using the relaxation programs dictates that parabolic points should be avoided wherever possible, because account is not taken about points in the neighboring strips, or the proximity of the boundary.

If parabolic points cannot be avoided:

There is a further restriction on a parabolic point near the upper boundary: If a parabolic point occurs near the upper boundary, the point following the parabolic point cannot have as neighbors any points, either to the right or left, that fall on the boundary.

For Example:



Not allowed as a parabolic point. This can be eliminated by adding the dotted vertical grid or by removing the horizontal grid on which this point lies.

This is allowed as a parabolic point because the following point has all interior points as neighbors.

IBM 650 Library Program Abstracts

File no. 4.0.010
Differential and Integral Equations

NUMERICAL SOLUTION OF LAPLACE, POISSON, AND HEAT FLOW EQUATIONS

J. B. Annable
Jack & Heintz, Incorporated
Cleveland 1, Ohio

a. Purpose: This program will solve partial differential equations such as the Laplace or Poisson which apply to any given two-dimensional region for a field T, where T is known for the boundaries. The field to be studied is represented by a grid approximation and T is found for each intersection by a finite difference approximation E applicable to that point. Output is both T and the residual at each point.

b. Range: The size of the field is limited such that $T \leq 704$; and $E \leq 50$.

Accuracy: Not given.

Floating/Fixed: Both input and output data are fixed point form.

c. Mathematical Method: The numerical method used, based on a finite difference approximation to the partial differential equation, yields equations of the form:

$$AT_1 + BT_2 + CT_3 + DT_4 - ET_0 + F = R_0$$

The values of the coefficients are determined by an analysis of the properties of the region at each intersection point. The equations are solved for T_0 at each point by setting $R_0 = 0$ and using an iterative process. Convergence is controlled by:

$$\sum_{i=1}^{n} \left| T_{i(m-1)} - T_{i(m)} \right| \leq 10^{x}$$

where m = iteration number, i = point number, n = number of points and $0 \leq X \leq 5$.

d. Storage Required: The entire drum is used; however, locations may be used with a consequent decrease in the maximum values of T and E.

Speed: Running time is approximately .4 seconds per point per iteration.

Relocatability: Not given.

e. Remarks: Convergence is not trivial and should be analyzed by a careful study of the problem to be solved. The convergence of the problem does not necessarily signify an error to the same number of decimal places as the convergence criteria specified above. Consequently, the error analysis is extremely difficult.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 4.0.011
Differential and Integral Equations

SOLUTION OF N SIMULTANEOUS DIFFERENTIAL EQUATIONS

R. R. Haefner
Savannah River Laboratory
E. I. du Pont de Nemours & Co.
Aiken, South Carolina

a. Purpose: This routine is designed to obtain the solution of a set of ordinary differential equations $\frac{dy}{dt} = Ay$, where A is an N x N matrix whose elements can depend upon the time or upon the components of the vector y.

b. Range: $N \leq 30$.

Accuracy: Not given.

Floating/Fixed: Computation is in floating decimal arithmetic.

c. Mathematical Method: 4th order Runge-Kutta and 5th order Milne.

d. Storage Required: 2000 storage locations are required.

Speed: 3.9 sec/pt for N = 7
9.5 sec/pt for N = 14 for ~ 2N non-zero matrix elements
14 sec/pt for N = 18

Relocatability: Non-relocatable.

e. Remarks: None.

f. 650 System: One 533, automatic floating decimal arithmetic, and indexing registers.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 4.0.012
Differential and Integral Equations

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS WITH AUTOMATIC ERROR ANALYSIS

N. J. Saber
Computation and Data Processing Center
University of Pittsburgh
Pittsburgh 13, Pennsylvania

a. Purpose: This program consists of two separate routines for solving differential equations. One makes use of Runge-Kutta-Gill over the whole range of integration. The other uses the Milne method as a main process and uses the Runge-Kutta-Gill as a starting procedure and as an auxiliary process for changing the mesh size when desired.

b. Range: See the program write-up for detailed information.

Accuracy: The programmer specifies the number of significant figures (≤ 7) he desires when using the Milne method. The routine automatically checks the truncation error at each step to see that it is not significant enough to affect the desired accuracy. The routine also checks to see whether the truncation error is so slight that a significantly larger interval may better be used.

Floating/Fixed: Floating decimal.

c. Mathematical Method: The Runge-Kutta-Gill and the Runge-Kutta-Gill-Milne methods are used.

d. Storage Required: The RKG routine requires 288 storage locations including printout subroutines. The RKGM routine requires 795 storage locations including printout subroutines.

Speed: Not given.

Relocatability: Not given.

e. Remarks: The changing of mesh size is done automatically under control of the program. There also exists a facility for punching out errors involved at each step. This punchout consists of the round-off error at each step when using RKG and the truncation error at each step when using Milne.

The routine is written in SOAP II and may be used as an extension for any SOAP II version of the Carnegie Tech Compiler (IT) in the usual automatic way. However, it may also be used as a Compiler I extension or as a separate SOAP II subroutine. In this case the programmer must make the following provisions:

1) Reserve an adequate block of storage.
2) Insert the subroutine variables into the 1950 read band as indicated in the write-up.
3) Make the necessary regional and symbolic address assignments as indicated by the main program.

(Continued on next page)

The printout subroutine used is Compiler Extension 3 and may be used by any other part of the program by making the usual reference.

f. IBM 650 System: One 533, automatic floating decimal arithmetic feature, and indexing registers.

Special Devices: Alphabetic device required.

IBM 650 Library Program Abstracts

File no. 4.0.013

NUMERICAL SOLUTION OF DIFFERENTIAL EQUATIONS OR ORDER N

Dennis M. Sinnett
University of Michigan
Willow Run Laboratories
Computation Department
Ann Arbor, Michigan

a. Purpose: The routine solves differential equations of order N.

b. Restrictions, Range: $N \leq 6$.

Accuracy: Specified by user.

c. Method: Combined Runge-Kutta Milne method, with an option for Runge-Kutta solution only.

d. Storage Requirements: 620 locations 0100→0720, with 100 or less storage locations (0001→0099) depending on the order of the equation.

e. Remarks: The user specifies the function to be integrated, its order, and the initial conditions.

Time: Milne - .2N seconds per point. Runge-Kutta - .6N seconds per point. Plus- .5 seconds per card punched.

f. IBM 650 System: Uses index registers and floating decimal arithmetic.

650 LIBRARY PROGRAM ABSTRACT — FILE NUMBER 5.1.001

MATRIX INVERSION

A. O. Garder and J. M. Kibbee
IBM, Houston

2-28-56

a) Inverts matrices of 25th order or less.

b) Matrix elements are ten-digit fixed-point numbers.

c) The inverting part of the routine is that of Mr. Dura Sweeney's, and performs Gaussian Elimination using eight-digit floating-point arithmetic.

d) The program with storage space for the matrix utilizes essentially the complete drum. For a matrix of order n $.00004n^2(n+5)$ hours are required.

e) The output consists of the inverse in fixed-point form and two figures of merit which represent the accuracy with which the product of the matrix and its inverse approximate the unit matrix.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT — FILE NUMBER 5.1.002

SOLUTION OF SIMULTANEOUS LINEAR EQUATIONS

A. O. Garder
IBM, Houston

April 1, 1956

a) Solves b systems of n simultaneous linear equations with b righthand sides and a common coefficient matrix.

b) Arithmetic is fixed-point form.

c) Method not given.

(Continued on next column)

d) Storage required is 450 locations, 1200 to 1649. Speed not given.

e) It is required that $(n+1)(n+b) < 1200$. The routine is self-loading and self-restoring.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT — FILE NUMBER 5.1.003

COMPLEX ARITHMETIC MATRIX INVERSION

Tsai H. Lee
Detroit Edison, Detroit

a) Computes the inverse of a complex matrix up to size 27 x 27 or the solutions to b systems of linear equations with a common coefficient matrix.

b) Matrix elements are fixed-point of the form xx.xxxx xxxx.

c) Standard elimination method is used.

d) Storage required for the program is 135 locations, 0300 to 0434. Storage for the complex matrix requires $2n^2$ locations; working storage 2n locations. Approximate running time is $n^2(.27n + .22)$ sec.

e) None.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT — FILE NUMBER 5.1.004

MATRIX-VECTOR MULTIPLICATION

J. D. Brown
IBM, New York

July 9, 1956

a) Multiplies a fixed-point, single-precision, square matrix M of order $n \leq 42$ by a vector X.

b) Each partial product is half-adjusted to reduce truncation error.

c) Does not apply.

d) LWA is 0075 in the relocatable version with no words open. Maximum time required is $(89.1+37.2n+43.0n^2)$ ms.

e) All elements are treated as fractions and only the high-order half of the products are accumulated. Overflow may occur if $\sum_j m_{ij} \cdot x_j > 20$ digits. Absolute and SOAP relocatable deck listings are included.

f) Alphabetic device if relocatable version is used.

IBM 650 Library Program Abstracts

File no. 5.1.006
Matrix Programs

EIGENVALUES OF REAL SYMMETRIC MATRICES BY THE JACOBI METHOD

K. M. Howell
D. J. Hall
Research Computing Center
Indiana University
Bloomington, Indiana

a. Purpose: This program will find the roots and vectors of real symmetric matrices.

b. Range: The program consists of three parts:

Part I which finds all roots and vectors of matrices up to 32 x 32;

(Continued on next page)

Part II which finds all roots only of matrices up to 56 x 56; and

Part III, the eigenvector reassembly of matrices up to 56 x 56. Part III uses rotation output of Part II.

Accuracy: Not given.

Floating/Fixed: Computation is in fixed decimal arithmetic.

c. Mathematical Method: The Jacobi Matrix Diagonalization method is used in these routines.

d. Storage Required: Part I and Part II require all 2000 locations for a maximum size matrix.

Speed: The time requirement for a well conditioned matrix may be computed as follows:

Part I: $(2.5 \times 10^{-4}n^4 + 4 \times 10^{-3}n^3)$ minutes, where n is the size of the matrix.

Part II: $(0.006n^3)$ minutes, plus punch-out time.

Part III: $(0.006n^3)$ minutes to reassemble vectors from rotation punch-out of Part II.

Relocatability: The program is not relocatable.

e. Remarks: None.

f. 650 System: One 533 required.

Special Devices: None

IBM 650 Library Program Abstracts

File no. 5.1.007
Matrix Programs

PATTERN QUARTIMAX ROTATION OF A FACTOR MATRIX

Miss Ruth W. Bredon
C. E. Helm
Educational Testing Service
Princeton, New Jersey

a. Purpose: This program employs a modification of the quartimax computation for factor rotation. In this modification a hypothesized factor pattern is given to the machine as well as the factor matrix. The machine uses the pattern to select the subset of variables to which it will attend when rotating in a given plane, in order to find an orthogonal solution which closely fits the hypothesis. The program also provides a measure of the goodness of this fit.

b. Range: The program will handle a matrix up to 900 elements.

Accuracy: Elements are rounded to 8 decimal places.

Floating/Fixed: Fixed decimal arithmetic is used.

c. Mathematical Methods: The quartimax method is used for rotation.

d. Storage Required: Locations 0000 to 0999 are used for the program, locations 1000 to 1899 for the factor matrix, and 1900 to 1999 by loading and punching routines.

Speed: Depends on the pattern used. A 6 factor, 35 variable factor matrix with pattern required approximately 3-4 minutes per cycle.

Relocatability: Not relocatable.

e. Remarks: None.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 5.1.008
Matrix Programs

FACTOR ANALYSIS BY THE CENTROID METHOD

S. O. Navarro
University of Kentucky
Lexington, Kentucky

a. Purpose: This program computes the factors of a symmetric matrix with unknown communalities by assuming each communality equal to the largest element in each column.

b. Range: Not given.

Accuracy: Not given.

(Continued on next column)

Floating/Fixed: Fixed decimal arithmetic is used.

c. Mathematical Method: The Centroid Method is used. Columns and rows are automatically reflected until all row sums are positive.

d. Storage Required: The entire drum is used.

Speed: The speed of computation depends on the number of reflections needed in each factor, and it is difficult to determine exactly. A good estimate is $t=6.7 \times 10^{-3} n^2$ minutes/factor.

Relocatability: Not relocatable.

e. Remarks: The program makes use of symmetry to allow factorization of matrices up to 50x50.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 5.1.009

MATRIX - VECTOR PRODUCT

Reverdy Wright
Agricultural Experiment Station
University of Florida
Gainsville, Florida

a. Purpose: To compute the portions of the total Sum of Squares of deviations of n observations from their mean, appropriate to the n-1 individual independent contributions to that sum. To accomplish this, the products of each row, after the first, of an n x n matrix and the n-row single column observation vector are computed and summed. In the development of this method, this sum has been called the Matrix-Vector Product or M-VP. A square matrix, herein called a primary matrix, is provided for each independent variable. From these primary matrices the computer develops the expanded n x n matrix by forming the direct or Kronecker product of these matrices.

b. Restrictions, Range: All computations are done in either single or double precision fixed-point arithmetic.

c. Method: Sums of Squares are obtained to 4 places of decimals in single precision.

d. Storage Requirements: The program is non-relocatable, consists of approximately 500 instructions and is reasonably fast in execution.

e. Remarks: Over 200 problems have been successfully run to date, the largest involving a product matrix of order 840.

f. IBM 650 System: The basic IBM 650 computer is required.

IBM 650 Library Program Abstracts

File no. 5.1.010

MAXF

Richard E. Chandler
Research Computing Center
Florida State University
Tallahassee, Florida

a. Purpose: MAXF is a FORTRANSIT I (s) subroutine designed to search a matrix of floating point numbers and to record the location of the numerically largest element. Since MAXF achieves this in what is essentially a fixed point manner, it will be much faster than any program accomplishing this which operates in floating point.

b. Restrictions, Range: Fixed point.

c. Method: Does not apply.

d. Storage Requirements: 80 locations plus 1455 (entry point) and 1950-1953.

Speed: Dependent on type of matrix. For an M by N matrix, operating time does not exceed .042 M.N. seconds.

e. Remarks: When using matrices in FORTRANSIT, the programmer must reserve locations for the matrix elements with a DIMENSION statement. Let A be a matrix of M rows and N columns. Let A* be a submatrix of A of M* rows and N* columns. Let the first element of A* (A* (1,1)) be in drum location L (determined from the DIMENSION statement).

The FORTRANSIT command: MM = MAXF (M, M*, N*, L)

causes the subroutine to search the submatrix A* for its numerically largest element. It then stores in locations MM a word of the form oo xxxx yyyy where xxxx is I and yyyy is J of A* (I, J), the numerically largest element of A*. MM can be split into oo oooo xxxx and oo oooo yyyy by multiplying and dividing by a proper power of 10 or by using a shift subroutine such as SHIFF (FSU 1.6.023).

(Continued on next page)

Note that the location given is relative to the submatrix and not the matrix itself.

f. IBM 650 System: Minimum 650 with alphabetic and special character devices. Of course, this subroutine can be modified for use as a strict machine language program.

650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 5.2.001

MATRIX INVERSION

D W. Sweeney
IBM, New York

October 6, 1955

a) Inverts matrices of order ≤ 42 or solves b sets of simultaneous equations for $n^2 + nb \leq 1764$

b) Matrix elements are in floating-point form.

c) Method not given.

d) Storage required is 236 locations, 1764 to 1999. The matrix inversion, exclusive of input and output time, is executed in approximately $.072n^3$ seconds.

e) Locations 0000 to $n^2 - 1$ are occupied by the elements of the input matrix. The inversion program is destroyed after use and must be reloaded for each new inversion.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 5.2.002

MATRIX INVERSION BY GAUSSIAN ELIMINATION

A. O. Garder
IBM, Houston

April 2, 1956

a) Inverts a floating-point matrix of order n or solves b systems of simultaneous linear equations with b constant vectors and a common coefficient matrix of order n.

b) All numbers are of the form ee aaaaaaa = a.aaaaaa 10^{ee-50}.

c) Method is Gaussian Elimination. Pivotal elements are selected in order without regard to size.

d) Storage required is approximately 350 locations 1650-1999. Time required for one inversion, or solution, is $.00002(n+b)^2 n$ hours.

e) Storage limitations require that $n^2 + (n+1)(b+1) \leq 1650$. The inverse of the coefficient matrix is obtained with solution of a system of simultaneous linear equations. This is a modified version of a program originally written by Dura Sweeney which is now self-restoring on the drum.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 5.2.005

COMPLEX AND REAL EIGENVALUES

R. W. De Sio
IBM, Schenectady

a) Determines real and complex eigenvalues for an n x n matrix A.

b) Matrix elements are in floating-point form. For large n (> 6) coefficients of small powers in the characteristic equation lose significance.

(Continued on next column)

c) Method consists of three phases: (1) matrix-vector multiplication, (2) solution to a system of equations by Dura Sweeney's Gaussian Elimination routine, file number 5.2.001, and (3) calculation of roots of a polynomial equation by De Sio's program Real and Complex Roots of Algebraic Equations, file number 7.0.001.

d) With respect to c) above (1) requires approximately 380 storage locations, (2) 236 locations, and (3) 336 locations. A fifth-order matrix requires about 3 minutes.

e) Only one of the three phases is on the drum at a time. The deck listing with this write-up includes only phase (1), the matrix-vector multiplication.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 5.2.007

LARGE SCALE MATRIX INVERSION

a) Computes the inverse of large order matrices.

b) Matrix elements are floating-point of the form x.xxxx xxxxx ee, where ee represents an exponent modulo 50. A matrix of order n $\leq$ 500 may be handled.

c) The Jordan method is used.

d) Approximately 330 storage locations are used for the program. Time required is $\frac{n^2(n+1)}{100}$ minutes.

e) Both absolute and SOAP symbolic deck listings are included. Each step in the elimination process requires a separate pass through the 650. The output from the kth elimination step is supplied as input for the k+1st step. A total of n passes is necessary.

f) Alphabetic device if SOAP symbolic version is used.

650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 5.2.008

MATRIX INVERSION

H. L. Norman
IBM, Washington

December 31, 1956

a) This program has modified 5.2.002 to include load and punch routines so that any number of matrices may be loaded, inverted and punched out without reloading the program. This program will invert a matrix of order N or will solve b systems of simultaneous linear equations with b constant column vectors on the righthand side of a common coefficient matrix of order N, where $N^2 + (N+1)(b+1) \leq 1600$.

b) Input data and solution are in floating point form.

c) The inversion is performed by the method of Gaussian Elimination.

d) The program, including the load and punch routines, utilizes storage locations 1600 - 1999. Locations 0000 - (N+1) (N+b) are used for storage of matrix elements and temporary storage. Loading and punching are at full speed; the calculation requires approximately $.0012N(N+b)^2$ minutes. The program is no in relocatable form.

e) A non-load starting card is required for each matrix inverted.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 5.2.009

DOUBLE PRECISION MATRIX INVERSION

James D. Chappell
IBM, Washington

December 31, 1956

(Continued on next page)

a) Inverts a matrix and solves systems of simultaneous linear equations in double precision floating point arithmetic, a revision of 5.2.004 to provide greater flexibility of input and output and increased speed.

b) Matrices up to 25 x 25 may be inverted and V systems of N equations may be solved where 2 (N+1) (N+V) $\leq$ 1300.

c) Method is Gaussian elimination, pivotal elements are selected in order without regard to size.

d) Not relocatable, running time is approximately $.30N^3$ seconds.

e) The program contains its own load and punch routines and is self-restoring.

f) Minimum 650.

ERRATA 650 Program Library - File No. 5.2.009

"Double Precision Matrix Inversion," by J. D. Chappell

The following correction should be made in the detailed write-up:

On page 3, in the paragraph headed "Deck Description," the last sentence should read: "The deck consists of 106 cards serially numbered from 001 to 106."

The program deck is correct as distributed.

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650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 5.2.010

SYMMETRIC SIMULTANEOUS LINEAR EQUATIONS

H. L. Norman
Service Bureau Corporation
Washington, D. C.

a) This program will solve "b" systems of "n" simultaneous linear equations consisting of "b" constant right-hand column vectors with a common symmetric nxn coefficient matrix and/or solve the determinant of the symmetric coefficient matrix. Both load and punch routines are incorporated in such a way that any number of systems can be solved with one program setup. By taking advantage of symmetry, this program is twice as fast as the corresponding non-symmetric general solution. Many desirable options are incorporated to increase the flexibility of the input and output.

b) Both input data and the solutions are in floating decimal point form. The size of the system to be solved is limited such that $(n+b)^2 - b \leq 1450$.

c) The simultaneous equations are solved by the Doolittle method, the b column vectors of constants considered to be on the right-hand side of the equation. The determinant is obtained by the product of the diagonal elements of the diagonalized matrix.

d) The program uses locations 1451 to 1999 with the exception of 46 scattered locations. The input matrix occupies locations 0000 to n (n + b) - 1 and the solution uses locations 0000 to $(n+b)^2 - b$. Calculation time is roughly $.03\ n\ (n+b)^2$ seconds. Loading and punching are at full speed. The program is not in relocatable form.

e) The coefficient matrix must be symmetric.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 5.2.011

MATRIX INVERSION AND SOLUTION OF SIMULTANEOUS LINEAR EQUATIONS

Prepared by 650 Applied Programming, IBM, New York

(Continued on next column)

B. N. Carr
IBM Corporation

a) Inverts matrices and solves simultaneous linear equations. This routine is more than three times as fast as programs which do not use index registers and the floating decimal device.

b) Square matrices, (nxn), can be inverted where n (n + 1) $\leq$ 1999. Rectangular arrays, nx (n + m), can be solved where (n + 1) (n + m) $\leq$ 1999. As with any similar procedure, error due to accumulated roundings may be large.

c) A progressive elimination technique is used to perform the inversion.

d) The entire drum, except 0000, can be used for matrix element storage. For any matrix, (n + 1) (n + m) consecutive locations are used starting with 0001. Immediate access storage is used for the load routine, the inversion program, and the output routine. The program is not relocatable. The time for inversion is approximately $.02n^3$ seconds. The program contains 32 instructions and 2 constants.

e) The inversion program fails if $a_{1,1}$ or any element which takes its place during the calculation is zero. The program is written in machine language.

f) This routine requires a 650 equipped with the floating decimal device, index registers, and immediate access storage.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 5.2.012

MATRIX INVERSION ROUTINE 1 (MIR 1)

K. B. Williams
University of California Radiation Laboratory
Livermore, California

a) MIR 1 inverts a matrix of order n or solves b sets of linear equations with a common coefficient matrix.

b) Matrix elements are floating point numbers of the form .XXXXXXXX YY where Y is the exponent (excess 50) base 10.

c) The method is by Gaussian Elimination.
The programming technique is a modification of one devised by R. W. DeSio.

d) MIR 1 occupies 79 locations from 0000 to 0078. It can be translated to any desired block of locations by an even amount (using a translating routine supplied with MIR 1). Approximately $10n^3$ milliseconds are required to invert a matrix assuming average times for floating point operations.

e) Location of the matrix on the drum is arbitrary.
Also, (n + 1) (n + b) $\leq$ 1921. MIR 1 must be loaded with a loading routine, SLR 2, which is supplied with the program.

f) 650 equipped with indexing accumulators and floating decimal device.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 5.2.013

SYMMETRICAL MATRIX INVERSION

J. Giblin
Detroit Edison Company
Detroit, Michigan

a) Computes the inverse of a symmetrical matrix up to size 54 or inverts and solves a rectangular system satisfying the inequality $n^2 + n(1 + 2b) \leq 3298$, where b is number of b vectors, with 1900 band open for punch routine.

b) All operations are in floating point arithmetic. Accuracy is that obtained by conventional elimination techniques.

c) The method is based upon standard elimination methods modified to require knowledge of only the elements on and above the main diagonal.

(Continued on next page)

d) Speed is that of fastest standard method to size 12 x 12, but from this point the necessarily complex address modification increases running time as n, and hence the number of iterations, increases.

e) Since the product of a matrix and its transpose is a symmetrical matrix, the routine can be extended to non-symmetrical matrices to size 54 x 54.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT	FILE NUMBER	5.2.014

VECTOR BY SYMMETRICAL MATRIX MULTIPLICATION

S. Young
Detroit Edison Company
Detroit, Michigan

a) Performs and punches the results of a vector by symmetrical matrix multiplication.

b) Multiplies an n-dimensional vector by an n x n symmetrical matrix, where $n \leq 45$. All operations are in floating point arithmetic.

c) Conventional vector by matrix multiplication methods are used, with modifications such that only those elements of the matrix which lie on or above the diagonal and the elements of the vector need to be loaded into the machine.

d) Speed and storage requirements are dependent on the size of the matrix. In the case of an n x n matrix, $n\left[\frac{(n+1)}{2}\right]$ storage locations are needed to put the matrix in memory.

e) None

f) Minimum 650.

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650 LIBRARY PROGRAM ABSTRACT	FILE NUMBER	5.2.015

MATRIX INVERSION

J. C. English
F. K. Townsend
E. I. du Pont de Nemours & Co., Inc.
Savannah River Laboratory
Aiken, South Carolina

a) Provides a matrix inversion routine with load and punch routines.

b) The routine will invert up to a 40th order matrix. The automatic floating decimal arithmetic of the 650 is utilized.

c) Gaussian Elimination.

d) Approximately 350 storage locations are used. The code is given in SOAP II format. Computation time for n^{th} order matrix is about $0.029\ n^3$ seconds.

e) If a matrix system has b constant vectors, then n+b working storage locations are required beyond the matrix and vector storage locations. Location 1936 contains zero to prevent optional punch out.

f) 650 with automatic floating decimal device and indexing registers. The alphabetic device is desirable.

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650 LIBRARY PROGRAM ABSTRACT	FILE NUMBER	5.2.016

LATENT ROOTS AND VECTORS OF A MATRIX

W. Granet
Boston University
Boston, Massachusetts

(Continued on next column)

a) Calculates all the latent roots and vectors of a real but otherwise arbitrary matrix. All the latent roots and vectors are assumed real.

b) Matrix input is assumed to be in floating decimal form. The SIR routine is used for floating arithmetic operations.

c) The method used is described by Bodewig in "Matrix Calculus," pages 309-310.

d) As a guide to time estimation, one iteration for an 8 x 8 matrix requires approximately 15 seconds. Iterations dominate latent vector computations.

e) Three programs are included:

1. Program I can calculate all the latent roots and vectors of a matrix up to a maximum size of 20 x 20 (unless round-off errors interfere).

2. Program II can handle a maximum size of 25 x 25, but will calculate, at most, seven latent roots and vectors for this maximum size.

3. Program III involves more card handling than the other programs, but will handle a maximum size of 34 x 34 and obtain all 34 latent roots and vectors (unless round-off errors interfere).

f) Minimum 650.

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IBM 650 Library Program

File no. 5.2.016
ERRATA

"Latent Roots and Vectors of a Matrix," by W. Granet

The following statement should be added to the write-up as the second sentence in the second paragraph on page 2:

"This program is not designed to obtain multiple roots."

On page 10 of the write-up following line 14 which reads:

"y = 7 minus the remainder when xx is divided by 7, e.g., for xx = 10, y = 7 - 3 = 4." the following statement should be added:

"When the remainder is zero, y = 0."

IBM 650 Library Program Abstracts

File no. 5.2.018
Matrix Programs

EIGENVALUES AND EIGENVECTORS OF A NON-SYMMETRIC SQUARE MATRIX

H. Klein
D. Dorfman
Lycoming Division of AVCO Mfg. Corp.
Gas Turbine Department
Stratford, Connecticut

a. Purpose: Determines eigenvalues and eigenvectors for both symmetric and non-symmetric real square matrices.

b. Range: Maximum size matrix can be of order 24.

Accuracy: Accuracy can be controlled up to 7 significant digits.

Floating/Fixed: Floating.

c. Mathematical Method: Iteration and acceleration. References given in the write-up.

d. Storage Required: Full drum storage.

Speed: Speed is approximately 15 seconds per iteration during acceleration for a 24 x 24 matrix.

Relocatability: Not given.

e. Remarks: Program is self restoring. Two types of floating point permitted.

f. 650 System: One 533, indexing registers, and automatic floating decimal arithmetic are required.

Special Devices: Alphabetic device required.

IBM 650 Library Program Abstracts

File no. 5.2.019
Matrix Programs

GENERAL SIMULTANEOUS EQUATIONS SOLUTION

J. H. Schenck
Curtiss-Wright Corporation
Propeller Division
Caldwell, New Jersey

a. Purpose: This program solves a series of inhomogeneous simultaneous equations in floating-point single-precision arithmetic.

b. Range: A maximum of 40 equations may be solved.

Accuracy: Accuracy of solution is indicated by residuals calculated from the check row of the equation matrix according to Crout's method.

Floating/Fixed: Floating.

c. Mathematical Method: Crout's method.

d. Storage Required: Requires all of drum, but about 200 locations may be used to develop equations before solution instructions are entered, or most of drum may be used to operate on solution after obtained.

Speed: Speed varies from approximately 30 minutes for 40 equations to about 2 minutes for 4 equations.

Relocatability: Program is not relocatable.

e. Remarks: None.

f. 650 System: One 533, automatic floating decimal arithmetic, and indexing registers are required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 5.2.020
Matrix Programs

EQU SOLV

G. Pulley
J. Gillespie
J. W. Hamblen
Computing Center
Oklahoma State University
Stillwater, Oklahoma

a. Purpose: To obtain the solutions for many small systems of linear equations. Also, to evaluate the determinants of the coefficient matrices.

b. Range: The program handles systems in 2, 3, 4 or 5 unknowns.

Accuracy: Not given.

Floating/Fixed: Floating decimal.

c. Mathematical Method: Cholesky's scheme is used.

d. Storage Required: The program uses storage locations 1300-1700; the data uses IAS locations 9011-9059.

Speed: Approximately 0.6 n seconds where n = the number of unknowns.

Relocatability: Not given.

e. Remarks: None.

f. IBM 650 System: One 533, indexing registers, IAS, and automatic floating decimal arithmetic feature.

IBM 650 Library Program Abstracts

File no. 5.2.021
Matrix Programs

SOLUTION OF SYSTEMS OF SIMULTANEOUS LINEAR EQUATIONS

T. R. Jackson
Ford Motor Company
21500 Oakwood Boulevard
Dearborn, Michigan

a. Purpose: This program solves systems of simultaneous linear equations of 39th order or less using the largest pivot elements. The inverse is computed and may be punched out.

b. Range: Up to 39 equations in 39 unknowns. (Continued on next column)

Accuracy: Matrix elements are ten-digit floating decimal numbers.

Floating/Fixed: Floating decimal.

c. Mathematical Method: The Gauss-Jordan elimination method is used. Pivotal elements are selected according to size. Zero elements may appear on the main diagonal.

d. Storage Required: The entire drum is used.

Speed: The time required for the inversion process is approximately $0.044n^3$ seconds, where n is the order of the system.

Relocatability: Not relocatable.

e. Remarks: A matrix check program is included.

f. IBM 650 System: One 533, indexing registers, and automatic floating decimal arithmetic feature.

IBM 650 Library Program Abstracts

File no. 5.2.022
Matrix Programs

MATRIX INVERSION WITH ITERATIVE IMPROVEMENT OF ACCURACY

R. D. Dean
M. R. Higgins
Development Department
Union Carbide Chemicals Company
South Charleston, West Virginia

a. Purpose: This program performs matrix inversion by modified Gaussian elimination, considers the inverse as a first approximation and then minimizes the round-off errors inherent in the initial inverse by means of an iterative technique.

b. Range: This routine will handle square arrays up to the 22nd order.

Accuracy: Iterations continue until the sum of squares of the elements in the approximate "zero" matrix (the identity matrix with unity subtracted from each diagonal element) ceases to decrease.

Floating/Fixed: The matrix elements are entered in fixed point form. The calculation is in floating decimal arithmetic. The output is punched in either floating or fixed decimal form, according to the setting of the Storage Entry Sign switch.

c. Mathematical Method: The following method is used for the iterative improvement of the inverse:

$$A^{-1}_{(n+1)\text{ approx.}} = A^{-1}_n \ (2I - AA^{-1}_n)$$

where A is the original matrix

$A^{-1}_{(k)}$ is the kth approximation of the inverse

I is the unit or identity matrix

d. Storage Required: Not given.

Speed: The inversion time, excluding input, is approximately $0.025n^3$ seconds. The calculation time for the improvement iterations is approximately $0.09n^3$ seconds per iteration.

Relocatability: Not relocatable.

e. Remarks: The program is loaded in two decks - the inversion routine and the iterative improvement routine. The latter deck loads automatically and duplicates storage locations used in the first deck. The iterative improvement routine requires that the original matrix be reread for each iteration. Iterations continue as given under Accuracy above. At this point the sum of the squares of the "zero" elements, the approximate identity matrix, and the final inverse matrix are punched.

f. IBM 650 System: One 533, IAS, and automatic floating decimal arithmetic feature are required.

IBM 650 Library Program Abstracts

File no. 5.2.023

MOLECULAR SPECTROSCOPY
MULTIPLICATION OF MATRICES

George J. Janz
Yukio Mikawa
Department of Chemistry
Rensselaer Polytechnic Institute
Troy, N. Y.

(Continued on next page)

a. Purpose: Pursues such type of multiplication as $K^k \ldots C^c B^b A$, where A, B, C, ... K are square matrices of order $r \leq 25$, and b, c, ...k are positive integers.

b. Restrictions, Range: Square matrices of order $r \leqq 25$ are handled. All of the elements of the matrices are expressed in the floating decimal form.

c. Method: Matrix multiplication is applied straight-forward in conventional manner.

d. Storage Requirements: For $r = 25$, nearly all the storages are used, but for $r \leqq 25$, storages $0501+r^2$ to 1150 and $1151+r^2$ to 1799 remain unused. The time required for multiplication BA depenus on the orders of matrices. Where the order $r=8$, the time required is about 115 sec. In another example the time required was roughly proportional to r^3.

e. Remarks: Multiplicand in the storages 0501 to $0500+ r^2$ is replaced by the result. Consequently, multiplication of the type $K^k \ldots C^c B^b A$ is developed at one run. The multiplier should be punched on one-word storage cards in such a way that these can be used as multiplicand cards.

f. IBM 650 System: IBM 650.

IBM 650 Library Program Abstracts

File no. 5.2.024

MOLECULAR SPECTROSCOPY
LATENT ROOTS AND VECTORS OF A MATRIX

George J. Janz
Yukio Mikawa
Department of Chemistry
Rensselaer Polytechnic Institute
Troy, N. Y.

a. Purpose: Computes the latent roots and vectors of unsymmetric matrix of order 30 or less.

b. Restrictions, Range: The matrix which can be treated should be of order 30 or less, providing that its roots are real and elementary divisors are linear.

Accuracy: Can be controlled up to seven significant digits.

Floating/Fixed: The floating decimal form is used for input and output.

c. Method: An iteration method with a device for accelerating convergence and the deflation method are used. For details, see A. C. Aitken, Proc. Royal Soc., Edinburgh, 57, 269 (1937).

d. Storage Requirements: For the matrix of order n = 30, almost the whole storages are used except 0350 - 0399. However for $n<30$ many storages remain unused.

Time required for the computation depends on the nature of matrix. In one example of a 9 x 9 unsymmetric matrix, the time required to obtain all of the nine roots and eighteen vectors was three (3) hours. One iteration for 8 x 8 matrices requires approximately 15 seconds.

e. Remarks: Some modifications of the program are also provided:

1. For symmetric matrix, a simple modification of the program can reduce time required for computation by almost half.

2. By skipping the program for accelerating convergence, the matrix of order 33 is available.

3. As well as (1, 0, 0...), any type of vector can be used as an initial vector.

4. Results can be checked in the two ways by use of modified programs. By a simple operation, on the console, it is possible to trace the value of λ (i) which approaches the true root to be gained by the iteration process.

f. IBM 650 System: IBM 650.

IBM 650 Library Program Abstracts

File no. 5.2.025

TO OBTAIN THE EIGENVALUES AND EIGENVECTORS OF A MATRIX

William Granet
Computing Center
Oklahoma State University
Stillwater, Oklahoma

a. Purpose: Calculation of real eigenvalues and their associated eigenvectors for real matrix.

b. Restrictions, Range: Floating decimal arithmetic.

c. Method: An adaptation of a method of Werner Frank for the calculation of the roots of $(f\lambda)$ to a matrix reduction method due to Givens.

d. Storage Requirements: Machine language program handles a 3 x 3 up to a 15 x 15 matrix. With more memory larger matrices can be handled by changing the Dimension statement in the Fortransit II (S) program.

(Continued on next column)

e. Remarks: This program can obtain multiple eigenvalues and their associated eigenvectors.

f. IBM 650 System: One that can process all phases of the Fortransit system used.

650 LIBRARY PROGRAM ABSTRACT — FILE NUMBER 6.0.001

MULTIPLE REGRESSION ANALYSIS

Arthur Cohen
IBM, Washington

September, 1955

a) Computes all components necessary for a complete regression and correlation analysis. There are four phases: (I) a logarithmic transformation of the initial data, V_i, to the form $x_i = \log V_i - C_i$ where C_i is an arbitrary constant or formation of new variables of the form $x_k = x_i x_j$; (II) Calculates means, standard deviations, and simple correlation coefficients; (III) part 1 computes the inverse of the matrix of simple correlation coefficients and part 2 computes partial correlation coefficients and multiple regression coefficients; (IV) computes the predicted values based on the regression equation or the residual between observed and computed dependent variable values.

b) For (I) initial variables $\leqq 14$, observations $< 10,000$; (II) variables $\geqq 33$, observations per variable $< 10,000$. Phases I and II are fixed-point, III and IV are floating.

c) Standard formulas are used.

d) The entire drum is used. Timing for phase (I) is at most $(45 + \frac{38}{3} N)$ sec.; (II) $(420 + N [\frac{n}{10} \{\frac{n(n-1)}{2}\} \frac{1}{2} + \{\frac{n(n-1)}{2}\} \frac{1}{4}])$ sec.; (III) part 1 $.072\, n^3$ sec., part 2 5 minutes; (IV) $(60 + \frac{nN}{5})$ sec. where n is the number of variables and N the number of observations.

e) Each phase may be used separately or in conjunction with the others. The program was designed for a specific application and some modification may be necessary in its general utilization.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT — FILE NUMBER 6.0.002

SIMPLE CORRELATION COEFFICIENTS

R. Rind and K. Brokate
IBM, New York

February 29, 1956

a) Computes the means, standard deviations, and all simple correlation coefficients of n variables, each with k observations.

b) The maximum number of variables is $n = 31$ with $k \leqq 2002$. Input data are five-digit decimal numbers, either integers or fractions. Means and standard deviations are computed in fixed-point, with accuracy, $\bar{x} \pm 1 \cdot 10^{-10}$ and $s \pm 1 \cdot 10^{-9}$. The correlation coefficients are computed in both fixed and floating-point with respective accuracies $r \pm 1 \cdot 10^{-9}$ and $r \pm 5 \cdot 10^{-9}$. Intermediate results Σx, Σx^2, $k\Sigma x^2 - (\Sigma x)^2$, and $k\Sigma xy - \Sigma x \Sigma y$ are computed exactly.

c) The standard formulas are used.

d) Storage required is 856 locations 0000 to 0855. Data is stored in locations 0856 to 0855 + 8p where p is the number of input data cards per variable, each card containing 14 observations. The time required for $n \leqq 17$ is $\frac{n(n+3)(p+1)}{210} + .585$ minutes; for $17 < n \leqq 31$ it is $\frac{n(n+3)(p+1)}{180} + .585$ minutes.

e) No observations may be missing.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 6.0.003

CORRELATION COEFFICIENT ROUTINE

J. W. Robinson, III
IBM, Houston

July 9, 1956

a) Computes the means, standard deviations, and product moment correlation coefficients of $n \leq 50$ variables.

b) The number of observations per variable is unlimited. Input data are ten-digit fixed-point pure decimal numbers. Output is fixed-point, and computations are single-precision.

c) The standard formulas are used.

d) All locations except $\frac{n(n+1)}{2}$ to 1274 are used; for n = 50 the entire drum is used. Approximate time for 100 observations is 8 min. for n = 10; 29 min for n = 20; 71 min. for n = 30; 125 min. for n = 40; 195 min. for n = 50. For other cases assume that the time varies linearly as the number of observations and as the square of the number of variables.

e) Self-loading and self-restoring.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 6.0.004

ANALYSIS OF VARIANCE PROGRAM

W. Andrus
IBM, Endicott

a) Computes the sums of squares, with the exception of the high-order interaction term, necessary in an analysis of variance.

b) Fixed-point positive integers are used. These can be at most seven factors and eight levels per factor, one observation per cell, and a total of $\leq$ 16,500 individual digits in all data cells.

c) Does not apply.

d) Storage required is approximately 341 locations, 0000 to 0340. Timing information not given.

e) Fractions and negative numbers may usually be avoided by multiplication or addition of a constant without affecting the validity of the analysis. It is necessary that the data be punched and stored systematically by level from the innermost to the outermost factor.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 6.0.005

AUTO-CORRELATION PROGRAM

W. E. Andrus, Jr.
IBM, Endicott

May 31, 1956

a) Computes the values of the auto-correlation function for up to 1500 data elements, or the values of the cross-correlation function for up to 750 data elements in each time sequence.

b) Arithmetic is fixed-point in the form x.xxxx xxxxx.

c) The standard formulas are used.

d) Storage required for the program and load routine is 301 locations 0000 to 0300; data locations are 0500 to 1999. Timing is $\frac{n^2}{2}(.09)$ seconds where n is the total number of data elements.

(Continued on next column)

e) The program is not optimized.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 6.0.006

POLYNOMIAL OF BEST FIT BY LEAST SQUARES METHOD

M. A. Kelly and M. S. Dyrkacz
GE, Schenectady

April 2, 1956

a) Finds four polynomials, 1st through 4th degree, that give the best fit a given set of points.

b) The maximum number of points is 100. Floating-point arithmetic is used.

c) The method is least squares.

d) Storage required is 998 locations, 0000 to 0997. Time estimate not given.

e) Output includes the coefficients of the four polynomials, the original points, the values of the polynomials at the original abscissae, and the RMS of the error for each polynomial.

f) Minimum 650.

ERRATA 650 Library Program - File No. 6.0.006

"Polynomial of Best Fit by Least Squares Method," by M. A. Kelly and M. S. Dyrkacz

The following error has been noted in the program deck:

In part 1 of the deck, card 001 should have a 12-punch in column 1 in addition to the 7-punch.

Copies of the program deck furnished by the 650 Program Library on or after March 3, 1958, have been corrected.

April 1958, Bulletin 18 - 47

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 6.0.007

MULTIPLE CORRELATION FOR 50 VARIABLES

J. D. Hall
University of Indiana, Bloomington

a) Obtains all possible correlations (1225) of 50 variables of 3 digits each.

b) The maximum number of observations for each variable is 10,000. Arithmetic is fixed-point.

c) The standard formulas are used.

d) Storage required is approximately 350 locations. Timing information not given.

e) The output includes the sum, sum of squares, mean, sum of cross products, standard deviation, and the number of observations for each variable along with all possible correlations.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT	FILE NUMBER 6.0.009

WEIGHTED LEAST SQUARE POLYNOMIAL APPROXIMATION

R. E. von Holdt and J. R. Brousseau May 22, 1956
University of California Radiation Laboratory, Livermore, California

a) Fits a weighted least square polynomial of order n to a set of m observation points, or obtains the solution of a system of n equations in n unknowns.

b) Limits for the least squares fit: $1 \leq n \leq 33$, $3 \leq m \leq 312$. Also $m(n + 3) \leq 1250$ and $m \geq n + 1$. Limits for a system of equations: $3 \leq n \leq 33$. Calculations are in floating-point.

c) An iterative method is used.

d) Storage required for the program is 750 locations 0000 to 0749; the rest of the drum is used to store data. Speed estimates not given.

e) The program includes an interpretive routine to perform the floating decimal arithmetic. In producing the nth order approximation, all other approximating polynomials from order one to n-1, and their respective residuals, are produced.

f) Minimum 650.

IBM 650 Library Program

File no. 6.0.009
ERRATA

"Weighted Least-Square Polynomial Approximation to a Continuous Function of a Single Variable," by R. E. von Holdt and R. J. Brousseau.

The following revised errata sheet, which replaces that published in IBM 650 Bulletin 15, has been received from one of the original contributors.

The following revisions are to be made:

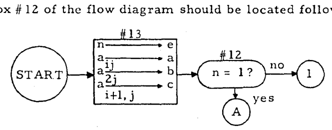
Page 24, line 20: $M_A = 1200$ limits: $1 \leq n \leq 32$
$3 \leq m \leq 300$

Page 25, lines 8-10: The memory required to store the matrix being solved must be less than or equal to the memory space available in the routine (1200 locations).

Page 26: Change the following to read

line 9 . . . such a value for n is 21. Thus . . .
line 10 . . . is a polynomial of order 21 to the given . . .
line 12 . . . obtain the polynomial of order 32, he . . .
line 13 . . . select manually the 33 most representative . . .
line 14 . . . code with an m = 33 to satisfy . . .
line 16 . . . solution of the 21 x 50 matrix, . . .

Page 29: Box # 12 of the flow diagram should be located following box # 13.



Page 34: The following sentence has been omitted from the top of the page:

Multiply row (2) by B_2^2 and subtract from row (3).

New Row (3) = $[0.02\ \ -0.01\ \ -0.02\ \ -0.01\ \ 0.02]$.

Page 37:	Inst. No.	Loc. Inst.	Oper.	Data Addr.	Inst. Addr.
line 7		0218	53	1200	0000

Page 40:

line 6	7.06	0701	RAL 65	0188	0294
line 11	7.11	0275	SLT 35	0001	0295
line 18	7.18	0732	SU 11	8003	0745
line 23	7.23	0208	SRT 30	0006	0270
line 42	8.00	0735	RD 70	1951	0258
line 43	9.00	0258	LD 69	0230	0284

(Continued on next column)

Page 41:

line 3	9.02	0266	LD 69	1951	0403
line 5	9.04	0162	LD 69	1952	0405
line 7	9.06	0272	LD 69	1953	0406
line 33	13.04	0371	STL 20	0475	0378

Page 42: The following instructions are missing at the bottom of the page.

Inst. No.	Loc. Inst.	Oper.	Data Addr.	Inst. Addr.
25.03	0483	RAL 65	0441	0445
25.04	0445	AL 15	0431	0485
25.05	0485	LD 69	0317	0439

Page 45:

line 46	48.14	0579	SL 16	0366	0575

Decks supplied on or after May 1, 1958 include the appropriate changes shown above.

650 LIBRARY PROGRAM ABSTRACT	FILE NUMBER 6.0.010

POLLY: POLYNOMIAL FIT BY LEAST SQUARES

Richard R. Haefner September, 1956
Savannah River Laboratory, du Pont, Augusta, Georgia

a) Obtains a least squares fit of a polynomial $\sum_{i=0}^{N} a_i x^i$.

b) A maximum of n=100 experimental points is allowed. Maximum order of polynomial is N = 15. Input data are in fixed decimal mode, and output coefficients are in floating decimal.

c) Least squares method.

d) Approximately $0.0016n\,(N^2+10N+20) + 0.002(3N^3+10N^2)$ minutes are required for an Nth order polynomial with n data points. Storage required is approximately 2000 locations.

e) Four types of weighting factors are allowed: (1) uniform weighting, (2) weighting by inverse first power of the dependent variable, (3) weighting by the inverse second power of the dependent variable, and (4) arbitrary weight factors at each point.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT	FILE NUMBER 6.0.012

SINH FIT

R. R. Haefner April, 1955
Savannah River Laboratory, du Pont, Augusta, Georgia

a) Obtains a least squares fit to data obtained in a subcritical reactor. The relative activities of foils corrected or uncorrected for epithermal neutron background may be obtained.

b) Fixed point arithmetic is used.

c) Least squares.

d) Storage required is approximately 1550 locations. An average speed for a sinh fit to 20 experimental points is 3 minutes. Relative activities of foils are obtained at a speed of 20 points per minute.

e) The routine can obtain (1) a hyperbolic sine fit when the absolute experimental uncertainty of the data is of the same magnitude at each point, (2) a hyperbolic sine fit when the relative uncertainty is the same at each point, and (3) a $J_0(\gamma r)$ fit when the relative uncertainty is the same at each point. A general description of the routine is give in DP-143, January 1956, available from the Department of Commerce. Pages 29 through 34 of this report are included.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 6.0.013

AUTOCORRELATION AND POWER SPECTRUM

Essor Maso and William J. Drenick
Hughes Aircraft Company, Culver City, California

January 14, 1957

a) Autocorrelation and power spectrum.

b) Fixed. Approximately 3 to 4 significant figures.

c) Numerical integration by addition of discrete input points.

d) 2,000 words. Non-relocatable.

e) Not to exceed 999 input points or 99 lags in autocorrelation.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 6.0.014

CORRELATION ANALYSIS WITH ANNOTATED OUTPUT

Staff, Scientific Computing Center
IBM, Washington

December 31, 1956

a) Computes the means, standard deviations, and simple correlation coefficients for as many as 25 variables and 9999 observations providing both fixed and floating decimal output. However, with three exceptions, this routine may be substituted for phase II and output of this routine may be used as input to later phases of the "Multiple Regression Analysis on the 650." file no. 6.0.001. The exceptions are: (1) Program 6.0.014 will not handle more than 25 variables. (2) Observation numbers appear in different columns on the data cards so that 6.0.014 data cards cannot be directly used as input to phase IV. (3) 6.0.014 does not produce the means in a suitable card form for direct applications as input to phase IV.

b) Input data can be a maxium of 8 digits for each variable. Summations are accumulated in double precision fixed point.

c) The standard formulas are used.

d) The entire drum is used by the program. No accurate timing formula is available, but this routine will run at least twice as fast as phase II of "Multiple Regression Analysis" by A. Cohen.

e) Fixed point means and standard deviations are scaled. Header cards identify output.

f) Alphabetic 650.

650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 6.0.015

CHI SQUARE FOR UP TO 10x10 CONTINGENCY TABLE

Albert Newhouse
Computing and Data Processing Center, University Of Houston

January 16, 1957

a) This routine computes Chi square for systems up to 100 observations and up to 70 one-digit variables.

b) Chi square is computed in fixed point arithmetic for every variable versus every other variable.

c) Standard formulas are used with option for correction.

d) 1950 locations are needed. Available in SOAP and/or absolute.

e) Self-restoring, available in self-loading 5/c.

f) Minimum 650, alphabetic device if SOAP version is used.

650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 6.0.016

CHI SQUARE AND PHI FOR 2x2 CONTINGENCY TABLE

Albert Newhouse
Computing and Data Processing Center, University of Houston

January 16, 1957

a) This routine computes Chi square and Phi for systems up to 100 observations and up to 70 one-digit variables.

b) Chi square and Phi are computed in fixed point arithmetic for every variable versus every other variable.

c) Standard formulas with option for correction.

d) 1286 locations are needed. Available in SOAP and/or absolute.

e) Self-restoring, available in self-loading 5/c.

f) Minimum 650, alphabetic device if SOAP version is used.

650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 6.0.017

A STATISTICAL INTERPRETIVE SYSTEM
FOR THE IBM 650 MAGNETIC DRUM CALCULATOR

G. E. Haynam
Case Institute of Technology
Cleveland, Ohio

a) A three address floating point statistical interpretive routine which is a modification of the interpretive routine by V. M. Wolontis described in IBM Technical Newsletter No. 11.

b) Some fixed point operations are included in order to preserve the accuracy in some statistical calculations.

c) Does not apply.

d) Storage required for the interpretive system is 1500 locations, 0500 to 1999. The time depends upon the operation being performed.

e) The trigonometric functions and negative multiply have been removed and the following operations added: float, mean, covariance, α_3^2, α_4, random number, negative, gamma function, normal probability, Poisson probability, binomial probability, cumulative Poisson, cumulative binomial, X^2 test, t test, F test, clear, store loop box, restore loop box, general exponentiation, and two statistical read commands.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 6.0.018

RAP - A REGRESSION ANALYSIS PROGRAM

C. E. Cates
T. H. Green
R. Y. Seaber
R. A. Stewart
Shell Oil Company
Houston Research Laboratory
Houston, Texas

a) A program written in SOAP and SIR to compute the constants and regression coefficients of polynomial equations which may contain up to 26 variables, of which up to 8 may be dependent. The equations may contain up to 26 terms, each of which may contain up to 5 independent variables. The variables can be independently changed by a number of different transformations as the data are entered.

b) Data are entered as positive, four digit floating decimal numbers. Internal operation is in the SIR mode.

(Continued on next page)

c) Normal least squares techniques.

d) Program is in 2 parts, each of which uses the entire drum. Output from Part I is the input to Part II. Speed is a function of equation size, number of observations, and type of transformations.

e) Output includes variance of dependent variable error and value of student t for each coefficient.

f) Minimum 650. Alphabetic device permits printing header cards, but is not essential to obtain correct results.

IBM 650 Library Program Abstracts

File no. 6.0.020
Statistical Programs

FACTOR ANALYSIS

C. W. Harris, Dept. of Education
W. H. Peirce, Numerical Analysis Laboratory
University of Wisconsin
Madison, Wisconsin

a. Purpose: Using an n x n (symmetric) correlation matrix with 1's in the main diagonal the program produces a maximum likelihood solution under the assumption of random sampling from a multivariate normal population. It provides a method of converging by iteration the initial estimates of the unique variances; and provides a test of significance for the residuals after the extraction of any given number of common factors.

b. Range: Maximum matrix size, 38 x 38.

Accuracy: Not given.

Floating/Fixed: Computation is in fixed point.

c. Mathematical Method: Rao's Canonical Factor Analysis method and Lawley's test of significance.

d. Storage Required: Practically the entire drum is required.

Speed: Exact timing information is not available, since it depends on the number of iterations necessary for convergence. One 18 x 18 matrix which was processed took 14 hours to meet the conditions of the Lawley test.

Relocatability: Not given.

e. Remarks: The number of iterations and hence the total time required may be reduced considerably by applying a less stringent significance test.

f. 650 System: One 533 required.

Special Devices: None.

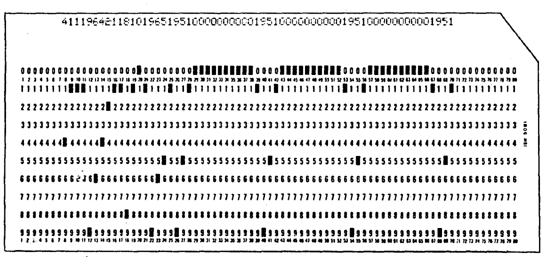
IBM 650 Library Program Abstracts

File no. 6.0.020
ERRATA

FACTOR ANALYSIS

When loading the "Words Displaced by Punch Drum Routine" deck, location 1964 is not properly restored. This may be remedied by adding to the deck on extra card as shown below. Also it is necessary to add a wire on Board #1, from (AL-55) to (C-44).

Decks received on or after March 1, 1961 have been corrected.



IBM 650 Library Program Abstracts

File no. 6.0.021
Statistical Programs

CURVE AND SURFACE FITTING ON EQUALLY OR UNEQUALLY SPACED POINTS

C. Hobby
A. Newhouse
L. Gieszl
Computing and Data Processing Center
University of Houston
Houston, Texas

a. Purpose: Fits a polynomial to the given data. By repeated use it will fit a polynomial to a function in several variables.

b. Range: The number m of points allowed varies with the degree $n \leq 10$ of the polynomial, e.g., for $n = 2$ or 3, $m \leq 99$; $n = 10$, $m \leq 43$.

Accuracy: Not given.

Floating/Fixed: Calculations are in floating point.

c. Mathematical Method: Not given.

d. Storage Required: The entire drum is used.

Speed: Not given.

Relocatability: Not relocatable.

e. Remarks: The program consists of three decks:

Deck 1: Determines a set of polynomials orthogonal on the given set of (equally or unequally spaced) points.

Deck 2: Uses these polynomials to fit the data in the least square sense.

Deck 3: Will compute the accuracy of fit and/or compute the values of the function for intermediate points.

The program is written in SOAP I and SIR.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 6.0.021
Addenda/Errata

"An Integrated Set of Programs for Curve and Surface Fitting on Equally or Unequally Spaced Points," by C. Hobby, A. Newhouse, and L. Gieszl.

(Note: Page numbers refer to those in the lower right-hand corner of the pages in the write-up.)

The following corrections and additions have been submitted:

1. For the write-up:

On page 7, line 8, the equation should read:

$$A = - \sum_{i=1}^{n} \frac{X_i}{n}.$$

In the original the right side of the equation was positive, in error.

On page 21, for Word 5 the line should read:

Word 5 Col 41-50 Number B for $Z = \frac{X + A}{B}$, in floating point form if this option is selected.

The underscored phrase has been added.

On page 21, Note 3 should be corrected to read: If -----, then option 4 in Deck 2 cannot -----etc. ----.

On page 22, correct the Col numbers as follows:

Word 7	Col 61-62	Decimal point ---etc.---.
Word 8	Col 63-80	Zeros

2. In the program and listings, page 60:

Correct card number 432 to read:

432	STR4A	LDD	CON26	1218	69	1201	1504

Insert the following between card numbers 432 and 433:

STD	CON17		1504	24	1457	1560
LDD	CON27		1560	69	1563	1566
STD	CON21		1566	24	1219	1471
RAL	STDC3	STDST	1471	65	1321	1325

(Continued on next page)

In the availability table, page 65, locations 1471, 1504, 1560 and 1566 should be made unavailable.

Programs decks furnished from the IBM 650 Program Library after August 1, 1959, incorporate the corrections given in par. 2 above.

IBM 650 Library Program Abstracts

File no. 6.0.022
Statistical Programs

MULTI-VARIABLE CORRELATION

R. Glaser
J. Taylor
General Electric Co.
Utica, New York

a. Purpose: Multi-variable Correlation Program computes the correlation of up to five variables simultaneously, one dependent and four independent from an n^{th} order matrix of simple correlation coefficients.

b. Range: The order of the matrix $n \leq 33$.

Accuracy: Not given.

Floating/Fixed: The elements of the correlation matrix are in floating point.

c. Mathematical Method: The "multiple-correlation" is built from the simple correlation coefficients as described in Croxton & Cowden's "Applied General Statistics", Second Edition, Chapter XXI.

d. Storage Required: Not given.

Speed: The approximate computation time for a five variable correlation is twelve seconds.

Relocatability: Not given.

e. Remarks: The program may be used in conjunction with A. Cohen's "Multiple Regression Analysis", Phase II (File No. 6.0.001) or "Correlation Analysis with Annotated Output" using Option 9 (File No. 6.0.014). The selection of variables is made on the console for ease in sequential analyses.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 6.0.023
Statistical Programs

LEAST SQUARES CURVE FITTING WITH ORTHOGONAL POLYNOMIALS

F. K. Chapman
Case Institute of Technology
Cleveland, Ohio

a. Purpose: A best polynomial fit is obtained using orthogonal polynomials. Unequally spaced data points may be used and the problems of solving simultaneous equations are avoided. Also, a criterion for choosing the best degree to use is provided during the first phase of the calculations.

b. Range: The present program is restricted to 100 points maximum and 10th degree maximum, for the sake of optimization. It may be easily changed to allow for perhaps 200 points or a degree of 20 or more.

Accuracy: Not given.

Floating/Fixed: Input and output are in floating point.

c. Mathematical Method: Recursively defined orthogonal polynomials.

d. Storage Required: There are two programs, used separately:

Phase I program: 415 loc.	Phase I data: 26 + 5m* loc.
Phase II program: 430 loc.	Phase II data: k^2 + 2k* + m + 6 loc.

Common subroutines: 300 loc. (Compiler II P I package.)

* m = no. of data points; k = degree

Speed: Phase I: $\cong$(m + 2.1km)secs.
Phase II: $\cong$(.7k^2 + .41km + .6m + k)secs.

Relocatability: Not given.

e. Remarks: This program is written in SOAP II compiler and uses the P I basic package only.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 6.0.024
Statistical Programs

LS - 3

G. Pulley
J. W. Hamblen
Oklahoma State University Computing Center
Stillwater, Oklahoma

a. Purpose: To fit polynomials of degree 1, 2, 3, and/or 4 by the method of Least Squares; to compute values and residuals, if desired; and to compute the standard error of estimate for each polynomial requested.

b. Range: Not given.

Accuracy: Not given.

Floating/Fixed: Floating decimal.

c. Mathematical Method: Cholesky's scheme is used.

d. Storage Required: The program occupies approximately 750 drum locations and 60 words of core storage.

Speed: Less than n seconds, without computed values and residual punch out, where n is the number of points.

Relocatability: Not given.

e. Remarks: The program is self-restoring, hence may be used to obtain fits for many sets of data without reloading.

f. 650 System: One 533, indexing registers, automatic floating decimal arithmetic, and IAS required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 6.0.025
Statistical Programs

COR IV

A. Oldehoeft
J. W. Hamblen
Oklahoma State University Computing Center
Stillwater, Oklahoma

a. Purpose: To compute the uncorrected and corrected sums of squares and cross products, the correlation coefficients, standard deviations, means, and sums for up to 57 variables and unlimited number of observations (except as limited by 650 floating decimal overflow).

b. Range: Not given.

Accuracy: Not given.

Floating/Fixed: Floating decimal.

c. Mathematical Method: Standard formulae given in write-up.

d. Storage Required: 2000 drum locations and 60 IAS locations for maximum number of variables.

Speed: Not given

Relocatability: Not given.

e. Remarks: Many studies may be processed without reloading the program.

f. 650 System: One 533, indexing registers, automatic floating decimal arithmetic, and IAS.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 6.0.026
Statistical Programs

MODEM II

A. Oldehoeft
J. W. Hamblen
Oklahoma State University Computing Center
Stillwater, Oklahoma

a. Purpose: To accept the output of COR IV (IBM 6.0.025) and build the entire "sums of squares" or correlation matrix in a manner such that it can be loaded with MA INV III (IBM 5.2.011. B. N. Carr).

(Continued on next page)

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Does not apply.

d. Storage Required: Entire program is contained in IAS.

Speed: Not given.

Relocatability: Not given.

e. Remarks: None.

f. 650 System: One 533, indexing registers, and IAS are required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 6.0.027
Statistical Programs

GENERAL LEAST SQUARES ANALYSIS

J. Spector
Picatinny Arsenal
Dover, New Jersey

a. Purpose: Determines the polynomial of any degree up to 6 which best fits a set of observed data points.

b. Range: Determination of coefficients of polynomials up to 6th degree.

Accuracy: Not given.

Floating/Fixed: Floating point.

c. Mathematical Method: Does not require that all terms be present. Polynomials can be specified as having only odd powers, etc.

d. Storage Required: Requires approximately 1460 locations.

Speed: Speed is dependent upon the number of input data points being considered and the degree of the polynomial desired.

Relocatability: Not given.

e. Remarks: Program actually consists of two parts so that large quantities of data need not be kept on drum: Part 1 provides coefficients of the desired polynomial. Part 2 uses these coefficients to obtain calculated ordinates, residuals, and square-errors.

f. 650 System: One 533, indexing registers, and automatic floating decimal arithmetic are required.

Special Devices: Alphabetic device.

IBM 650 Library Program Abstracts

File no. 6.0.028
Statistical Programs

THE WHERRY-WINER METHOD OF FACTOR ANALYSIS

H. R. Brenner
Miss Frances Dallow
The Standard Oil Company of Ohio
Midland Building
Cleveland 15, Ohio

a. Purpose: This routine presents a method of analyzing variables on the basis of their inter-correlations to determine whether the variations represented can be accounted for adequately by a number of basic categories smaller than the number initially considered.

b. Range: Not given.

Accuracy: Not given.

Floating/Fixed: Fixed point arithmetic is used.

c. Mathematical Method: An iterative procedure is used for stabilizing communalities.

d. Storage Required: Part 1 (obtaining observations' subtest scores and correlation between subtests) requires approximately 2,000 locations.
Part 2 (obtaining item-subtest correlations) requires 850 locations.
Part 3 (calculating projections on group centroid vectors) requires 600 locations.
Part 4 (an alternative procedure to obtain summations of inter-item correlations for each subtest which failed to converge) requires 1100 locations.
The number of passes through Part 2 equals the number of subtests.

(Continued on next column)

Speed: Not given.

Relocatability: Not given.

e. Remarks:

Maximum number of subtests	15
Maximum number of items in a subtest	19
Maximum number of items	100
Maximum number of observations	300

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 6.0.029
Statistical Programs

FITTING OF THE GAMMA-DISTRIBUTION TO RAINFALL DATA

H. O. Hartley
W. T. Lewish
Iowa State College
Ames, Iowa

a. Purpose: This program will obtain the parameters q and γ for the Gamma distribution.

b. Range: Input data must be in the form xx.xx. $\gamma < 10.0$.

Accuracy: The parameters are accurate to four decimal places.

Floating/Fixed: Fixed point input and output.

c. Mathematical Method: The method of Maximum Likelihood and the usual approximation.

d. Storage Required: Storage locations 1600-1999 are not used.

Speed: The input cards are read at 200 cards per minute.

Relocatability: Not in relocatable form.

e. Remarks: Special remarks are contained in the program description.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 6.0.030
Statistical Programs

MULTIPLE REGRESSION ANALYSIS PROGRAMS: RAP; RAPA; TRAP

J. E. Nichols
Houston Research Laboratory
Shell Oil Company
Houston 1, Texas

a. Purpose: Three versions of the same regression analysis program, modified for use on different equipment, are included in this write-up.

RAP is for the basic 650 with the alphabetic device.
RAPA is for the 650 with the alphabetic device, IAS, indexing registers, automatic floating decimal arithmetic feature, and an on-line 407.
TRAP is for the 650 equipped as for RAPA plus one 727 tape unit.

These programs offer improvements over the previous regression analysis program, File Number 6.0.018, in many important respects. Multiple transformation of variables as the data is entered permits more flexibility in the form of equations used. The programs also provide for the following:

1. Additional output, some of which is optional.
2. Error detection and correction features which check on the form of the data and of the equation.
3. An option to force the curve through the origin when certain physical situations require this.

Several modifications to the program logic have been made which reduce computing time.

b. Range: Data is entered as positive and/or negative four-digit floating decimal numbers. The programs provide for the entry of 32 variables and up to 999 observations. Nine dependent variables can be correlated in one pass in the RAPA and TRAP programs, while eight is the maximum number in the RAP program. The regression equation to be fitted may contain a maximum of 26 terms and dependent variables. Each term may be the product of up to five transformed variables, all raised to various powers ranging from 0.1 to 9.9. Variable transformations are done by means of codes and constants. The programs provide for thirty-two constants and thirty-two codes.

(Continued on next page)

Accuracy: Not given.

Floating/Fixed: Floating decimal arithmetic is used. RAPA and TRAP utilize the automatic floating decimal arithmetic feature, and RAP uses the programmed floating decimal arithmetic in SIR.

c. Mathematical Method: Conventional least squares techniques are used. Matrix inversion is done by Gaussian elimination.

d. Storage Required: Each program is divided into two parts. See the availability tables of each part in the program write-up for the storage requirements. The output from TRAP, Part I, is stored on magnetic tape, and the output from RAPA and RAP, Part I, is punched into cards. The output from Part I in any case is the input for Part II.

Speed: The speed of each program is a function of equation size, the number of observations, and the number and type of transformations of the variables.

Relocatability: Not given.

e. Remarks: TRAP output contains the following:

1. Original least squares matrix.
2. Inverse least squares matrix.
3. A set of constants and coefficients for each dependent variable.
4. Total variation.
5. Variation by regression.
6. Correlation coefficient.
7. Error variance and standard deviation.
8. "F" and "T" test values for each term.
9. Table of residuals for each observed and calculated dependent variable.
10. Sum of residuals squared.
11. Chi-square test values.
12. Variance check to indicate round-off errors, if any.

RAPA and RAP outputs do not contain items 9, 10, 11 and 12. RAP is further limited by not containing items 4, 5 and 6 in the above list.

f. IBM 650 System:

1. For RAP: One 533 and the alphabetic device.
2. For RAPA: One 533, alphabetic device, IAS, indexing registers, automatic floating decimal arithmetic feature, and an on-line 407.
3. For TRAP: Same system as for RAPA plus one 727 tape unit.

IBM 650 Library Program Abstracts

File no. 6.0.030
Errata

"Multiple Regression Analysis Programs: RAP, RAPA, TRAP" by J.E. Nichols.

The following correction has been submitted for the addenda sheet of the above writeup. It affects only the page entitled IDENTIFICATION OF CARDS; the card deck is accurate.

The column reading	7-001 - 7-025	Sample Data — TRAP, RAPA, RAP should be changed to read
	7-001 - 7-075	Sample Data — TRAP, RAPA, RAP

IBM 650 Library Program Abstracts

File no. 6.0.031
Statistical Programs

MULTIPLE REGRESSION ANALYSIS

Mrs. Emma E. Iulo
State College of Washington
Computing Center
Pullman, Washington

a. Purpose: This program completes a multiple regression analysis and provides related statistics in concise form, utilizing a minimum number of control cards.

b. Range: Maximum number of variables is 25. Maximum number of observations is 9999. The maximum size of any single variable is eight digits. All output (except identification and number of observations) is in floating decimal notation.

Accuracy: Not given.

Floating/Fixed: Floating decimal.

c. Mathematical Method: See the program write-up.

d. Storage Required: The entire drum.

Speed: See timing chart in the program write-up.

Relocatability: Not relocatable.

(Continued on next column)

e. Remarks: Input data is checked for proper sequence of card number within observation number. Any number of selected independent variables may be eliminated from the regression equation, if desired. The program utilizes the "Matrix Inversion Routine 1 (MIR 1)," by K. B. Williams, IBM 650 Library Program No. 5.2.012.

f. IBM 650 System: One 533, indexing registers, and automatic floating decimal arithmetic feature.

IBM 650 Library Program Abstracts

File no. 6.0.032
Statistical Programs

CORRELATION ANALYSIS WITH ANNOTATED OUTPUT - PART II

Staff, The Service Bureau Corporation
Washington, D. C.

a. Purpose: This program does the following:

Computes the inverse of a matrix.
Loads any number of matrices as one continuous 650 operation.
Extracts any number of submatrices from a loaded matrix.
Identifies output by alphabetic header cards.
Punches the inverses in such a manner that columns of the inverse appear as columns in the listing.

b. Range: Matrices up to 25 x 25 may be inverted. Any number of rows and columns may be omitted.

Accuracy: Inversion is in single-precision floating decimal form.

Floating/Fixed: Floating decimal.

c. Mathematical Method: The inverting part of the routine is that of D. W. Sweeney. Gaussian elimination is performed.

d. Storage Required: The entire drum is used for a 25 x 25 matrix.

Speed: The inversion, exclusive of input and output time, requires approximately $0.072n^3$ seconds, where n is the order of the matrix.

Relocatability: Not relocatable.

e. Remarks: None.

f. IBM 650 System: One 533 required.

Special Devices: Alphabetic device required.

IBM 650 Library Program Abstracts

File no. 6.0.033
Statistical Programs

10 x 90 CORRELATION COEFFICIENTS

J. E. Farmer
Computing Center
State College of Washington
Pullman, Washington

a. Purpose: This program provides simple correlation coefficients and related data for up to ten dependent variables correlated with up to 90 independent variables.

b. Range: Maximum number of observations is 9999. Maximum size of any single variable is eight digits (positive or negative).

Accuracy: Not given.

Floating/Fixed: Floating decimal.

c. Mathematical Method: See the program write-up.

d. Storage Required: The entire drum.

Speed: For reading and computing, time required = $\frac{2(i + d) + 5d + 8i + 5id}{208}$ seconds per observation, where d is the number of dependent variables and i is the number of independent variables.

For punching, time required = (i + d + id)(0.6) seconds per problem.

Relocatability: Not relocatable.

e. Remarks: An unpacking routine must be written for each problem to place the data in particular locations in normalized form. Zero is treated as a significant observation.

f. IBM 650 System: One 533, indexing registers, and automatic floating decimal arithmetic feature are required.

IBM 650 Library Program Abstracts

File no. 6. 0. 033
Errata

"10 x 90 Correlation Coefficients," by J. E. Farmer

The following correction has been submitted for the write-up, page 4, paragraph E., subparagraph 3. The last sentence there should be changed to read:

"If not, the unpacking routine must be loaded separately and behind the main program deck."

IBM 650 Library Program Abstracts

File no. 6. 0. 034
Statistical Programs

ANALYSIS OF VARIANCE OR COVARIANCE AND ADJUST MEANS PROGRAM

G. Ingram
State College of Washington
Computing Center
Pullman, Washington

a. Purpose: This program computes either the complete analysis of variance or analysis of covariance, including F values. In addition, adjusted means may be computed for the analysis of covariance.

b. Range: Maximum number of variables is six. Maximum number of observations is 9999. Maximum number of sources of variation is 60. All output is in floating decimal form. There can be no missing observations.

Accuracy: Not given.

Floating/Fixed: Floating decimal.

c. Mathematical Method: See the program write-up.

d. Storage Required: The entire drum is used.

Speed: See the timing table in the program write-up.

Relocatability: Not relocatable.

e. Remarks: None.

f. IBM 650 System: One 533, indexing registers, and automatic floating decimal arithmetic feature.

IBM 650 Library Program Abstracts

File no. 6. 0. 035
Statistical Programs

RANDOM NORMAL DEVIATES

R. A. Conger
The Emerson Electric Mfg. Co.
St. Louis 21, Missouri

a. Purpose: This is a relocatable subroutine which will generate a random number upon entry. A sequence of these numbers produced by repeated entry will be approximately normally distributed with mean $\overline{X}$ and variance s^2 supplied by the user. The Central Limit Theorem is utilized to produce a t-distribution with N degrees of freedom. The sequence is asymptotically pseudo-Gaussian as the value of N, supplied by the user, becomes increasingly large.

b. Range: $\frac{-Ns}{2} \leq \overline{X} \leq \frac{Ns}{2}$.

Accuracy: Does not apply.

Floating/Fixed: Floating decimal.

c. Mathematical Method: A sequence of uniformly distributed random numbers is generated by the multiplicative congruence method. A group of N of these is then added to produce a single random deviate having zero mean and unit variance. These random deviates are then modified so that they have mean $\overline{X}$ and variance s^2. For most problems a value of 10 for N is sufficiently large. However, when sampling from the tails of the distribution is fairly important, N should be larger.

d. Storage Required: 35 storage locations are used.

Speed: The time required is approximately (25 N + 50) milliseconds.

Relocatability: Relocatable.

e. Remarks: Values of $\overline{X} = 0$, $s^2 = 1$, and N = 10 are incorporated into the program. The user need only change any of these which are unsatisfactory for his needs. A fourth parameter, R_0, which determines all subsequent random numbers generated by the subroutine, must be changed if different sequences are desired.

(Continued on next column)

f. IBM 650 System: One 533 and automatic floating decimal arithmetic feature are required.

IBM 650 Library Program Abstracts

File no. 6. 0. 036
Statistical Programs

GENERAL ANALYSIS OF VARIANCE

J. E. Farmer
Computing Center
State College of Washington
Pullman, Washington

a. Purpose: This program computes the sums of squares necessary to compute an analysis of variance, as well as the mean and a measure of dispersion for each variable.

b. Range: Maximum number of variables is 99. Maximum number of observations is 9999. Maximum size of any single variable is eight digits. Maximum number of components (without special identification procedures) is 98. Corrected sums of squares for all interactions obtained are corrected with the grand total correction term only, and not for any main effects. One pass of input data through the machine is required for each component except "Total".

Accuracy: Not given.

Floating/Fixed: Floating decimal.

c. Mathematical Method: Not given.

d. Storage Required: The entire drum.

Speed: Not given.

Relocatability: Not relocatable.

e. Remarks: Corrected sum of squares for any given level represents the "within" corrected sum of squares for that particular level. Zero may be significant or nonsignificant through use of a control card.

f. IBM 650 System: One 533, indexing registers and automatic floating decimal arithmetic feature.

IBM 650 Library Program Abstracts

File no. 6. 0. 037
Statistical Programs

CORRELATION ANALYSIS WITH ANNOTATED OUTPUT - PART III

Marlene Hirsch
The Service Bureau Corporation
Washington, D. C.

a. Purpose: This program computes regression coefficients, constant term of the regression equation, partial correlation coefficients, unbiased standard error of the regression coefficients, computed t, biased and unbiased standard error of estimate, multiple correlation coefficient and computed F. Any number of problems can be loaded as one continuous operation; options for deleting variables or omitting output are provided; and output is completely identified.

b. Range: Maximum number of variables permitted is 25. Input and output are in floating decimal. Only that portion of the correlation matrix inverse above the main diagonal is used; whereas the program available under IBM 650 Program Library File Number 6. 0. 001 uses the portion below the main diagonal. The inverse should be symmetric for the result in either case to be accurate.

Accuracy: Not given.

Floating/Fixed: Floating decimal in the SIR mode.

c. Mathematical Method: The standard formulas are used.

d. Storage Required: The entire drum is used.

Speed: The maximum time for processing a complete problem is less than two minutes.

Relocatability: Not relocatable.

e. Remarks: Both input and output for this program are compatible with several existing programs (e.g., file number 6. 0. 014, 6. 0. 001, and 6. 0. 032).

f. IBM 650 System: One 533 required.

Special Devices: Alphabetic device required.

IBM 650 Library Program Abstracts

File no. 6. 0. 038
Statistical Programs

PAIRED COMPARISONS FROM BALANCED INCOMPLETE BLOCKS

H. Gulliksen
L. Tucker
Educational Testing Service
and Princeton University
Princeton, New Jersey

a. Purpose: This program utilizes input data from a questionnaire involving 31 objects arranged in 31 blocks of six objects each, and gives the paired comparisons matrix and scale values determined from this matrix.

b. Range: The program will handle a maximum of 999 subjects in a single group.

Accuracy: Proportions are rounded to four decimals. The approximations for the normal deviate, arc sine, and logistic have a maximum discrepancy of 0. 0005 for proportions between 0. 98 and 0. 02.

Floating/Fixed: Fixed decimal.

c. Mathematical Method: The least squares solution for scale values is used. Scale values are computed using the normal deviate, the arc sine, and the logistic transform.

d. Storage Required: The program uses 1, 964 drum storage locations.

Speed: Each subject is processed in approximately 35 seconds. The final paired comparisons computations for the total group requires approximately fifteen minutes.

Relocatability: Not relocatable.

e. Remarks: It is desirable to use the auxiliary checking program to insure that the input cards are in correct form. This program checks to see that the cards are in consecutive numerical order and that each item contains some permutation of the rank orders 1 to 6. Errors here may produce misleading results.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 6. 0. 039
Statistical Programs

ORTHOGONAL POLYNOMIAL CURVE FITTER

E. McCauley
J. Kaehler
Wayne State University
Detroit, Michigan

a. Purpose: The program fits least square polynomial of i points to degree m.

b. Range: $2 \leq i \leq 99$; $1 \leq m \leq 19$.

Accuracy: The coefficient output is computed to double precision accuracy.

Floating/Fixed: Input and output are in fixed decimal form.

c. Mathematical Method: Least squares curve fitting with orthogonal polynomials.

d. Storage Required: Program requires approximately 1900 locations; locations 0900-0999 are reserved for an optional weight computing subroutine.

Speed: Maximum time for curve fitting is 25 minutes.

Relocatability: Not given.

e. Remarks: Three methods of weighting may be used:

1. Uniform weights.
2. Weights arbitrarily assigned to each point.
3. Weights as computed by any subroutine not longer than 100 words.

The complete routine consists of three sections:

1. Curve Fitter
2. Discriminator, which selects and evaluates best fitted curve.
3. Evaluator (in SOAP II form) which may be utilized to evaluate any polynomial ($1 \leq m \leq 19$) from section 1 above.

f. IBM 650 System: One 533 required.

Special Devices: Alphabetic device required if re-assembly of SOAP II deck is desired.

IBM 650 Library Program Abstracts

File no. 6. 0. 040
Statistical Programs

DETERMINING PROBABILITIES FROM A FITTED GAMMA DISTRIBUTION

H. O. Hartley
W. T. Lewish
Iowa State University
Ames, Iowa

a. Purpose: This program computes three decimal digit probabilities and is a sequel to "Fitting of the Gamma-Distribution to Rainfall Data" by H. O. Hartley and W. T. Lewish (file #6. 0. 029).

b. Range: The parameter γ must be less than 100, but q must be greater than 0. 2 and be less than 100.

Accuracy: Usually 3 decimal digits, but at the extremes, accuracy will be less.

Floating/Fixed: Fixed decimal arithmetic is used.

c. Mathematical Method: For $q < 7.0$ probabilities are computed from a stored table of the Incomplete Gamma Function. Linear and/or quadratic interpolation is used within the table. For $q > 7.0$, Wilson-Hilferty approximation, requiring a table of Normal Probabilities, was used.

d. Storage Required: Entire drum is used.

Speed: About seven seconds for 20 probability values.

Relocatability: Not relocatable.

e. Remarks: Up to twenty probabilities are packed per output card. The levels at which the probabilities are calculated can be very easily changed.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 6. 0. 041
Statistical Programs

SEASONAL ADJUSTMENT OF ECONOMIC TIME SERIES

S. H. Haeckel
IBM, St. Louis, Mo.

a. Purpose: This program is designed to isolate and remove the seasonal factor in time series.

b. Range: From five to ten years of monthly data may be adjusted at one time. Longer series may be broken down into ten-year periods and overlapped.

Accuracy: Does not apply.

Floating/Fixed: FOR TRANSIT floating decimal mode.

c. Mathematical Method: Shiskin-Eisenpress.

d. Storage Required: The entire drum is used.

Speed: Ten years of monthly data are processed in thirty minutes.

Relocatability: Not given.

e. Remarks: The original source program was written in FOR TRANSIT, and may thus be compiled on the "700 series" machines.

f. IBM 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 6. 0. 042
Statistical Programs

PROGRAM TO CALCULATE SEASONALLY ADJUSTED INDICES

W. Mehl
Prudential Life Insurance Company
Newark, New Jersey

M. Turin
IBM, New York

a. Purpose: The program will adjust a time series, generally composed of a trend, cyclical movement, seasonal variations, and random or irregular fluctuations, to a form that shows primarily the non-seasonal movements.

(Continued on next page)

b. Range: The program will process series of from 6 years through 21 years duration. No original observations may be missing.

Accuracy: Final moving seasonal indices to 0.1%.

Floating/Fixed: Fixed decimal arithmetic is used.

c. Mathematical Method: The method is a modification of the Bureau of Census Method I.

d. Storage Required: The entire drum is used.

Speed: 10 year series (120 input items) - approximately 4 minutes.
21 year series (252 input items) - approximately 15 minutes.

Relocatability: Not relocatable.

e. Remarks: Due to storage space requirements, it is necessary to reload the instructions with each series to be adjusted.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 6.0.043
Statistical Programs

MINIMAX POLYNOMIAL APPROXIMATION ON A FINITE POINT SET

D. W. Marquardt
Mary Anne Stormfeltz
E. I. duPont de Nemours & Co., Inc.
Wilmington, Delaware

a. Purpose: To compute the polynomial of specified degree n which approximates in the minimax sense to a finite set of points (values of some function f (X) on a finite interval).

b. Range: Up to 100 values of f(Xi); where the X_i, i = 1, 2, ..., N may be spaced as desired on any finite interval.
Degree of polynomial: $1 \le n \le 12$

Accuracy: Program normalizes range of X_i to $-1 \le x_i \le 1$, to minimize roundoff error. Accuracy is limited only by roundoff.

Floating/Fixed: Floating decimal arithmetic is used.

c. Mathematical Method: This program uses the iterative method of P. C. Curtis and W. L. Frank, as described in the Preprints of papers presented at the June 1958 meeting of the Association for Computing Machinery, pages 23-1 to 23-3.

d. Storage Required: Most of drum, all of immediate access storage.

Speed: Depends upon N, n, and number of iterations required.

Typical cases:	N = 33	n = 3	time = 3 min.
	N = 33	n = 5	time = 5 min.
	N = 33	n = 7	time = 12 min.
	N = 51	n = 5	time = 6 min.

Relocatability: Not relocatable.

e. Remarks: Output includes: coefficients of minimax polynomial, minimax error of the approximation, normalization constants. Utility board is used.

f. IBM 650 System: One 533 (or one on line 407), indexing registers, IAS and automatic floating decimal arithmetic feature.

IBM 650 Library Program Abstracts

File no. 6.0.044
Statistical Programs

AN ANALYSIS OF VARIANCE PROGRAM FOR THE IBM 650

J. W. Johnson
Canadian Army Operational Research Establishment
Ottawa, Ontario
Canada

a. Purpose: This program calculates the analysis of variance table including the components of variance for crossed, nested, or mixed experiments with three or fewer factors.

b. Range: The restrictions imposed by use of this program are:
$qr+r \le 920$
(number of digits in $\sum x$) ≤ 10
(number of digits in $\sum x^2$) ≤ 20
The sizes of p and n are restricted only by word size.
The number of replications must be constant.

Accuracy: Double precision arithmetic is used in summing squared terms to preserve accuracy.

(Continued on next column)

Floating/Fixed: Fixed decimal arithmetic.

c. Mathematical Method: Double precision arithmetic is used. Computational techniques are those described in Bennet and Franklin, Statistical Analysis in Chemistry and the Chemical Industry, Wiley, New York.

d. Storage Required: Not given.

Speed: The example problem required about 75 seconds.

Relocatability: Not given.

e. Remarks: 1. The ratio of the number of levels in the sample to that in the corresponding population is entered as either 0 or 1. That is, finite random models cannot be analyzed with this program.

2. The program may be conditioned to punch the partial sums and means, and cell sums of squares and variances.

f. IBM 650 System: One 533 required.

Special Devices: Alphabetic device required.

IBM 650 Library Program Abstracts

File no. 6.0.045

COMPLETE PAIRED COMPARISONS SCHEDULE
(PARCOPLET-2-21)

Harold Gulliksen
Psychology Department
Princeton University
Princeton, New Jersey

a. Purpose: This program utilizes input data from a paired comparison questionnaire of 21 objects or less (with or without the Like-Dislike section) and punches out the summary data for each subject and the scale values. The detail paired comparison matrix may be punched out or omitted as desired.

b. Range, Accuracy, Floating/Fixed: The program will handle a maximum of 9999 subjects in a single group. Fixed point is used throughout. Proportions are rounded to four decimals. The approximation for the normal deviate, arc sine, and logistic have a maximum discrepancy of .0005 for proportions between .98 and .02.

c. Mathematical Methods: The least squares solution for scale values is used. Scale values are computed, using the normal deviate, the arc sine, and the logistic transform.

d. Storage Requirements, Speed, Relocatability: The analysis program utilizes 1972 drum locations, and is not relocatable. Depending on the number of stimuli in the questionnaire the program processes each subject in about three to 15 seconds and the final paired comparisons computations for the total group take from one to five minutes.

e. Additional Remarks, Precautions or Restrictions: It is desirable to use the auxiliary checking program to insure that the input cards are in correct form. This program checks to see that the cards are in consecutive numerical order and that each item response is a 1 or a 2. Errors here may produce misleading results.

f. Equipment Specifications: It requires the minimum 650 installation and uses the standard 80-80 board for eight ten-digit words for the 533 input-output.

IBM 650 Library Program Abstracts

File no. 6.0.046

MULTIPLE REGRESSION ANALYSIS

Numerical Computation Laboratory
Ohio State University Research Center
Columbus 12, Ohio

a. Purpose: This program performs the multiple regression analysis under the hypothesis

$$y = b_1x_1 + b_2x_2 + \cdots + b_Ix_I + b_{I+1}.$$

The x_i are the observable independent variables, the y is the observable dependent variable, and the b_i, called the regression coefficients, are the constants to be estimated.

b. Range: Not given.

Accuracy: Not given.

Floating/Fixed: All input data must be described by six digit fixed point numbers of the form XXX.XXX.

c. Mathematical Method: The method used is a standard one for multiple regression analysis. Details are contained in the program write-up.

d. Storage Required: This program utilizes the entire drum and high speed storage.

(Continued on next page)

Speed: Not given.

Relocatability: Not relocatable.

e. Remarks: Several sets of y's may be used with the same set of x's. The problems will be solved simultaneously and separate sets of solutions for the b_i will be obtained. In particular, if

I = maximum number of independent variables
J = maximum number of dependent variables
K = I + J

it is possible to solve any problem for arbirary I and J provided $I + J = K \leq 20$ and $I \leq 18$.

The number of observations which can be accomodated, N, is in the range 1 _ N _ 9999, subject to the mathematical restriction $N > I + 1$.

IBM 650 Library Program Abstracts

File no. 6.0.046

If several separate problems are to be solved, they may be stacked consecutively. All punched results will contain specific identification.

This program contains four subroutines; they are used for tracing, punching, and loading.

f. 650 System: This program utilizes the basic 650 and all of the features of the 653B4 - high speed storage, three indexing accumulators, and the automatic floating decimal device.

IBM 650 Library Program Abstracts

File no. 6.0.047

SIMPLE CORRELATION - COR_1

Numerical Computation Laboratory
Ohio State University Research Center
Columbus 12, Ohio

a. Purpose: COR_1 computes simple correlations between two variables, x_1 and x_2. Results include sums, sums of squares, sums of crossproducts, means, standard deviation, variance, covariance, correlation coefficient, and its square.

b. Range: This routine will handle up to 60 variables at a time and compute up to 427 correlations.

Accuracy: Not given.

Floating/Fixed: Fixed point data forms - see write-up for details.

c. Mathematical Method: The computations of COR_1 are based on the formula:

$$r_{12} = \frac{\frac{\sum x_1 x_2}{N} - \frac{\sum x_1}{N}\frac{\sum x_2}{N}}{\sqrt{\frac{\sum x_1^2}{N} - \left(\frac{\sum x_1}{N}\right)^2}\sqrt{\frac{\sum x_2^2}{N} - \left(\frac{\sum x_2}{N}\right)^2}}$$

d. Storage Requirements: COR_1 occupies essentially the entire drum.

Speed: Time required for accumulation of sums is approximately (in minutes)

$\frac{1}{625}(2.5a + b)c$ where a = number of variables
b = number of correlations
c = number of observations

Correlation requires approximately (in seconds) 1.5n, where n is number of correlations.

Relocatability: Not relocatable.

e. Remarks: See write-up for restrictions of input deck.

f. 650 System: Minimum 650; no special equipment required.

IBM 650 Library Program Abstracts

File no. 6.0.048

GENERAL TABULATION PROGRAM

V. H. Nicholson
Agricultural Marketing Service
U.S. Dept. of Agriculture
Washington 25, D. C.

a. Purpose: The purpose of this program is to tabulate any desired field of 10 digits or less controlling on minor, intermediate, and major fields

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of 5 or less columns each. As many as 6 fields of 10 digits or less may be tabulated at one time. No total must exceed 10 digits.

By punching one control card, controls can be shifted to any columns of the card and fields in any part of the data card may be tabulated.

b. Restrictions, Range: Sums accumulated must be 10 digits or less. Fixed decimal point is used throughout.

c. Method: Does not apply.

d. Storage Requirements: Storage required is approximately 800 locations. Program is written in one per card SOAP II language and can be completely relocated. Speed varies from 150 to 200 input cards per minute depending upon the number of fields tabulated.

e. Remarks: Can be used to tabulate fewer than 6 fields if desired.

f. IBM 650 System: Runs on minimum 650 equipment.

IBM 650 Library Program Abstracts

File no. 6.0.049

CALCULATION OF THE AUTO-CORRELATION FUNCTION AND THE SPECTRAL DENSITY

Mrs. V. D. Mikuteit
Battelle Memorial Institute
505 King Avenue
Columbus 1, Ohio

a. Purpose: This computer program computes the auto-correlation function and the spectral density. The program is divided into two phases as follows:

Phase I - Part 1: Calculation of the mean value, $\bar{f}$
Part 2: Calculation of the auto-correlation function, $R_f(K)$

Phase II - Calculation of the spectral density, $W_f(w)$.

The two phases are used independently. The output of Phase I is the input for Phase II.

b. Limitations of Program: Range: Phase I - The input data must not exceed four significant digits over the range $-1000 \leq f(t) \leq 1000$ where the decimal point may be arbitrary. The number of observations (N) must be less than 10,000.

Phase II - The range of the discrete variable K must be less than 1350. In general the range of K is defined as $0 \leq K < N/5$*.

Accuracy: Phase I - The mean value is calculated to the same number of significant digits as the given function. The auto-correlation function is computed to one more significant figure than the given input.

Phase II - The spectral density is evaluated to one more significant figure than the auto-correlation function.

c. Mathematical Method: Formulae are given in the write-up.

d. Storage Requirements: Phase I - Approximately 500 drum locations are used.

Phase II - Almost the entire drum is used. Locations 0000-1350 are, however, reserved for storage of input data. For open memory locations of both phases see the availability tables included in the write-up.

Speed: Computation speed of the computer program is dependent on the number of input data. Approximate formulae are given in the write-up.

Relocatability: The program cannot be relocated.

e. Remarks: None.

f. 650 System: One 533, indexing registers, floating point device, and three tape units are required.

Special Devices: None

IBM 650 Library Program Abstracts

File no. 6.0.050

CALCULATION OF THE CROSS-CORRELATION FUNCTION AND THE CROSS-SPECTRAL DENSITY

Mrs. V. D. Milkuteit
Battelle Memorial Institute
505 King Avenue
Columbia 1, Ohio

a. Purpose: This computer program computes the cross-correlation function and the cross-spectral density. The program is divided into two phases as follows:

Phase I - Calculation of the cross-correlation functions $R_{uv}(K)$ and $R_{vu}(k)$.

Phase II - Calculation of the cross-spectral density, $W_{vu}(w)$.

The two phases are used independently. The output of Phase I is the input for Phase II.

b. Limitations of Program: Range: Phase I - The input data must not exceed four significant digits over the range $0 \leq u(t), v(t) \leq 1000$ where the decimal point may be arbitrary. The number of observations, N must be

(Continued on next page)

less than 10,000.

Phase II - The range of the discrete variable K must be less than 700. In general the range of K is defined as $0 \leq K \leq N/5$.*

Accuracy: Phase I - The cross-correlation function is computed to one more significant figure than the given input.

Phase II - The cross-spectral density is evaluated to the same significant figure as the cross-correlation function.

c. Mathematical Method: Formulae are given in the write-up.

d. Storage Requirements: Phase I - Approximately 260 drum locations are used.

Phase II - Approximately the entire drum is used. Locations 0000-1400 are, however, reserved for storage of input data. For open locations of both phases see availability tables of the write-up.

Speed: Computation speed of the program is dependent on the number of input data. Approximate formulae are given in the write-up.

Relocatability: The program cannot be relocated.

e. Remarks: None.

f. 650 System: One 533, indexing registers, floating point device, and two tape units are required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 6.0.051

FITTING OF DATA TO THE TWO PARAMETER GAMMA DISTRIBUTION WITH SPECIAL REFERENCE TO RAINFALL DATA

H. O. Hartley
W. T. Lewish
Computing Group
Statistical Laboratory
Iowa State University
of Science and Technology
Ames, Iowa

a. Purpose: Calculates the two parameters $\hat{q}$ and $\hat{\gamma}$ for the Gamma distribution as well as the mean, variance and the covariance.

b. Range: Input - 4 digits or less and less than 20,000 observations
Output - $\hat{q}, \hat{\gamma}$. and $\bar{x} \leq 100$
Variance and covariance scaled 1

Accuracy: If $0 \leq u \leq .5772$ maximum error q = 0.0088%
If $.5772 \leq u \leq 4$ maximum error = 0.0054%
for additional information see reference in the program description.

Floating/Fixed: All calculations in fixed.

c. Mathematical Method: Greenwood and Dumond's polynomial approximations to the maximum likelihood method.

d. Storage Requirements: Entire drum (2,000 words).

Speed: 4 digits input data about 170/min. 3 digits or less at 200/min. Punch loop of about 2 seconds.

e. Remarks: Test example and answers contained in description.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 6.0.052

54 X 54 CORRELATION COEFFICIENTS

James E. Farmer
Computing Center
Washington State University
Pullman, Washington

a. Purpose: This program provides simple correlation coefficients and related statistics for all combinations of up to 54 variables. Zero is considered as a significant observation.

b. Range: Maximum number of variables 54. Maximum size of any variable is eight digits (positive or negative).

(Continued on next column)

Floating/Fixed: Floating Decimal.

c. Mathematical Method: See program write-up.

d. Storage Required: Entire 2000 word drum.

Speed: Timing approximation

$$\text{Input--seconds/observation} \doteq \frac{V^2 + 20 - 25}{100}$$

$$\text{Output--seconds/problem} \doteq 0.5\,(V)(V-1)$$

where V = number of variables.

Relocatability: Not relocatable.

e. Remarks: Original data cards may be used as input. Eleven or more variables require the use of an unpacking routine.

f. IBM 650 System: One 533, 2000 word drum, indexing registers and automatic floating decimal arithmetic.

IBM 650 Library Program Abstracts

File no. 6.0.053

FOUR WAY ANALYSIS OF VARIANCE

Numerical Computation Laboratory
Ohio State University Research Center
Columbus 12, Ohio

a. Purpose: This routine produces the analysis of variance table as described in the detailed program write-up. All means on one, two, three, and four subscripts (i.e., replications are always averaged) together with estimates for the main effects and first and second interaction effects are computed.

b. Range: Not given.

Accuracy: Not given.

Floating/Fixed: Fixed point input and output. Included in the output is the error computation.

c. Mathematical Method: See program write-up.

d. Storage Requirements: Locations occupied: 1450-1999 (859 words)

Speed: Not given.

Relocatability: Not relocatable.

e. Remarks: This routine is easily adapted to any smaller dimensional analysis of variance, with or without replications. The replication subscript is always ---ℓ.

The program card deck includes the loading and punching subroutines (and the necessary control cards for these subroutines) which are used by the program.

f. 650 System: Minimum 650, no special equipment is needed.

IBM 650 Library Program Abstracts

File no. 6.0.054

TWO VARIABLE LINEAR REGRESSION AND CORRELATION

Philip J. Kinsler
Oscar Mayer & Co.
Madison, Wisconsin

a. Purpose: This program fits a straight line:

$Y = a + bX$

by the method of Least Squares. It also produces the arithmetic mean and standard deviationof each variable, the simple correlation coefficient and the standard error of estimate about the fitted line. If desired, the basic summations developed for calculation coefficient and the standard error of estimate about the fitted line. If desired, the basic summations developed for calculating these statistics can be punched out.

b. Restrictions, Range: Input data are limited to fixed decimal numbers of no more than 8 digits. The number of observations is essentially unlimited. (99,999 observations maximum). Output is in floating decimal notation.

c. Method: The Method of Least Squares is used for fitting the line. The standard deviations are computed as unbiased estimates.

d. Storage Requirements: Uses 371 instructions in three-instruction-per-card format. Data cards feed at 60 cards per minute. Punch-out occurs almost immediately after last data card is read. This program is not relocatable.

e. Remarks: Program deck includes the Erco Floating Decimal Point Subroutine (650 file 2.0.009) and the square root subroutine from the Trimble-

(Continued on next page)

Kubie Interpretive Floating Decimal Point System (IBM Technical Newsletter No. 8). Both of these subroutines are modified slightly.

f. IBM 650 System: Minimum 650.

IBM 650 Library Program Abstracts

File no. 6.0.055

MISSING DATA CORRELATION COEFFICIENTS

James E. Farmer
Computing Center
Washington State University
Pullman, Washington

a. Purpose: This program provides simple correlation coefficients and related statistics for all combinations of up to 23 variables. Zero is considered as a non-significant or missing datum, the zero variable and its pairs are eliminated from the computation for this observation. The program makes maximum utilization of data not missing ($\neq 0$).

b. Range: Maximum number of variables is 23. Maximum size of any variable is eight digits (positive or negative).

Floating/Fixed: Floating decimal.

c. Mathematical Method: See program write-up.

d. Storage Required: Entire 2,000 word drum.

Speed: Timing approximation: Input--seconds/observation $= \frac{13(V)(V-1)}{208}$
Output--seconds = 0.75 (V)(V-1) where V = number of variables.

Relocatability: Not relocatable.

e. Remarks: Original data cards in any format may be used as input. Eleven or more variables require the use of an unpacking routine.

f. IBM 650 System: One 533, 2,000 word drum, indexing registers and automatic floating decimal arithmetic.

IBM 650 Library Program Abstracts

File no. 6.0.056

ESSO STEPWISE REGRESSION PROGRAM

M. A. Efroymson
Esso Research & Engineering
Linden, N. J.

a. Purpose: Computes and prints the F-value, regression coefficients, standard error or coefficients, "A" coefficients, inverse of variables in regression and variance of actual and predicated values of dependent variable.

The equation may contain up to 33 independent variables, and each set of data can be assigned a different weight if desired.

Variables enter automatically on basis of goodness of fit or in any desired preselected order. From one set of data, either one or a number of different regression can be automatically calculated correlating any of the variables against any group of other variables.

b. Restrictions, Range: Data are entered in 10 digit fixed points.

c. Method: Normal least sequence techniques.

d. Storage Requirements: Entire drum is used - non-relocatable.

e. Remarks: Output is complete in fixed point decimal form, one iteration at a time. It is superior to that available from other regression programs available from 650 library.

f. IBM 650 System: Minimum 650 with one 533.

IBM 650 Library Program Abstracts

File no. 6.0.057

ANALYSIS OF CONVARIANCE
DISPROPORTIONATE SUBCLASS NUMBERS

Glenn R. Ingram
Assistant Computing Analyst
Washington State University
Pullman, Washington

a. Purpose: This program computes the statistics for an analysis of convariance, allowing for disproportionate subclass numbers, and assuming that interactions are zero. The analysis is completed, and an F-value given for each factor tested.

b. Restrictions, Range: No restrictions except those required by the floating point device.

Accuracy: Not specified.

(Continued on next column)

Floating/Fixed: Floating point arithmetic is used.

c. Method: The method of "fitting constants" is used.

d. Storage Requirements: The entire 2000-word drum is used.

Speed: Speed is a function of the number of factors and number of levels within factors.

Relocatability: Not in relocatable form.

e. Remarks: 1) This routine used IBM 650 Library Program No. 05.2.012, Matrix Inversion Routine.
2) Special remarks are contained in the program write-up.

f. IBM 650 System: Three indexing accumulators and the floating decimal feature are used in the program.

IBM 650 Library Program Abstracts

File no. 6.0.058

ANALYSIS OF VARIANCE, DISPROPORTIONATE SUBCLASS NUMBERS

Glenn R. Ingram
Assistant Computing Analyst
Washington State University
Pullman, Washington

a. Purpose: This program computes the statistics for an analysis of variance, allowing for disproportionate subclass numbers, and assuming that interactions are zero. The analysis is completed, and an F-value given for each factor tested.

b. Restrictions, Range: No restrictions except those required by the floating point device.

Accuracy: Not specified.

Floating/Fixed: Floating point arithmetic is used.

c. Method: The method of "fitting constants" is used.

d. Storage Requirements: The entire 2000-word drum is used.

Speed: Speed is a function of the number of factors and number of levels within factors.

Relocatability: Not in relocatable form.

e. Remarks: 1) This routine used IBM 650 Library Program No. 05.2.012, Matrix Inversion Routine.
2) Special remarks are contained in the program write-up.

f. IBM 650 System: Three indexing accumulators and the floating decimal feature are used in the program.

IBM 650 Library Program Abstracts

File no. 6.0.059

ANALYSIS OF VAPIANCE OR COVARIANCE FOR
NON-ORTHOGONAL DATA AND FOR ANY STATISTICAL DESIGN

John R. Howell
Agricultural Experiment Station
University of Florida
Gainesville, Florida

a. Purpose: In writing a general analysis of variance program, one is confronted with the problems of (1) devising a general systematic scheme for retrieving from the computer storage the elements that occur in each of the many sums necessary for the analysis desired, (2) making the program general enough to be useful for analyzing the data from as many types of statistical designs as possible and (3) providing for the situation where there are missing data or unequal sub-class numbers. The purpose of this program is to analyze the variances in such a way that all three problems stated above are answered.

In addition, this program will solve a set of least squares equations of large order without using external storage.

b. Range: All computations are in double precision fixed point arithmetic. Sums of Squares can be obtained to approximately 12 significant digits.

c. Mathematical Method: The mathematical method used in adjusting for disproportionate frequencies (solving a set of least squares equations) is an iterative scheme which does not require that the matrix of coefficients be stored in the computer. For this reason up to 200 least squares equations in as many variables may be solved without using external storage.

d. Storage Required: The program is non-relocatable, uses practically all of 2,000 word drum storage and is reasonably fast in execution.

(Continued on next page)

e. Remarks: Does not apply

f. IBM 650 System: The basic IBM 650 computer is required.

IBM 650 Library Program Abstracts

File no. 6.0.060

DISTRIBUTION PROGRAM GENERATOR

James E. Farmer
Computing Center
Washington State University
Pullman, Washington

a. Purpose: The purpose of this program is to provide a distribution program without programming effort. The generator provides a symbolic program in SOAP II input format, after being assembled the object program will provide the counts and percentages for simple distributions. Input to the generator consists of the number of items (questions) to be distributed and the highest numerical response to each item.

b. Restrictions, Range: Maximum number of items (questions) is 80. Maximum size of any item is 2 digits (positive response only).

Floating/Fixed: Not applicable.

c. Method: Not applicable.

d. Storage Requirements: Entire 2,000 word drum.

Speed: Approximately 2 to 6 minutes depending upon number of items.

e. Remarks: None.

f. IBM 650 System: One 533, 2,000 word drum and indexing registers.

IBM 650 Library Program Abstracts

File no. 6.0.061

CONTOUR CODE FOR THE IBM 650

L. N. Shapiro & W. W. Marks
IBM Corporation
3424 Wilshire Blvd.
Los Angeles 5, California

a. Purpose: The Contour Code for the IBM 650 accepts data in three coordinates (x, y, z) and yields contour (or representative) lines for given z values.

b. Range, Accuracy, Floating/Fixed: The range for the results are as follows:

Interpolation - Full range (no limit)
Extrapolation - Limit is a function of the data

The difference between the largest and the smallest x, y, or z input value must not exceed 104.
The accuracy for linear interpolation is dependent on the significance of the data. A trial run involving an exponential, triginometric function showed an average interpolation error of 2. 4% Fixed point arithmetic is used exclusively.

c. Mathematical Methods: Linear algebra forms the basis for the arithmetic.

d. Storage Requirements, Speed: Availability tables are included for the Contour Code which requires three passes through the 2000 work 650. The time for a maximum problem (49 points) is 12 minutes for loading, calculating, and punching the first contour and 15 seconds for each additional contour.

e. Remarks: None.

f. Equipment Specifications: IBM 650 with Index Registers - Standard 80-80 board for 533.

IBM 650 Library Program Abstracts

File no. 6.0.062

EXPANDED SIMPLE CORRELATION COEFFICIENT ROUTINE FOR THE BASIC AND AUGMENTED 650

F. P. Fisher
International Business Machines Corporation
3424 Wilshire Blv'd.
Los Angeles, California

a. Purpose: To provide the ability to obtain simple correlation coefficients of a dependent variable against several combinations of independent variables, to include; linear terms, quadratic terms and interaction terms. This information will serve as an aid in Regression Analysis by giving the analyst more information on which to determine the form of the regression equation.

(Continued on next column)

b. Range: All computations are performed in single precision floating point. There is no restriction on the amount of data that may be processed. The program is available in two versions:

(1) Up to 6 independent variables and one dependent variable.
(2) Up to 13 independent variables and one dependent variable.

The restriction on dependent variables is not rigid. Any of the independent variables could be dependent variables provided the output is interpreted accordingly.

c. Mathematical Method: Notation and methods are largely derived from "Statistics in Research", by Bernard Ostle.

d. Storage Required: Because FORTRANSIT was used as coding media, precise times or storage requirements were not determined. However, the following information from a test problem will serve as a guide:

Problem:	1 dependent variable
	3 independent variables
	30 observations
Basic 650:	3-4 minutes including reading and punching
Augmented 650:	1-2 minutes including reading and punching

e. Remarks: None

f. IBM 650 System: The code is available in two formats: (1) Basic 650 (2) Basic 650 with index registers and floating point arithmetic.

533 Panel Required - the IT - SOAP board for machines without the special character device or the 3-phase board for machines with the special character device.

IBM 650 Library Program Abstracts

File no. 6.0.063

ANALYSIS OF VARIANCE FOR PARTIALLY OR SINGLY REPLICATED K BY 2^J FACTORIAL EXPERIMENT WITH OPTIONAL SINGLE CONFOUNDING (K= 2 8;J= 1 5)

Robert W. Naylor
Spencer Chemical Company
Research Center
9009 West 67th Street
Merriam, Kansas

a. Purpose: The program calculates the analysis of variance and F-test ratios of a K by 2^J factorial experiment wherein K may be any number of levels from 2 through 8 for the first factor and J may be any number of additional factors from 1 through 5. Fractional or single replicates of such designs can be handled with or without single confounding in up to 8 blocks.

b. Restrictions, Range: The program runs in two parts; and listing the Segment 2 output gives all two-way tables in conventional arrangement plus corrected sums of squares, mean squares, and F-ratios along with degrees of freedom where they may be greater than one. Three-factor and higher interactions are combined into the residual for the F-test, but an external error estimate may be used instead.

Any number of measured value sets (temperature, pressure, yield, etc.) may be processed continuously for the same statistical experiment.

c. Method: Does not apply.

d. Storage Requirements: Dependent upon the statistical experiment being analyzed. Segment 1 requires about 2 minutes plus 40-50 seconds per seven experimental values fed. Segment 2 runs 3-6 minutes per set of measured values.

e. Remarks: Fortransit I

Machine language decks - 5/card.

f. IBM 650 System: Basic IBM 650.

IBM 650 Library Program Abstracts

File no. 6.0.064

CARP - A CORRELATION AND REGRESSION PROGRAM

R. E. Bacon
International Harvester Company
Wisconsin Steel Works
Chicago 17, Illinois

a. Purpose: The program computes means, standard deviations, simple correlation coefficients, partial correlation coefficients, and multiple regression coefficients. Provision is made for re-entering output to add or subtract observations, interchange and remove variables, and combine results of problems of equal dimensions.

b. Range: Up to 39 variables are permitted, of which any number may be designated as dependent.

Accuracy: Not given

Floating/Fixed: Data may be entered in SIR floating-point-8 variables per card, or in standard 7-per-card FOR TRANSIT format. Internal operation and output are in SIR floating-point.

(Continued on next page)

c. Mathematical Method: Least squares.

d. Storage Required: The entire drum is used.

Speed: Reading time for a 9 variable observation is 0.144 minutes; for a 39 variable observation 1.722 minutes are required. Calculation and output time are from 1 to 100 minutes, depending on size of problem.

Relocatability: Not relocatable.

e. Remarks: Transformations are accomplished on the input variables by either a FOR TRANSIT program or the RAP, Part I transformation program (File No. 6.0.030).

f. 650 System: One 533 required. Alphabetic device if available.

650 LIBRARY PROGRAM ABSTRACT — FILE NUMBER 7.0.002

ROOTS OF A FUNCTION OF A REAL VARIABLE

F. Edelman
RCA, David Sarnoff Research Center, Princeton

July 7, 1956

a) Locates the roots of an arbitrary function lying in a given interval and computes them to a specified precision.

b) The floating-point interpretive routine by Dr. V. M. Wolontis of Bell Laboratories in Technical Newsletter No. 11 is used.

c) Method is to detect a sign change in f(x) in an interval and then to successively halve this internal until the desired accuracy is obtained.

d) Storage required is 1200 locations, 0800 to 1999, which includes the interpretive routine.

e) The programmer specifies the function, interval, precision, and the initial increment of the independent variable. Multiple roots of an even order may not be detected. Program decks are available upon request from the author.

f) Minimum 650.

IBM 650 Library Program Abstracts

File no. 7.0.003
Mathematical Routines

SOLUTION OF SIMULTANEOUS EQUATIONS

S. Rabushka
The Emerson Electric Mfg. Co.
St. Louis 21, Missouri

a. Purpose: This program solves n linear or nonlinear equations in n unknowns for values of n equal to or less than 15.

b. Range: As noted above, values of $n \leq 15$.

Accuracy: Usually may be selected by the user.

Floating/Fixed: Floating decimal.

c. Mathematical Method: Newton-Raphson.

d. Storage Required: Locations 500-1494 are available for the programming of the equations that are to be solved. See the program write-up for more information.

Speed: Varies greatly with different problems.

Relocatability: Not given.

e. Remarks: The program fails in certain cases. However, these cases give additional information about the problem, as failure indicates one of the following:

1) Multiple solutions

2) Two or more solutions close together

3) No solutions in the neighborhood of the initial guess

These cases are indicated by an overflow stop with 34 1967 1533 in the program register or by the program running a long time without answers. However, it may be that in the latter case the accuracy demanded is simply too much.

f. IBM 650 System: One 533, indexing registers, and automatic floating decimal arithmetic feature.

IBM 650 Library Program Abstracts

File no. 7.0.004
Mathematical Routines

ROOT FINDING SUBROUTINE

I. Tolstoy
J. May
Hudson Laboratories
Columbia University
Dobbs Ferry, New York

a. Purpose: This subroutine finds a root of the equation f (x) = 0, where f is a given function of an unknown, x.

b. Range: See the program write-up.

Accuracy: Determined by the input.

Floating/Fixed: Floating decimal arithmetic.

c. Mathematical Method: Method of false position is used.

d. Storage Required: 133 drum storage locations, plus the number used to compute f (x).

Speed: Depends upon the accuracy desired.

Relocatability: The program is written in SOAP II form.

e. Remarks: Initialization must be done by the programmer in the main program.

f. IBM 650 System: One 533, and automatic floating decimal arithmetic feature are required.

Special Devices: Alphabetic device required for SOAP II assembly.

IBM 650 Library Program Abstracts

File no. 7.0.005
Mathematical Routines

RUNGE-KUTTA ROUTINE FOR SOLVING DIFFERENTIAL EQUATIONS ON THE IBM 650

A. S. Rosenthal
Naval Air Development Center
Johnsville, Pennsylvania

a. Purpose: The programmer writes a SOAP II program for each of the derivatives beginning at one of a set of specified entry locations and exiting to a specified fixed location. Information such as number of equations, expected duration of problem, allowable terminal error, and initial conditions is supplied to the system by the programmer. The system then computes, choosing its own time intervals and punching variables and derivatives at each time interval.

b. Range: The routine solves up to 35 simultaneous first order ordinary differential equations.

Accuracy: The routine provides automatic time interval control designed to keep small the estimated accumulated errors in certain of the variables designated by the programmer.

Floating/Fixed: Floating decimal arithmetic is used.

c. Mathematical Method: Integration is by standard Runge-Kutta formulas. Special formulas are derived for error estimation.

d. Storage Required: The main program uses 178 drum storage locations in addition to which seven locations are needed for the processing of each system variable. Two spaces are required to punch an auxiliary function (a function which may be obtained from the system variables by algebraic manipulation alone).
The input-output routine (Read-Punch "B") uses drum locations 1831-1999.

Speed: Processing time required is approximately 1 second per interval for each variable.

Relocatability: Not given.

e. Remarks: In addition to the main program the system contains an input-output routine Read-Punch "B" which allows reading or punching any chosen number of words sequentially with any chosen number of drum locations as a fixed increment. This routine, which is extremely flexible, may be used independently, as well as with the system.

f. IBM 650 System: One 533 and indexing registers required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 7.0.006

ZEROS OF COMPLEX POLYNOMIALS

Lou Andrews
Technical Staff
Greenwich Engineering Division
AMF, Greenwich, Connecticut

a. Purpose: This SOAP II program will find the complex roots of the general algebraic equation of the nth degree.

$$f(X) = a_o X^n + a_1 X^{n-1} + \ldots + a_n = 0$$

where the coefficients are complex numbers, $a_o \neq 0$ and $n \leq 20$.

b. Range: N must be less than or equal to twenty.

c. Mathematical Method: Successive approximations toward a particular root are obtained by finding the nearest root of the quadratic which passes through the last three iterates.

d. Storage Required: 649 locations.

Speed: Depends on the location of the roots.

Relocatability: Non-relocatable.

e. Remarks: None.

f. 650 System: One 533, indexing registers, and automatic floating decimal arithmetic.

IBM 650 Library Program Abstracts

File no. 7.0.007

MATH FIN

Mr. Clay C. Ross, Jr.
Department of Mathematics
University of Kentucky
Lexington, Kentucky

a. Purpose: The program is designed to compute double-precision tables of the following:
   1. Amount of 1 at Compound Interest.
   2. Present Value of 1 at Compound Interest.
   3. Amount of an Annuity of 1
   4. Present Value of an Annuity of 1
   5. The Annuity That 1 will Purchase

b. Range: $9X10^{-12} <$ table value $< 9X10^{9}$

Accuracy: Programs 1, 2, 3 above: 16 significant figures. Programs 4, 5, above: 15 significant figures.

c. Mathematical Method: Formula equation, using DOPSIR IBM abstract #2.0.010.

d. Storage Required: Uses approximately 1000 drum locations.

Speed: 100 cards/min. maximum output. 77 cards/min. minimum output.

e. Remarks: Self contained.

f. IBM 650 System: Minimum 650.

IBM 650 Library Program Abstracts

File no. 7.0.008

$E_n(x)$ SUBROUTINE

Tsuneo Tsutsui
Hiroshi Takahashi
Japan Atomic Energy Institute
Tokai, Ibaragi Pref., Japan

a. Purpose: To compute any of the following functions: $E_1(x)$, $E_2(x)$, $E_3(x)$, $E_4(x)$, and $E_5(x)$.

b. Range: The range of the argument must be: $0.00100 \leq x \leq 5.00$.

Accuracy: Whenever any term of the infinite sum becomes less than 10^{-8}, the subsequent terms are neglected.

Floating/Fixed: The computation is done in fixed point arithmetic.

c. Mathematical Method: Refer to "The functions $E_n(x) = \int_1^\infty e^{-xu} u^{-n} du$" G. Placzek. in "Tables of Functions and of Zeros of Functions" National Bureau of Standards Applied Mathematics Series. 37.

d. Storage Required: 250 locations (0000 through 0249) are used.

(Continued on next column)

Speed: The average execution time is about $1.5^{sec.}$.

Relocatability: Not relocatable.

e. Remarks: 650 Library Program # 3.1.005 for exp X and # 3.1.014 for ln x are incorporated as subroutines.

f. IBM 650 System: Minimum 650.

IBM 650 Library Program Abstracts

File no. 7.0.009

$K_{in}(x)$ SUBROUTINE

Tsuneo Tsutsui
Hiroshi Takahashi
Japan Atomic Energy Institute
Tokai, Ibaragi Pref., Japan

a. Purpose: To compute any of the following functions: ln x, $K_O(x)$, $K_1(x)$, $K_{i1}(x)$, $K_{i2}(x)$, and $K_{i3}(x)$.

b. Range: The range of the argument must be: $0.01001 \leq x \leq 5.00$.

Accuracy: Whenever any term of the infinite sum becomes less than 10^{-8}, the subsequent terms are neglected.

Floating/Fixed: The computation is done in fixed point arithmetic.

c. Mathematical method: Refer to "A Short Table of the Functions $K_{in}(x)$, from n=1 to n=16" by W. G. Bickley, D. Sc., and John Hayler, A.C.G.I., B.Sc. (Eng), D.I.C.--Philosophical Magazine, Vol. 20, 1934, pp. 343-347.

d. Storage Required: 500 locations (0000 through 0499) are used.

Speed: The average execution time is as follows:

for l_n x	1 sec.
for $K_O(x)$	2 sec.
for $K_1(x)$	2 sec.
for $K_{i1}(x)$	6 sec.
for $K_{i2}(x)$	6 sec.
for $K_{i3}(x)$	6 sec.

Relocatability: Not relocatable.

e. Remarks: 650 Library Program #3.2.002 for ln x is incorporated as a subroutine.

f. IBM 650 System: Minimum 650.

IBM 650 Library Program Abstracts

File no. 7.0.010

NUMERICAL INTEGRATION OF THE DOUBLE INTEGRAL

A. Anastasio
C. Cassidy
Columbia University
Hudson Laboratories
Dobbs Ferry, N. Y.

a. Purpose: To approximate the integral having the general form $\int_A\int f(x, y)\, dx\, dy$.

b. Restrictions, Range: Region of integration over the annulus with outer radius one and inner radius R.

c. Method: Numerical integration over the Planar Annulus, a method by Dr. W. H. Peirce.

d. Storage Requirements: Does not apply.

e. Remarks: None.

f. IBM 650 System: Uses floating point and index register.

IBM 650 Library Program Abstracts

File no. 7.0.011

FLOATING POINT SQUARE ROOT SUBROUTINE

Charles Goldberg
IBM 650 Applied Programming
Time & Life Building
New York, New York

a. Purpose: This routine computes the square root of numbers in floating decimal form using an initial approximation and five iterations with Newton's method. This program was designed to use a minimum of drum space.

(Continued on next page)

b. Range: This routine accepts floating point numbers of the form. .DDDDDDDDMM. Answers are in floating point form and all eight significant digits are exact.

c. Mathematical Method: After taking an initial approximation, Newton's method is used to find the square root. With the initial approximation used, this method converges to eight significant figures in five iterations.

d. Storage Required: 21 Permanent drum locations including a programmed stop for negative arguments. 3 Temporary storage locations.

Speed: 140 ms.

The deck is in SOAP II form.

e. Remarks: The routine uses index register B which is not reset.

f. IBM 650 System: This routine requires a 650 with floating decimal arithmetic device and one index register. An alphabetic device is needed for SOAP II assembly.

IBM 650 Library Program Abstracts

File no. 7.0.012

CLEBSCH-GORDAN COEFFICIENT SUBROUTINE

B. E. Chi
Rensselaer Polytechnic Institute
Troy, New York

a. Purpose: The subroutine computes the Clebsch-Gordon or vector-coupling coefficient $C(j_1j_2j_3\,;\,m_1m_2m_3)$ or $(j_1m_1j_2m_2/j_1j_2j_3m_3)$.

b. Range: $j_1 + j_2 + j_3 \leqq 15$. Accuracy, 2 parts in 8th decimal place. Input-output is fixed point.

c. Mathematical Method: Not applicable.

d. Storage Required: 305 consecutive locations are required. The sub-routine is written in SOAP-II relocatable format.

e. Remarks: None.

f. IBM 650 System: Minimum 650 with alphabetic unit (minimum SOAP reqnirements).

IBM 650 Library Program Abstracts

File no. 7.0.013

PYRAMID OF RANOMANU

John Burgeson, Robert Bushnell
IBM
340 S. Broadway
Akron 8, Ohio

a. Purpose: This program generates a set of random non-matched numbers which span a predetermined range or field size.

b. Range: Up to 99,999 numbers may be generated for each computer pass. Any field size from a minimum of five "cells" may be used. Normal use of the program calls for a field size of CC columns $01 \leq CC \leq 99$ by 10 rows, the "cells" being numbered 000 to 10CC-1.

c. Mathematical Method: Does not apply.

d. Storage Required: About 600 words of 650 memory optimally scattered in lower memory.

Speed: Depends on field size used and the number of ra-no-ma-numbers desired. Usually runs close to 1/2 punch speed.

Relocatability: The program deck is furnished on SOAPed single instruction load cards and is therefore relocatable by further SOAPing.

e. Remarks: 1. The program is furnished in SOAP form so that modifications may be made easily.

2. This program was designed to give a "dictionary" of numbers for use in an information retrieval system centering about a 108. It is possible to generate a set of ra-no-ma-numbers, use them, then run the program again, obtaining a new and completely different set of ra-no-ma-numbers, none of which duplicate any number in the first run. For practical applications, this process can repeat itself indefinitely.

f. IBM 650 System: Minimum 650.

IBM 650 Library Program Abstracts

File no. 7.0.014

COMPLEX I
AN INTERPRETIVE PACKAGE FOR COMPLEX ARITHMETIC

(Column on next column)

Lloyd W. Dreher
Computation Center
University of Texas
Austin 12, Texas

a. Purpose: This package of programs is designed to facilitate arithmetic operations with complex numbers of the form $a+ib$.

b. Restrictions, Range: Does not apply.

c. Method: Mathematical Method: All arithmetic operations are performed in floating-point arithmetic. In some operations a method of exponent adjustment is used to prevent overflow and underflow.

d. Storage Requirements: Drum locations 0000, 1280 through 1999.

e. Remarks: The program incorporates a floating-decimal arithmetic routine and a square root subroutine to perform necessary arithmetic operations.

f. IBM 650 System: Minimum IBM 650.

IBM 650 Library Program Abstracts

File no. 7.0.015

COMPLEX II
AN INTERPRETIVE PACKAGE FOR COMPLEX ARITHMETIC

Loyd W. Dreher
Computation Center
University of Texas
Austin 12, Texas

a. Purpose: This package of programs is designed to facilitate arithmetic operations with complex numbers of the form a + i b.

b. Remarks: Does not apply.

c. Mathematical Method: All arithmetic operations are performed in floating-point arithmetic. In some operations a method of exponent adjustment is used to prevent overflow and underflow.

d. Storage Requirements: Drum locations 1600 to 1900, core locations 9050 through 9059, Index Registers A, B, and C.

e. Remarks: The program incorporates a floating decimal square root subroutine to extract square roots.

f. 650 System: IBM 650 with core storage, index registers and floating-point device.

IBM 650 Library Program Abstracts

File no. 7.0.016

SYMBOLIC INTERPRETIVE SYSTEM FOR THE IBM 650 - 653
(REAL AND COMPLEX ARITHMETIC)
(SIS)

Toru Takeshita
Applied Science
IBM Japan
Tokyo, Japan

a. Purpose: This system is an assembler - interpreter processor, which accepts a program written in symbolic synthetic language and performs the actual computation in a single machine pass. The symbolic commands are translated into their numeric equivalences while being loaded. To facilitate debugging, the symbolic commands (originally written in the coding sheets) are reproduced in the tracing outputs. Complex arithmetic and machine language operations can be included by using mode change commands.

b. Range: Depends on the operation being performed.

Accuracy: Depends on the operation being performed.

Floating/Fixed: Computation is normally performed in floating point arithmetic, but a command for fixed point addition-subtraction is included.

c. Mathematical Method: The built-in subroutines for sine, cosine, arctan, exp. and log. functions adopted from the "650 Rocket Package" and the modified version of Sweeney's "SQUARE ROOT X" are provided.

d. Storage Requirements: The SIS system program occupies the drum locations above 1000 and the remainder (1000 locations) are available for an SIS programmer.

Speed: The Loading - Assembly speed is 150 - 200 c.p.m. The computing speeds are several times faster than those for the Bell L_2.

Relocatability: The system program is not relocatable, but library routines are relocated when loaded.

(Continued on next page)

e. Remarks: This system was specially designed for small- and intermediate-size problems of non-repetitive nature in science and engineering, and, for such problems, can reduce the overall cost of programming and machine operation to a greater extent than the FOR TRANSIT system.

f. IBM 650 System: One 533, indexing registers and automatic floating decimal arithmetic are required.

Special Devices: Alphabetic device and 10 additional pilot selectors are required; the latter are not absolutely essential.

IBM 650 Library Program Abstracts

File no. 7.0.017

PRESENT VALUE AND RATE OF RETURN
(PV1A)
(INFINITE CHAIN OF MACHINES)

Martin B. Solomon, Jr.
University of Kentucky
Lexington, Kentucky

a. Purpose: Will compute the present value of an investment at the end of each year of its useful life and the discounted rate of return over the whole life. It assumes an infinite chain of replacements.

b. Range: Life can range from 1 to 50 years.

Accuracy: Present value to eight significant digits. Rate of return to three decimals.

Floating/Fixed: Floating Point generally, although a few input and output figures are fixed point.

c. Mathematical Method: $PV = \left[\frac{R_1 - E_1}{(1+r)} + \frac{R_2 - E_2}{(1+r)^2} + \cdots + \frac{R_n - E_n + S_n}{(1+r)^n} - C\right]\frac{(1+r)^n}{(1+r)^n - 1}$

d. Storage Required: Optimized by SOAP II so program is scattered throughout drum.

Speed: Computes present value in a few seconds. Rate of return is computed by successive approximations. Requires about 6 seconds for each percent computed.

Relocatability: Not relocatable.

e. IBM 650 System: IBM 650 with alphabetic device, one 533, automatic floating decimal, IAS, indexing registers.

f. Remarks: None

IBM 650 Library Program Abstracts

File no. 7.0.018

PRESENT VALUE AND RATE OF RETURN
(PV2A)
(FOR A FINITE CHAIN OF ONE INVESTMENT - SINGLE MACHINE HORIZON)

Martin B. Solomon, Jr.
University of Kentucky
Lexington, Kentucky

a. Purpose: Will compute the present value of an investment at the end of each year of its useful life and the discounted rate of return over the whole life.

b. Range: Life can range from 1 to 50 years.

Accuracy: Present value to eight significant digits. Rate of return to three decimals.

Floating/Fixed: Floating Point generally, although a few input and output figures are fixed point.

c. Mathematical Method: $PV = \frac{R_1 - E_1}{(1+r)} + \frac{R_2 - E_2}{(1+r)^2} + \cdots + \frac{R_n - E_n + S_n}{(1+r)^n} - C$

d. Storage Required: Optimized by SOAP II so program is scattered throughout drum.

Speed: Computes Present Value in a few seconds. Rate of return is computed by successive approximations. Requires about 6 seconds for each percent computed.

Relocatability: Not relocatable.

(Continued on next column)

e. IBM 650 System: IBM 650 with alphabetic device, one 533, automatic floating decimal, IAS, indexing registers.

f. Remarks: None

IBM 650 Library Program Abstracts

File no. 7.0.019

IBM 650 PROGRAM FOR THE ANALYSIS OF TWO-LEVEL FACTORIAL DESIGNS

Margaret Younge Kreig
Leslie Zurick
The Brown University Computing Laboratory
Box 1885
Providence 12, R. I.

a. Purpose: IBM 650 Program for the analysis of Two-Level Factorial Designs.

b. Range: Fixed point, 5 digit data.

c. Mathematical Method: Method, based on Yates' algorithm, developed in collaboration with Mr. Cuthbert Daniel.

d. Storage Required: Does not apply.

Speed: Timing: About three minutes required by basic program for a 16 run experiments with eight cases taken out. The graph program requires about four minutes for the same experiment.

e. Remarks: None.

f. IBM 650 System: Basic IBM 650

650 LIBRARY PROGRAM ABSTRACT — FILE NUMBER 8.1.001

OPTICAL RAY TRACING

Dale J. Raar
IBM, Detroit

November 29, 1955

a) Determines the path of a beam of light as it passes through an optical system consisting of a number of different media with spherical boundaries.

b) Arithmetic is fixed-point in the form xx.xxxx xxxx. Any size system may be traced.

c) The standard formulas for refraction are used.

d) Approximately 300 locations are used for the program. Time required is less than one second per surface.

e) All rays are considered to be skew.

f) Minimum 650.

IBM 650 Library Program Abstracts

File no. 8.1.002

TRANSIENT HEAT TRANSFER PROGRAM

J. T. Anderson
Mech. Eng'g. Dept.
West Virginia University
West Virginia

K. W. Cheng
Mech. Eng'g. Dept.
Tulane University

W. Nettleton
Computer Center
Tulane University

a. Purpose: Transient Heat Transfer Program to find the temperatures in complex, composite geometrical bodies, as function to time and location. The geometry is broken into up to 100 nodes, in two or three demensions, and input data on each node allows the program to assemble in eqns. in unknowns for each time step of the transient, using the backward time step, which insures convergence of the system for Gauss Seidell iteration regardless of the length of time step. Up to four materials, each having properties as functions of temperature and five sets of boundary conditions, each as function of time, may be used. Program handles conduction,

(Continued on next page)

convection, internal generation and thermal storage. The program calculates the surface areas and volumes of regular nodes automatically. Techniques for extending the use of the program are easy to apply because of the general form of input, e.g. contact coefficients may be taken into account using the concept of an irregular node. Steady state temperature distributions are easily found using the program.

b. Range: Program will handle almost any problem which can be described in 100 nodes or less, while accuracy depends upon the amount of truncation in setting up the nodes and time steps, it can easily be held to under 2% error.

c. Mathematical Method: Gauss-Seidell iteration was chosen because of the inherent speed and small storage requirements as opposed to the time and storage required for matrix inversion.

d. Storage Requirements: Storage of about 2000 words on the drum plus up 4000 words on magnetic tape are needed. Machine time for 7 node problem with 30 time steps is about 20 minutes. Time increases linearly with number of nodes and number of time steps, assuming reasonable rates of convergence, i.e. 5 sweeps per time step.

e. Remarks: Modifications were made to the object program to incorporate a tape unit.

f. IBM 650 System: For Transit II was used for computing, on an augmented IBM-650 with 533 card reader and punch and one 727 magnetic tape unit.

File no. 8.1.003

IBM 650 Library Program Abstracts

A RAY TRACING PROGRAM

J. May
Columbia University
Hudson Laboratories
Dobbs Ferry, N. Y.

a. Purpose: Traces the path of a ray in a layered inhomogenious medium with regular boundries.

b. Range: Maximum of 48 different Velocity points.

Floating/Fixed Floating Point Arithmetic

c. Mathematical Method: Snell's law is used at the boundries between layers. See L. Gardner, Hudson Laboratories Technical Report No. 47 dated June 4, 1957.

d. Storage Required: Approximately 150 unused drum locations.

Speed: Depends upon number of layers. Up to 100 points per minute.

Relocatability: Not relocatable.

e. Remarks: None.

f. Special Devices: Automatic Floating Point, Three Indexing Registers.

File no. 8.1.004

IBM 650 Library Program Abstracts

SOLUTION OF HEAT DIFFUSION EQUATION

R. R. Haefner
Theoretical Physics Division
E. I. du Pont de Nemours & Co.
Savannah River Laboratory
Aiken, S. C.

a. Purpose: Equations and a routine are presented to obtain the temperature distribution in a section of a tubular heat source. The solution of the heat diffusion equation in (r,θ) geometry is approximated by the solution of a set of appropriate difference equations. Three regions with possible differences in heat conductivity or heat source are allowed in the radial direction, e.g., inner cladding, fuel, and outer cladding. Heat is transferred to a bulk coolant at each radial surface. The program can be used to study the effects of nonbonding between regions and of inhomogeneities in the surface heat transfer and in the heat source.

b. Range: Floating.

c. Mathematical Method: Not given.

d. Storage Requirements: 2000 locations. Speed depends on number of grid points used.

e. Remarks: Not given.

f. IBM 650 System: Model 2 with Floating decimal & index registers.

650 LIBRARY PROGRAM ABSTRACT	FILE NUMBER	8.2.001

MOONSHINE

R. Stuart,
University of California Radiation Laboratory, Livermore, California

a) Solves the one-dimensional neutron diffusion equation. The multi-group diffusion equasion is solved for the case of a sphere, a cylinder, and a slab.

b) A maximum of three different material regions and eighteen groups can be handled. Fixed decimal arithmetic is used.

c) The method is an iterative process.

d) The entire drum is required. Total running time, using all eighteen energy groups, is about thirteen minutes.

e) Two or three iterations are usually needed for a solution.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT	FILE NUMBER	8.2.002

PARACANTOR

S. P. Stone
University of California Radiation Laboratory, Livermore, California

a) Paracantor I is a two energy group, two region, time independent reactor code, which obtains a closed solution for a critical reactor assembly for cylindrical reactors of finite length and with a radical reflector of finite thickness. Paracantor II computes the fluxes, including the adjoint fluxes, from the output of Paracantor I.

b) Floating-point arithmetic is used.

c) The method, in general, follows the two energy group theory found in The Elements of Nuclear Reactor Theory by Glasstone and Edlund.

d) The entire drum is required. The average running time for Paracantor I is 5 to 8 minutes; for Paracantor II 5 minutes.

e) The program contains all of the load, punch, and interpretive routines, tables, and miscellaneous constants necessary for running.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT	FILE NUMBER	8.2.003

ONE-SPACE-DIMENSIONAL MULTIGROUP

G. J. Habetler and V. A. Walbran — December 1, 1956
GE, Knolls Atomic Power Lab, Schenectady

a) Solves the one-space-dimension multigroup formulas.

b) Input is in fixed decimal form. Approximately 50 groups, each of a 50 point mesh, may be handled. The exact range of the many variables is given in the write-up.

c) The method is described in a 43 page paper which is supplied with the write-up and listing.

d) The entire drum is used. Timing is from 20 seconds to one minute per group for a 40-point mesh, depending on the choice of input data.

e) The program is divided into two parts, the Multigroup Calculation and the Power Calculation. Allowance has been made for variations in geometry, boundary conditions, and handling of scattering cross sections.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 8.2.004

LOST, A CROSS-SECTION AVERAGING PROGRAM

C. J. Hibbert
G. E., Knolls Atomic Power Laboratory, Schenectady

a) Computes cross-section integrals over specified lethargy groups.

b) Input is in floating-point form. The maximum number of lethargy points is 200.

c) Integrations are performed using the trapezoidal rule.

d) Storage required for the program is 424 locations, 1571 to 1994. The rest of the drum is used for data storage. Time required for a typical compostion with six materials and self-shielding for 170 point and 15 point files is 12.5 minutes and 1.24 minutes respectively.

e) The program distinquishes between the absorption of moderator or non-fissionable materials and those of fissionable or associated fission product materials.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 8.2.005

DONATE

Harvey Amster and
Roland Suarez
Westinghouse Bettis Plant, Pittsburgh Pa.

May 1956

a) Distribution of neutrons at thermal energies - a solution for the energy distribution of neutrons in equilibrium with an infinite homogeneous medium of pure monatomic hydrogen undergoing thermal motion. Allowing varying cross sections, elements other than hydrogen and a buckling turn for leakage from a finite volume.

b) Floating point.

c) Milne's Predictor-corrector formulas,
3 point Lagrangian interpolation,
5 and 8 point integration formulas.

d) 3 runs.

e) None.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 8.2.006

MUFT III

R. L. Hellens
R. W. Long, and
B. H. Mount
Westinghouse Electric Corp., Pittsburgh, Pa.

July 1956

a) Computes the energy distribution of neutrons having a given Faurier mode in an infinite medium.

b) Four approximations are provided with the inclusion of isotropic inelastic scattering, resonance capture, and fast fission. Fixed point arithmetic is used.

c) The output includes flux, current, and slowing density spectra and computes the fast constants for a variety of few group schemes.

d) Solution requires two runs through the computer. The entire drum is used.

e) Twenty is the maximum number of elements that can be used as input for any one problem.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 8.2.007

LIL ABNER: A FEW-GROUP ONE-DIMENSIONAL CODE

H. Bohl
G. Gelbard
R. Suarez
Westinghouse Electric Corp., Pittsburgh, Pa.

a) Lil Abner is a one-to-eight group code designed, primarily, to treat one-dimensional reactor and cell problems.

b) This code will handle a maximum of ten regions and one hundred mesh points. Floating point arithmetic is used.

c) The method is an iterative process.

d) None.

e) All physical parameters in the Few-Group equations as well as the mesh width must be constant within each region. In the fast groups these parameters may be obtained directly from MUFT III (8.2.006) calculations or from microscopic cross sections fitted to match MUFT III results. Sample problem is enclosed.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 8.2.008

K-CODE

W. V. Baxter
Savannah River Laboratory, du Pont, Augusta, Georgia

December, 1955

a) Obtains the transients of neutron flux in response to a change in the reactivity of a reactor.

b) Eleven delayed groups of neutrons and two power coefficients of different relaxation times are allowed. Floating decimal arithmetic is used.

c) Theoretical treatment is given in a paper by H. D. Brown, submitted for the journal "Nuclear Science and Engineering" under the title, "A General Treatment of Flux Transients."

d) Storage required is approximately 1800 locations. One time increment requires 30 seconds.

e) A very general change in reactivity as a function of time can be made by proper input parameters. The set of differential equations is solved by integraticn of the associated difference equations.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 8.2.009

BEEHIVE AND HORNET
REACTOR CODES FOR SPHERICAL GEOMETRY

S. P. Stone (Beehive)
S. P. Stone and R. Shaffer (Hornet)
University of California Radiation Laboratory
Livermore, California

a) "Beehive" is a five energy group, two region, time independent, spherical reactor code. It considers the problem of a reactor system in which the core material is assumed to be at a higher energy (temperature) than the reflector material. The companion code, "Hornet," computes the neutron fluxes for the critical assembly determined by the Beehive calculations.

b) The majority of arithmetic is performed in interpretive floating point.

c) The code obtains a closed solution for the critical reactor assembly by a procedure which is a logical extension of normal two group theory. The solution is obtained by an iterative process.

(Continued on next page)

d) Storage: 2,000 words. Speed: "Beehive" requires 2-1/2 minutes per iteration, and 5 or 6 iterations. "Hornet" requires 7 minutes.

e) Only a preliminary investigation has been made for cases where the G/2 2-5 spacing is "close," a situation in which the critical 10 x 10 determinant evaluation might be subject to error.

f) Minimum 650.

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650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 8.2.010

UNCLE I

THE DIFFUSION EQUATION IN CYLINDRICAL GEOMETRY

R. R. Haefner
E. I. du Pont de Nemours & Co., Inc.
Savannah River Laboratory,
Aiken, S. C.

a) UNCLE I - Solution of the Neutron Diffusion Equation in Cylindrical Geometry.
b) Uses network of 9 points in the r-direction and 16 in the z-direction. Fixed decimal.
c) Extrapolated Liebmann Method.
d) 20 seconds per iteration.
e) One group only.
f) Minimum 650.

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650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 8.2.011

UNCLE II
THE DIFFUSION EQUATION IN (x, y) SPACE

R. R. Haefner
E. I. du Pont de Nemours & Co., Inc.
Savannah River Laboratory,
Aiken, S. C.

a) UNCLE II - Solution of the Neutron Diffusion Equation in (x, y) Space.

b) Uses network of 9 points in the x-direction and 16 in the y-direction. Fixed decimal.

c) Extrapolated Liebmann Method.

d) 20 seconds per iteration.

e) One group only. $\frac{\partial \phi}{\partial x}=0$ at x = 0 is a restriction on the types of problems that can be solved.

As the program for UNCLE II is the same as that for UNCLE I with a few exceptions, the write-up for UNCLE II does not include a complete listing of the program instructions, but only the exceptions. A complete listing is included in the UNCLE I write-up.

f) Minimum 650.

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650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 8.2.012

UNCLE III
THE DIFFUSION EQUATION IN ONE DIMENSION

R. R. Haefner
E. I. du Pont de Nemours & Co., Inc.
Savannah River Laboratory,
Aiken, S. C.

a) UNCLE III - Solution of the Neutron Diffusion Equation in One Dimension.
b) Uses network of K + 1 points, K = 36. Fixed decimal.
c) Extrapolated Liebmann Method.
d) Time required: 0.16 K seconds/iteration.
e) One group only.
f) Minimum 650.

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650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 8.2.013

VALPROD

C. M. White
GE, Vallecitos Atomic Laboratory
Pleasanton, California

a) Once dimensional reactor flux calculation for slab, cylinder, and sphere.
b) Fixed point. Range is discussed in the report; it is too complex for this abstract.
c) This is PROD II in a form more convenient for use. PROD II is described in abstract 8.2.003. References are KAPL-1415, KAPL-1531, and GEAP-0952.
d) Full 2000 words of drum. Non-relocatable.
e) None.
f) Minimum 650.

ADDENDA/ERRATA 650 Library Program - File No. 8.2.013

"ValPROD," by C. M. White

The program write-up for ValPROD has been amended by the inclusion of two memoranda supplied by the original contributors. The first of these, dated June 18, 1957, deals with a revision of the program designated ValPROD II; the other, dated January 15, 1958, discusses in detail several coding errors contained in ValPROD I and ValPROD II. Program decks for the revised programs are designated ValPROD IB and ValPROD IIB.

AEC contractors and other 650 users concerned with nuclear reactor problems may obtain the amended program material in the usual manner.

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650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 8.2.014

P-3 FLUX DISTRIBUTION

J. W. Weil
P. Cabral
GE Atomic Power Equipment Dept.
San Jose, California

a) This code computes the one-velocity neutron flux distribution in concentric cylindrical geometry using a P_3 spherical harmonics approximation to the neutron transport equation. Anisotropic scattering is included and each region may have different properties and may or may not have a neutron source. The properties of any one region and a source in that region must remain constant throughout the region.

b) There is no limit to the number of concentric cylindrical regions which can be handled. The code operates in floating point interpretive mode.

c) The P-3 Flux Code is an analytic solution of the P_3 flux problem. Details of the code have been published through the American Nuclear Society. Further information may be obtained from KAPL 1173 (Secret).

d) The program occupies virtually the entire 2000 word drum and is thus not relocatable.

e) The following difficulties have been observed but do not limit the normal utilization of the code.

i) Regions of high cross section at large radii will cause a machine stop because the calculated Bessel functions become too large for the floating point representation.

ii) Regions of small cross sections which do not include the origin will cause difficulty. This is most easily recognized by irregularities in the resulting fluxes.

iii) The code will not handle regions with zero absorption. The insertion of a small absorption cross section will, however, not affect the flux distribution and will permit the code to operate.

The P-3 Flux Code will automatically compute the neutron flux distributions throughout the regions in the problem (the number of points computed is controllable) and will also provide average fluxes in each region.

f) Minimum 650.

IBM 650 Library Program File no. 8.2.014 ERRATA

"P - 3 Flux Distribution," by J. W. Weil and P. Cabral

Part I of the P - 3 program deck originally furnished to the library was discovered to contain erroneous multiple punches in column 70 in several cards. A number of copies of the deck were furnished to 650 installations before the errors were noted. Accordingly, it is recommended that any decks obtained from the library prior to August 1, 1958 be replaced. Decks mailed on or after that date have been corrected.

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650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 8.2.016

BALL
A REACTOR CODE FOR SPHERICAL GEOMETRY

S. P. Stone
T. B. Kerr
University of California
Radiation Laboratory
Livermore, California

a) Ball is a two-energy-group, two-region, time-independent reactor code. It obtains a closed solution for a critical reactor assembly of spherical geometry, and also computes the normal and adjoint fluxes.

b) Floating point. Accuracy is dependent on input data.

c) Iterative solution.

d) Approximately 1,700 storage locations are used. A typical problem requires eight to ten iterations and takes approximately 2 1/2 minutes.

e) None

f) Minimum 650.

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650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 8.2.017

N E D

D. B. MacMillan
GE Knolls Atomic Power Laboratory
Schenectady, New York

a) NED is a 650 program for computing the Wigner-Wilkins kernel (reference: AECD 2275).

b) The value of the kernel is computed in fixed point arithmetic at the points of an N by N mesh, where N may not exceed 34. Accuracy of 5 to 7 decimal places is obtained; see the write-up for a more specific statement.

c) The numbers are computed in parallel, or parameter study, style.

d) The program uses the whole drum and is not relocatable. For H moderator, sample calculations required $\frac{N^2}{7}$ minutes. For Be moderator, sample calculations required $\frac{N^2}{20}$ minutes.

e) None.

f) Minimum 650.

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IBM 650 Library Program Abstracts File no. 8.2.018 Physical Sciences

UNCLE IV

W. V. Baxter
E. I. du Pont de Nemours & Company, Inc.
Savannah River Laboratory
Aiken, South Carolina

a. Purpose: One Dimensional Solution of the Neutron Diffusion Equation in Cylindrical Geometry.

b. Range: Uses 64 lattice spaces in 1 to 6 radial regions. Can obtain criticality by varying B^2 in all or in any one of 6 regions, or by varying the radius of any region.

Accuracy: Not given.

Floating/Fixed: Fixed decimal.

c. Mathematical Method: Integration of a difference equation.

d. Storage Required: 750 locations.

Speed: 3 minutes per problem.

Relocatability: Not given.

e. Remarks: One group only.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts File no. 8.2.019 Physical Sciences

ARMOUR REACTOR KINETICS (ARK-I) CODE

T. Engelhart
W. E. Loewe
Armour Research Foundation of
Illinois Institute of Technology
Chicago 16, Illinois

a. Purpose: This routine is used to obtain the transients of neutron flux in response to a change in reactivity of a nuclear reactor. The routine is a modification of the Savannah River Laboratory K-code (IBM 650 Library Program 8.2.008), from which it differs in the following respects: (1) driven changes in reactivity remain arbitrary functions of time, but must occur as a result of a change in the average neutron absorption cross section; (2) temperature coefficients are restricted to those affecting $\Sigma_a k_\infty$; (3) the feedback equations are slightly more general; and (4) a substantial savings in running time is realized. This last difference results from the fact that integration is accomplished by a fourth order Runge-Kutta technique.

b. Range: Six delayed groups of neutrons and two reactivity feedback loops are allowed.

Accuracy: Not given.

Floating/Fixed: Computation is in the floating decimal mode as described by G. R. Trimble in Technical Newsletter 8, pp. 37 - 43.

c. Mathematical Method: Integration is accomplished by the fourth order Runge-Kutta.

d. Storage Required: Approximately 1930 storage locations are required.

Speed: A representative problem using the full program takes about 1 hour.

Relocatability: Not relocatable.

e. Remarks: Recipes are provided to reduce to several special cases of physical interest. Directions are given to allow addition of one more feedback loop.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 8.2.020
Physical Sciences

ART-I

F. Narin
E. J. Voltaggio
Armour Research Foundation of
Illinois Institute of Technology
Chicago 16, Illinois

a. Purpose: ART-I evaluates the analytic solution of the equations describing the time dependent temperature distribution in a three region composite slab during a nuclear power excursion. The slab typifies clad nuclear reactor fuel elements immersed in a coolant, and consists of a homogeneous heat source which varies exponentially with time, followed by two consecutive slabs of non-source material. Heat transfer is by conduction only.

b. Range: Not given.

Accuracy: Not given.

Floating/Fixed: Floating point arithmetic is used.

c. Mathematical Method: The code evaluates the solution given in the Argonne National Laboratory Report ANL-4951, "Reactor Engineering Division Quarterly Report, September 1, 1952 through November 30, 1952."

d. Storage Required: The program consists of 204 instructions and one constant.

Speed: Running time is two seconds per point. Loading time of interpretative system deck with program is 2.25 minutes.

Relocatability: Not given.

e. Remarks: Transient terms, important for the first six periods only, are neglected. All material constants are fixed for any one run. The program is written in the Bell Telephone Laboratories L_2 General Purpose System, IBM 650 Library Program 2.0.008.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 8.2.021
Physical Sciences

NEUTRON ENERGY SPECTRA IN WATER

J. C. English
E. I. du Pont de Nemours and Company
Aiken, South Carolina

a. Purpose: This code computes the distribution in energy from zero to 2.5 ev. It includes the effects of moderator motion and chemical binding.

b. Range: Not given.

Accuracy: Not given.

Floating/Fixed: Computation is in fixed decimal arithmetic.

c. Mathematical Method: The equation for the conservation of neutrons is expressed in difference form as the matrix equation N = KN which is solved by iteration.

The Rand fit to the erf function is used in the evaluation of elements of the matrix.

d. Storage Required: Not given.

Speed: The matrix Q is obtained in about twenty minutes. Distributions with three digit precision are obtained with about twenty-five minutes of iteration.

Relocatability: Not given.

e. Remarks: The code as written assumes that the input parameters are in the range of those for H_2O and D_2O moderators.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 8.2.022
Physical Sciences

ENSIGN CODE

B. L. Anderson
H. Bohl, Jr.
Bettis Atomic Power Division
Westinghouse Electric Corporation
Pittsburgh 30, Pennsylvania

a. Purpose: ENSIGN is a few-group, one-dimensional code designed to handle symmetric slabs, nonsymmetric slabs, and cylinders.

b. Range: Problems may not exceed 4 groups, 10 regions, and 100 points.

Accuracy: Not given.

Floating/Fixed: Fixed point arithmetic is used.

c. Mathematical Method: Fluxes and eigenvalues are computed by means of an iterative scheme in which it is necessary to make an initial source guess. At either of the outer boundaries, there may be a flux of zero or a derivative of the flux equal to zero. The balance check method is used for crossing internal boundaries.

d. Storage Required: The program requires 2000 words of storage.

Speed: The time required for a 2-group, 100-point, 7-iteration problem is 20 minutes.

Relocatability: Not relocatable.

e. Remarks: Since fixed point arithmetic is used, limits must be set on the input. Even with these limits, an overflow condition may occur. Also, many restrictions are placed upon the magnitudes of the parameters.

f. IBM 650 System: One 533 is required.

IBM 650 Library Program Abstracts

File no. 8.2.024
Physical Sciences

RAYTHEON REACTOR SURVEY CODES 2G 2RI, 2G 2RII, AND 2G 3R

L. Holway
Research Division
Raytheon Manufacturing Company
Waltham, Massachusetts

a. Purpose: These routines will find the critical radius or the critical value of the infinite multiplication constant using two energy group diffusion theory in thermal reactors with two or three regions.

b. Range: Includes all values of core radius greater than 15 centimeters in 2G 2RI and all values of k_∞ greater than 1.1 in 2G 2RII and 2G 3R.

Accuracy: Depends upon the number of iterations as determined by the comparison constant used.

Floating/Fixed: Floating point arithmetic is used.

c. Mathematical Method: The continuity conditions joining the analytic solutions at a boundary produce a determinant which is solved by an iterative process for that value of the radius (2G 2RI) or k_∞ (2G 2RII and 2G 3R) which makes the determinant equal to zero.

d. Storage Required: Approximately 575 storage locations for 2G 2RI and 2G 2RII; approximately 900 storage locations for 2G 3R.

Speed: For 2G 2RI and 2G 2RII the running time is about 45 seconds per set of data, and for 2G 3R, about 1 minute.

Relocatability: Not given.

e. Remarks: None.

f. IBM 650 System: One 533, indexing registers, and automatic floating decimal arithmetic feature are required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 8.2.025
Physical Sciences

AN IBM 650 PROGRAM TO CALCULATE THE NEUTRON ATTENUATION IN A WATER-METAL REACTOR SHIELD

(Continued on next page)

H.S.P. Jones
Numerical Analysis Section
Computer Department
Rolls-Royce Limited
Derby, England

a. Purpose: This program calculates the neutron attenuation in water-metal reactor shields in one dimension of plane or cylindrical geometry for up to fourteen regions.

b. Range: $1 < n \leq 398$, where n is the total number of divisions of range.
$1 < m \leq 14$, where m is the number of regions.

Accuracy: The results cannot be accepted to more than three significant figures.

Floating/Fixed: All calculations are done in floating decimal arithmetic.

c. Mathematical Method: See the program write-up.

d. Storage Required: On tape the program is stored in fourteen 53-word records, the last three words of each record containing reference data.

Speed: Time required per point is 2n seconds, where n is the total number of divisions of range.

Relocatability: Not giver

e. Remarks: None.

f. IBM 650 System: Tape system, consisting of one 533, one 'on line' 407, IAS, one 727 Magnetic Tape Unit, indexing registers, and automatic floating decimal arithmetic feature.

IBM 650 Library Program Abstracts

File no. 8.2.026
Physical Sciences

TEMPERATURE DISTRIBUTION IN FUEL ELEMENTS

G. R. Hoke
E. I. duPont de Nemours & Company
Savannah River Laboratory
Aiken, South Carolina

a. Purpose: Equations and a routine for the IBM 650 to calculate axial temperature distribution in fuel assemblies are presented. The routine can accommodate as many as three heat sources and four coolant channels alternately spaced in either plane or cylindrical geometry.

b. Range: Not given.

Accuracy: Not given.

Floating/Fixed: Floating decimal arithmetic.

c. Mathematical Method: Not given.

d. Storage Required: 1750 words.

Speed: One minute per problem.

Relocatability: Not given.

e. Remarks: None.

f. IBM 650 System: One 533, indexing registers and automatic floating decimal arithmetic feature are required.

IBM 650 Library Program Abstracts

File no. 8.2.027

MULTIREGROUP

J. C. English
Savannah River Laboratory
E. I. du Pont de Nemours & Co.
Aiken, S. C.

a. Purpose: This program solves the one-dimensional neutron diffusion equation by means of the associated difference equations in several energy groups. The program is essentially the WAPD "Lil' Abner" code rewritten for the Model 2 IBM 650. A gain in speed of a factor of five over "Lil' Abner" is realized.

b. Restrictions, Range: Floating point arithmetic is used.

c. Method: Difference equations which approximate the set of coupled differential equations

$$-D^i \nabla^2 \phi^i \quad (\Sigma_a^i \; \Sigma_r^i + D^i B_z^2)\phi^i = X^i S + \Sigma_r^{i-1} \phi^{i-1}$$

are used to obtain flux profiles for each neutron group. Here B_z^2 is the transverse buckling; i is the group index; D, Σ_a, and Σ_r are the diffusion

(Continued on next column)

constant, absorption cross section, and the removal cross section respectively

d. Storage Requirements: Approximately 1750 storages are required, including input data allocation. The program is supplied in SOAP II format and deck.

e. Remarks: Requires automatic floating decimal feature and index registers.

f. IBM 650 System: Not given.

IBM 650 Library Program Abstracts

File no. 8.2.028

A MULTIGROUP P_3 PROGRAM FOR THE NEUTRON TRANSPORT EQUATION

Richard R. Haefner
E. I. du Pont de Nemours & Co.
Explosives Department
Atomic Energy Division
Technical Division
Savannah River Laboratory
Aiken, South Carolina

a. Purpose: An IBM 650 routine that computes the spherical harmonic approximation of the neutron transport equation in five energy groups, in one dimension, and for cylindrical geometry. The P_3 approximation is used for the lowest energy group and the P_1 approximation is used for the higher energy groups.

b. Restrictions, Range: Floating.

c. Method: Analytic.

d. Storage Requirements: 2,000 words, 10 minutes/region.

e. Remarks: None.

f. IBM 650 System: Model 2 computer with automatic floating decimal and indexing registers.

IBM 650 Library Program Abstracts

File no. 8.3.001

LQC SURFACE FITTING PROGRAM FOR BASIC 650

W. C. Krumbein
Department of Geology
Northwestern University
Evanston, Illinois
&
C. E. Faulkner
IBM, UK, Ltd.
London, England

a. Purpose: To fit linear, quadratic, and cubic surfaces to map data where the points of observation are distributed irregularly over the map area, rather than on a rectangular grid.

b. Restrictions, Range: The program handles as many as four mapped variables at a time for an indefinite number of map points, inasmuch as the computations are in floating point.

Accuracy: Double precision used in matrix inversion and computation of coefficients. Other computations in single precision.

Floating/Fixed: Input in fixed point. Program converts to SIR floating point. Output in floating point.

c. Method: Least squares polynomial fitting.

Speed: Part I computes basic 10 x 10 cubic matrix and four 10 x 1 vectors at the rate of 1 data card per 9 seconds. The output is in the form of 10 x 10, 6 x 6, and 3 x 3 matrices and their corresponding vectors.

Part II inverts the L, Q, and C matrices and computes the coefficients at the rate of 10 minutes per mapped variable.

Part III computes 3 answer cards per data card every 4 seconds (Observed value, computed value, and deviation). Sums of squares cards at end.

Relocatibility: Not relocatible.

e. Remarks: Full description of data and output cards in program write-up.

f. IBM 650 System: Basic 650 and 533.

IBM 650 Library Program Abstracts

File no. 8.4.001
Physical Sciences

STRUCTURE FACTORS

R. Shiono
University of Pittsburgh
Pittsburgh 13, Pa.

a. Purpose: The programs compute structure factors of triclinic, monoclinic and orthorhombic space groups. The output cards of these programs are used as the input cards for "Differential Fourier Synthesis" program (File No. 8.4.002). Six individual programs were prepared for centric and non-centric space groups of the three classes respectively, and the modifications for any particular space group are made by addition of a few cards.

b. Range: The following upper limits are given:

Number of independent atoms (at a time)	50
Number of different kinds of atoms	8
Number of temperature factors:	
1. Isotropic temp. factor for each kind	8
2. Individual anisotropic temp. factor	50
Indices of reflexion:	
1. Centro-symmetric	no limit
2. Non-centrosymmetric	99

Accuracy: Not given.

Floating/Fixed: Fixed point.

c. Mathematical Method: Geometrical structure factors are computed with simplified expressions in the International Tables for X-ray Crystallography. Trigonometric functions are computed with Trimble's subroutine (IBM Technical Newsletter No. 9, 1955). Atomic scattering factors are stored in table form and linear interpolation is used.

d. Storage Required: Most of the 2000 storage locatio are used.

Speed: The following examples of speed are given:

$P\ 2_1/c$	9 atoms, 2 kinds	3.5 sec/reflexion
$P\ 2_1 2_1 2_1$	7 atoms, 7 kinds	8 sec/reflexion
P 1	28 atoms, 2 kinds, anisotropic temp. factors	20 sec/reflexion

Relocatability: Since the programs occupy most of the drum, it is not convenient to relocate. The programs are written in SOAP I.

e. Remarks: The necessary modification cards for each space group are listed (except for Fdd2 and Fddd).

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 8.4.001
Errata

"Structure Factors," by R. Shiono

The following corrections have been submitted in the listing of the writeup of the above program:

PAGE	LOCATION	LINE	WORD	WORD
49	0427	233	60 0126 0432 should be	65 0118 0384
50	0392	308	69 0134 0442 should be	69 0375 0442

IBM 650 Library Program Abstracts

File no. 8.4.002
Physical Sciences

DIFFERENTIAL FOURIER SYNTHESIS

R. Shiono
University of Pittsburgh
Pittsburgh 13, Pa.

a. Purpose: This program uses the output cards from the program "Structure Factors" (File No. 8.4.001) as the input cards. It computes the electron densities, their nine derivatives of observed and calculated structure factors at a given coordinate, and solves the shift from them. The modifications for each space group are made by the addition of a few cards.

b. Range: There is no limit to the number of reflexions.

Accuracy: Not given.

Floating/Fixed: Fixed point.

(Continued on next column)

c. Mathematical Method: The expressions of electron density in the International Tables for X-ray crystallography are used directly or expanded and combined.

d. Storage Required: Not given.

Speed: The following examples of speed are given:

$P\ 2_1 2_1 2_1$	600 reflexions	approx. 40 minutes/atom
$P\ 2_1/c$	1200 reflexions	

Relocatability: Not given.

e. Remarks: The necessary modification cards for each space group are listed.

f. IBM 650 System: One 533 required.

650 LIBRARY PROGRAM ABSTRACT

FILE NUMBER 9.2.001

SURVEY TRAVERSE

J. T. Ahlin and G. E. Mitchell
IBM, Houston

May 1, 1956

a) Computes the departures and latitudes for each traverse line, the x and y coordinates for each station, and the length, bearing, departure and latitude of the closure.

b) Angle data are to either the nearest second or the nearest hundreth of minute; distance data in the form xxxxx.xx feet. Sines and cosines are computed to six decimal places.

c) Does not apply.

d) Storage required is about 500 locations between 0000 and 0999. Speed is 100 stations per minute.

e) Self-restoring.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT

FILE NUMBER 9.2.002

R. W. Blaylock and J. M. Kibbee
IBM, Houston

a) Computes the amount of cut and fill volume between survey stations on a highway using the data from the original survey and from either a final survey (for billing) or design specification.

b) Fixed-point arithmetic is used with a maximum of 100 points per station with no limit to the number of stations. Volumes are punched to the nearest cubic yard, areas to the nearest hundredth square foot, horizontal distances to the nearest tenth of a foot, vertical distances to the nearest hundredth of a foot.

c) The average end-area is used for computing volumes.

d) Storage required is about 975 locations assembled between 0800 and 1950. Input data and computed tables occupy locations 0000 to 0799. Timing is a function of the number of stations and readings at each station. For 25 readings per station and 100 stations per mile computations require about 15 minutes per mile.

e) For design purposes the program also computes the slope stake points (intersections of proposed road with terrain). A SOAP symbolic deck listing in addition to an absolute deck listing of the program assembled between 0800 and 1950 is included.

f) Alphabetic device if the SOAP symbolic version is used.

650 LIBRARY PROGRAM ABSTRACT

FILE NUMBER 9.2.004

CUT AND FILL

J. M. Kibbee and J. W. Robinson
IBM Houston

(Continued on next page)

a) Computes slope stake intercepts, cut, fill, and net volumes, adjusted, and accumulated volumes.

b) Fixed decimal.

c) Average end-area method.

d) Uses entire memory: approximately 1200 program steps
approximately 800 table locations.
Speed varies with type of problem run.

e) Road is described in terms of crown height and width, and slope depth and width.

f) Minimum 650.

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650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 9.2.005

MOMENT DISTRIBUTION

J. D. Hutchinson
University of Houston
Computing and Data Processing Center
Houston, Texas

a) Computes the bending moments in structural members of a rigid frame, given fixed end moments.

b) Meets all engineering requirements. The program is written in fixed point.

c) The "Moment Distribution" method of Hardy Cross is used. (See Paper 1793, Trans, A.S.C.E., 1932.)

d) Program requires 540 memory locations; data require 10 words per member in the frame. Speed: 1/8 to 1/10 seconds per member per joint per iteration. Relocatability: Program is written in SOAP, but all data locations are in absolute.

e) Handles frames with up to 100 members. Not more than 8 members can meet at any given joint.

f) Minimum 650.

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650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 9.2.006

TRUSS ANALYSIS

A. A. Aucoin
J. D. Hutchinson
University of Houston
Computing and Data Processing Center
Houston, Texas

a) Computes axial forces in statically loaded, simple, determinate, pinned trusses.

b) Range: Loads varying from 1 to 99999 (units arbitrary). Accuracy: Depends on number of significant figures in data; 1 part in 500 accuracy can be obtained on large trusses. Program is written in fixed point.

c) The "Method of Joints" is used. (See any standard text on truss analysis.)

d) The program requires 1200 memory locations; data require six locations per member. Speed: Approximately jj seconds where jj is the number of joints in the truss. Relocatability: Since the program and data occupy most of the drum, it is not convenient to relocate. The program is written in SOAP, however.

e) The program is self restoring and will process either many loading configurations for the same truss or many trusses, or any combination, in sequence, automatically. For indeterminate trusses, see Abstract 9.2.007, "Connector and Redundancy Programs for Indeterminate Truss Analysis."

f) Minimum 650.

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650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 9.2.007

CONNECTOR AND REDUNDANCY PROGRAMS FOR INDETERMINATE TRUSS ANALYSIS

Irene Tung
University of Houston
Computing and Data Processing Center
Houston, Texas

a) Designed to compute true axial forces in all members of indeterminate trusses from output of "Truss Analysis" program.

b) Fixed point except the Sweeney Matrix Inversion routine which is incorporated.

c) Castigliano's Theorem of Least Work is applied. (See any standard text on indeterminate structures.)

d) The Connector requires 750 locations for program and data. The Redundancy Program requires 1725 locations for program and data. The programs are written in SOAP in fixed point except the Sweeney Matrix Inversion program which is incorporated.

e) Up to 24 redundants in a truss can be handled.

f) Minimum 650.

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650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 9.2.008

GEORGIA SKEWED BRIDGE PROGRAM

C. P. Reed
Rich Electronic Computer Center
J. M. Nieves-Olmo
State Highway Department of Georgia
Atlanta, Georgia

a) This program determines the placement of bents, the intersection of radial lines with concentric circles, the chord distances between bents, and other related data for substructure of a curved bridge.

b) Accuracy to tenths of a second for angles. Most calculations are performed in floating decimal with part of input being submitted in floating decimal.

c) Makes use of plane geometry and trigonometry which pertain to chords of concentric circles and radial triangles.

d) Uses entire drum. Speed: 4 seconds per radius per bent.

e) Can handle any number of bents and up to 17 concentric circles at each pass. Can handle either left, right, or partially skewed bridge.

f) Minimum 650.

April 1958, Bulletin 18 - 7

650 LIBRARY PROGRAM ABSTRACT	FILE NUMBER	9.2.009

MOMENT DISTRIBUTION

P. Yeager
L. C. McReynolds
Computer Section
Washington Department of Highways
Olympia, Washington

a) Computes final end moments in beams and in column tops of continuous beams built integrally with columns when distribution coefficients, carry-over factors and fixed-end moments are given.

b) Will solve any single story continuous frame bridge structure with up to 15 spans. All data is in fixed point.

c) Uses Hardy Cross method of moment distribution.

d) Program occupies 1158 positions of memory storage and is not relocatable. Speed is 3 seconds per joint.

e) None.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT	FILE NUMBER	9.2.010

TEXAS ENGINEERING SUBROUTINES

Texas State Highway Department
Austin, Texas

a) To convert degrees to radians, radians to degrees, and bearing to slope, and to perform 20 digit divisions.

b) Range: 0.00000000 to 9.99999999 radians.
Accuracy: XXX° XX' XX.X"
Fixed point arithmetic.

c) Normal conversion formulas.

d) Locations: 1801-1899. Non-relocatable.

e) None.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT	FILE NUMBER	9.2.011

FORECASTING ZONAL TRAFFIC VOLUMES

J. Petersen
Computer Section
Washington Department of Highways
Olympia, Washington

a) Computes future zone-to-zone traffic movements given the present zone-to-zone movement and the estimated growth factors for each zone, using a method of successive approximations.

(Continued on next column)

b) Will solve any system with up to 192 zones. All data is in fixed point.

c) Uses the method of Howard W. Bevis presented in "Traffic Quarterly" Volume X, No. 2, April, 1956, pages 207-222, entitled "Forecasting Zonal Traffic Volumes."

d) Program occupies 930 positions of memory storage and is not relocatable. Speed is punch speed (100 per minute).

e) None.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT	FILE NUMBER	9.2.012

MAXIMUM DENSITY OF GRANULAR MATERIALS

R. V. LeClerc
H. E. Sandahl
Materials Laboratory
Washington Department of Highways
Olympia, Washington

a) Computes points on a curve for determination of the maximum densities of coarse granular materials.

b) Input and output are in fixed point.

c) Used with laboratory method for determining maximum density developed by H. W. Humphres.

d) Program occupies 363 positions on drum and is not relocatable. Speed is 2 seconds.

e) None.

f) Minimum 650. Alphabetic device is required if alphabetic identification is used.

650 LIBRARY PROGRAM ABSTRACT	FILE NUMBER	9.2.013

ANALYSIS OF LATERALLY LOADED PILES

C. B. Rader, Sr.
C. R. Hobby
E. I. Organick
University of Houston
Computing and Data Processing Center
Houston, Texas

a) Computes lateral deflection, bending moment, shear, fiber stress due to vertical as well as horizontal loading, and soil pressure for $t + 1$ positions along a pile divided into t sections ($t \leq 49$). Piles are assumed to be made of pipe or to have a circular cross section.

b) The program is written in fixed point machine language; range and accuracy are discussed in program write-up.

c) Focht and McClelland method (see Texas Engineer, Vol. 25, nos. 9, 10, 11, Sept., Oct., Nov., 1955).

d) The program is not relocatable and uses approximately 1000 storage locations. Time required, for each wall thickness, is $(t + 3)$ seconds plus punch-out time, where t is the number of divisions of the pile; punch-out occurs at maximum rate.

e) Does not apply.

f) Minimum 650.

IBM 650 Library Program Abstracts

File no. 9.2.013
Errata

"Analysis of Laterally Loaded Piles," by C.B. Raeder, Sr., C.R. Hobby, E.I. Organick.

The following correction has been submitted for the listing of the writeup. Page 19, location 0784, should be changed from 10 1411 0794 + to 11 1411 0794 +.

This change affects only those cases where the slope of the pile at the top is other than zero.

Also note that the one per card listing in the writeup should be ignored. Only the five per card deck listing should be considered reliable.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 9.2.015

REVISED TRAVERSE AND TRAVERSE ADJUSTMENT COMPUTATION

J. A. Haller
California Division of Highways
Sacramento, California

a) This routine calculates traverse data for the typical highway survey, right of way, or design problem. Input is in the form of one card per course. Any two unknowns within a traverse may be accepted. Results are punched one course to a card and show identification, distance, bearing, sine, cosine, latitude, departure, and coordinates for regular courses. Areas are obtained for closed figures and segment areas are also computed. The factors developed in one traverse may be stored for use in a later traverse. Where two mathematically correct solutions are possible, both solutions are presented from a single set of input data, and the engineer must choose the proper solution.

b) Ninety-eight regular courses may be submitted for each traverse. Cards need not be sorted by course number, but all cards for a given traverse must be together. Distances are given to thousandths of feet and bearings to seconds. Functions are computed to nine decimal places.

c) Library subroutines used are from Technical Newsletter #9 for sine, and cosine, arctangent, and arcsine.

d) Ninety-eight locations each are required for storage of sine, cosine, distance, and bearing. Other program and temporary storage requirements use the remainder of the two thousand drum locations, with the exception of seventy-nine locations. Speed is about two thousand courses per hour. The program is considered optimum and is not in relocatable form.

e) Some coded stops may be reached because of incorrect input data.

f) A 650 with twenty pilot selectors, half-time emitters, and alphabetic device is used.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 9.2.016

CONTOUR CHART OF TRIP DESIRES

J. A. Haller
California Division of Highways
Sacramento, California

a) This program computes the desire line trip values for each coordinate point within a traffic survey area. The output from the program may be listed with proper spacing to post contour values. The listing may then be used to draw a contour chart of trip desires.

b) Up to approximately 1750 contour points may be posted in one pass of the trip cards. Coordinate boundaries for each pass must be set up.

c) The X and Y coordinates of each point along a straight line from origin to destination are computed. The number of points computed for any one trip will be one more than the number of ordinates crossed by the longer axis of the trip.

(Continued on next column)

d) The entire program requires about 300 locations, but this number may be reduced if the punching phase is separated from the reading phase. The program should not be relocated except to separate punching from reading phases. Speed varies with the concentration of trips within the particular swath being processed.

e) Reading of trip cards may be suspended and the trip values for each coordinate point may be punched out at any time so that the 650 does not need to be reserved for the entire time necessary to compute a given swath.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 9.2.017

FREEWAY ASSIGNMENT PROGRAM

California Division of Highways
Sacramento, California

a) Determines best alternate route for a proposed freeway based on time-rate-distance studies of existing traffic.

b) Fixed decimal.

c) Formula as outlined by the Traffic Section, California Division of Highways.

d) Uses all locations except 1000 and 1999.

e) Will handle one alternate freeway at a time and up to 3 speeds on city streets.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 9.2.018

CURVED BRIDGE PROGRAM

Texas Highway Department
Austin, Texas

a) This program relieves the detailer of much of the laborious computation involved in the plan preparation of a curved bridge.

b) Fixed point. Accuracy varies for different variables in program.

c) Mathematical formulas as now used by bridge designers.

d) Optimized through most of memory. About 500 program steps.

e) Only 20 bents may be computed at one time. The values of radii are limited to less than 10,000. Other limitations given in write-up.

f) Minimum 650.

IBM 650 Library Program Abstracts

File no. 9.2.019
Engineering Applications

COMPOSITE BEAM*

R. E. Shields
J. A. Haller
California Division of Highways
Sacramento, California

(Continued on next page)

a. Purpose: This program will compute steel girder size and all other factors needed to complete the design of a concrete-steel composite girder.

b. Range: 138 plate sizes from 10" x 5/8" to 28" x 3-1/4" are available as trial sizes.

Accuracy: Not given.

Floating/Fixed: Fixed decimal arithmetic is used.

c. Mathematical Method: The routine picks a trial size of top and bottom flange, computes the stresses on such a beam, and then modifies top and bottom flange sizes separately as a result of the test of the stresses. When both top and bottom flanges are within the proper stress band, the program computes reductions in flange sizes, end reactions, or shear stress, and punches results. A single card input produces a single card output for each beam to be designed. AASHO recommendations are observed.

d. Storage Required: Approximately 1700 locations of table, instruction, and temporary storage are used.

Speed: Varies, but the average beam will be designed in 25 to 60 seconds.

Relocatability: Not given.

e. Remarks: Provision is made to compute initial factors which are not specified by the engineer. The minimum data include span length, spacing between girders, structure depth, and steel stress. If other data are given, these data will be used in place of values computed from the minimum. The design engineer may restrict the solution to a specified width for top plate, bottom plate, or both plates. Error cards will be punched if no flange of specified width can satisfy the maximum stress requirements.

Plate girders without composite action may also be designed by the program.

f. IBM 650 System: One 533 required.

Special Devices: None.

*This program supercedes the original program bearing the same name and file number.

IBM 650 Library Program Abstracts — *File no.* 9.2.019 ADDENDUM

CALIFORNIA COMPOSITE BEAM

The addendum causes the Composite Beam program to furnish design data for low alloy steel (A242) as well as any type of carbon steel as before.

The writeup and list of coded instructions are available from the library.

Any request received after March 1, 1961 will automatically receive this revision.

650 LIBRARY PROGRAM ABSTRACT — FILE NUMBER 9.2.020

THREE CENTER CURVES FOR SHORT RADIUS TURNS

California Division of Highways
Sacramento, California

a) This program performs the computations of short radius turns as set forth in the Planning Manual of the California State Highway Department.

b) The value of the angle Δ cannot fall within the ranges between 179°55' and 180°05', and between 359°55' and 0°5'.

c) Uses IBM sine-cosine, square root, and arc-sine subroutines.

d) Uses approximately 650 locations. Can be relocated anywhere on drum.

e) The program was written for the ranges prescribed in the Planning Manual, so not all possible variations have been tested.

f) Minimum 650.

(Continued on next column)

650 LIBRARY PROGRAM ABSTRACT — FILE NUMBER 9.2.021

TRAVERSE AND COORDINATE PROGRAM

K. F. Kohler
R. R. DeClark
Bureau of Public Roads
Portland, Oregon

a) Using either Stations and Deflection Angles right or left, Length of Courses and Deflection Angles right or left, or Stations and Azimuths as input, the Bearings, Stations, Length of Courses, Course Lats. and Deps. and Coordinates of angle points are computed. Using P. I. Numbers and Coordinates as input, the Bearings, Delta Angles, and Length of Courses are computed. In all, fourteen different problem types are computed.

b) Coordinates CC, CCC, CCC. CC, Bearings N. or S. DDMMSS E. or W., Stations SSSS+SS. SS, Deflection Angles DDDMMSS R. or L., Delta Angles DDDMMSS, P. I. Numbers PP, PPP, PPP, and Course Lengths LLL, LLL. LL, (L, LLL. LL when using coordinates as input). The subroutines used are SR-3 (Square Root), SC-1 (Sine - Cosine) and AS-1 (Arcsine). Program is in fixed point.

c) Does not apply.

d) Storage required is about 1000 locations between 0000 and 1836. Speed is 40 courses per minute.

e) Program is written in SOAP.

f) 650 with alphabetic device.

IBM 650 Library Program Abstracts — *File no.* 9.2.022 Engineering Applications

EARTHWORK LINE SHIFT

C. Travis
S. R. Cason
Computer Section
Washington Department of Highways
Olympia, Washington

a. Purpose: Shifts the center line on earthwork cross-section and interpolates a rod reading for the new center line if the new center line is located at a point for which no rod reading was given.

b. Range: Makes both left and right shifts of any size which will not cause the final distances to exceed four digits.

Accuracy: Not given.

Floating/Fixed: The program is in fixed point arithmetic.

c. Mathematical Method: The interpolation is a straight line interpolation.

d. Storage Required: 436 drum locations.

Speed: Program runs at almost punch speed.

Relocatability: Program may be relocated.

e. Remarks: Self loading five instructions per card deck is available.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts — *File no.* 9.2.023 Engineering Applications

SPEED CHECK ANALYSIS

C. Travis
Computer Section
Washington Department of Highways
Olympia, Washington

(Continued on next page)

a. Purpose: Computes 85% speed, average speed, standard deviation, %'s over given speed and S curve %'s.

b. Range: Handles speeds from 5 to 80 MPH with as many observations as desired. Six groups may be read in for each station.

Accuracy: Most answers are given to 1/10%.

Floating/Fixed: Computation is in fixed point arithmetic.

c. Mathematical Method: Usual methods for average speed and %'s.

Standard deviation by the following equation:

$$G = 5\sqrt{\frac{\sum f_0 (d^2)}{N} - \left(\frac{\sum f_0 \ d}{N}\right)^2} \qquad \text{Variance} = G^2$$

d. Storage Required: Program leaves 329 locations available.

Speed: Requires about 2 minutes per problem.

Relocatability: Program is non-relocatable.

e. Remarks: Self loading five instructions per card deck is available.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 9.2.024
Engineering Applications

SLOPE TOPOG PROGRAM

K. F. Kohler
R. R. DeClark
Bureau of Public Roads
Portland, Oregon

a. Purpose: Converts cross section slope topog (slope in percent or degrees and slope distance) to H. I. and rod topog.

b. Range: Input is Station (SSSS + SS), Base Elevation (EEEE.EE), Slope in Degrees (SS.S±) or Slope in Percent (PPP.±), and Slope Distance (DDD.). Output is Station (SSSS + SS), Base Elevation (EEEE.EE), Rod Reading (RRR.R±) and Horizontal Distance (DDD.D). Output is type "0" form used in the Design Cut and Fill Program, (H841, B. P. R. revised), and other related programs developed or revised by the Bureau of Public Roads. The subroutines used are SC-1 (Sine-Cosine) and SR-3 (Square Root).

Accuracy: As indicated above.

Floating/Fixed: Program is in fixed point arithmetic.

c. Mathematical Method: Does not apply.

d. Storage Required: Approximately 890 locations between 0000 and 1800 are required.

Speed: The computation time varies with the number of readings per section and is slightly less for the Percent Slope Topog computation than for Degree Slope Topog.

Relocatability: Not given.

e. Remarks: This program was developed on the supposition that between any pair of topog points the instrument height and target height above the actual ground would be the same, and that the chaining height at both points would be equal. The program does not provide for a height of instrument correction.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 9.2.025
Engineering Applications

CONTOUR INTERPOLATION

K. F. Kohler
R. R. DeClark
Bureau of Public Roads
Portland, Oregon

a. Purpose: This program develops the location of each contour within any highway topog cross section that is in the H. I. and rod and distance form. The contour interval desired is selectable between 00.0 and 99.9 feet.

(Continued on next column)

Contours are developed and tabulated in a form ideally suited for plotting purposes. The output for each section is the station, the elevation and distance of the left-most topog point, all contours as elevation and distance from centerline that lie between the left-most topog point and centerline, the elevation of centerline, all contours as elevation and distance from centerline that lie between centerline and the right-most topog point, and the elevation and distance of the right-most topog point.

b. Range: Desired Contour Interval, (II.I) on header card. Topog cards (type "0" cards) used as input are same as used in the Design Cut and Fill Program (H841 B. P. R. revised). Station (SSSS + SS), H. I. (EEEE + EE), Rod Reading (RRR.R±), and Distance (DDD.D). The output is Station (SSSS + SS), Elevation of contours, end topog points or centerline (EEEE.E), and Horizontal Distance from centerline (DDD.D).

Accuracy: As indicated above.

Floating/Fixed: Program is in fixed point arithmetic.

c. Mathematical Method: Does not apply.

d. Storage Required: Approximately 560 locations between 0000 and 1800 are required.

Speed: Computation time varies with the number of topog points per section and the number of contours within a section.

Relocatability: Not given.

e. Remarks: None.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 9.2.026
Engineering Applications

SLOPE STABILITY ANALYSIS

J. Petersen
Computer Section
Washington Department of Highways
Olympia, Washington

a. Purpose: Computes the factor of safety against failure of an embankment or will find the steepest embankment slope with a factor of safety greater than one.

b. Range: Three layers of different materials may exist below the embankment.

Accuracy: Not given.

Floating/Fixed: Not given.

c. Mathematical Method: Uses the Swedish Slip-Circle method.

d. Storage Required: 1397 positions of memory.

Speed: Speed varies from 45 seconds to 5 minutes.

Relocatability: Program is not relocatable.

e. Remarks: Self loading five instruction per card deck is available.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 9.2.027
Engineering Applications

SURVEY TRAVERSE PROGRAM

S. E. LaMacchia
Ohio Department of Highways
Columbus, Ohio

a. Purpose: Using as input the following survey traverse information:

1) Course length
2) Course angle:
   Bearing
   Deflection
   Azimuth

the program computes and supplies as output the latitude, departure, station coordinates, and components of closure error.

b. Range: In the case of a closed traverse, the number of courses must be less than one hundred.

(Continued on next page)

Accuracy: Output data is accurate to the nearest one-tenth foot.

Floating/Fixed: Computation is made in fixed point arithmetic.

c. Mathematical Method: The angle is first converted to an azimuth and then added to the previous sum. Latitudes and departures are computed with the use of the sine-cosine subroutine, SC 2.

d. Storage Required: Memory locations 1 - 50 and 200 - 600 approximately, are used.

Speed: Speed is approximately the maximum for card reading and punching.

Relocatability: The program is relocatable.

e. Remarks: None.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 9.2.028
Engineering Applications

ROD READING CONVERSION PROGRAM

M. Gold
Ohio Department of Highways
Columbus, Ohio

a. Purpose: The program reduces rod readings to elevations for use in the Road Design Program (IBM 650 Library Program 9.2.029).

b. Range: The maximum X value is 999.9 feet. The maximum R value is 99.9 feet.

Accuracy: Values are rounded to the nearest tenth from the field notes. In the simple process of one subtraction of these values, the difference remains significant to the nearest tenth.

Floating/Fixed: The decimal is fixed in all calculations.

c. Mathematical Method: Simple arithmetic is used.

d. Storage Required: 368 memory locations in the first eight bands of the drum.

Speed: Data is processed at card reading speed.

Relocatability: The program is relocatable in multiples of fifty.

e. Remarks: None.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 9.2.029
Engineering Applications

ROAD DESIGN PROGRAM

B. T. Wade
Ohio Department of Highways
Columbus, Ohio

a. Purpose: Computes coordinates of the road design template from the shoulder to the slopestakes according to design criteria.

b. Range: The range of input is as follows: $0.00 \leq$ station $\leq 999,999.99$; $-999.9 \leq$ offset ≤ 999.9; $0.0 \leq$ elevation ≤ 9999.9; $0.00 \leq$ profile grade ≤ 9999.99; $0.00 \leq$ shoulder slope ≤ 99.9; $0.0 \leq$ ditch slopes ≤ 9.9. The range of the output is the same as input except that elevations are not punched but rather distances above or below profile grade which have the same range as the offsets.

Accuracy: Values are computed to the nearest tenth foot.

Floating/Fixed: Values are computed in fixed point arithmetic.

c. Mathematical Method: The methods used incorporate analytical geometry plus comparisons on design criteria.

d. Storage Required:

0000 - 0399 Tables
0400 - 1715 Program
1823 - 1900 Constant and temporary storage locations.
(LD_1 occupies 1900 - 1999 but is wiped out by the program.)

(Continued on next column)

The sections can be read into the machine in any order provided links are set by LD_1 (IBM 650 Library Program 1.2.007).

Speed: An average station requires approximately 20 seconds.

Relocatability: All sections of the routine are relocatable within the present limits of 0400 and 1823.

e. Remarks: The number of points on each side of the center line of the roadway cannot exceed 33. The number of points of each side of the center line of survey cannot exceed 66. The input cannot have X and Y both zero. The shoulder cannot be at the center line of survey.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 9.2.030
Engineering Applications

OHIO CUT AND FILL

T. S. Gemmell
Ohio Department of Highways
Columbus, Ohio

a. Purpose: Computes areas at each station, volumes between stations, and seeding area between stations, and accumulates volumes for entire project.

b. Range: A maximum of 100 points each for road and terrain points. Number of stations that can be processed is only determined by size of accumulated volumes.

Accuracy: Volumes are punched to nearest cubic yard. Areas to the nearest square foot, and seeding area to the nearest square yard.

Floating/Fixed: Fixed point arithmetic is used.

c. Mathematical Method: The trapezoidal and intersecting triangle method is used for computing areas. The average end area method is used for computing volumes.

d. Storage Required: Storage requirements are: tables between 1000 and 1799, square root routine and LD_1 loading routine (IBM 650 Library Program 1.2.007) 1850 - 1999, and 774 coding locations between 0000 and 0999.

Speed: Timing is a function of the number of stations and readings at each station. With seeding area for 51 readings per station, and 107 stations per mile, an average of 48.2 minutes per mile; without seeding area, an average of 30.1 minutes per mile.

Relocatability: Not given.

e. Remarks: Program will compute through a station equation, allow shrinkage factor to apply to cut and fill, and will either compute or not compute seeding area.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 9.2.031
Engineering Applications

SUPERELEVATION TABLES

C. R. Caylor
Ohio Department of Highways
Columbus, Ohio

a. Purpose: Computes the coordinates of the surface of the pavement for stations which are within the limits of a curve and its transition.

b. Range: The X ordinates have a maximum value of 100 feet, the Y ordinates have a maximum value of 10,000 feet.

Accuracy: All values are to the nearest 100th of a foot.

Floating/Fixed: Computation is in fixed point arithmetic.

c. Mathematical Method: Simple mathematics.

d. Storage Required: 850 consecutive memory locations.

Speed: Punches at approximately maximum speed.

Relocatability: Program is relocatable by multiples of 50, plus the last 200 locations which cannot be transferred.

e. Remarks: None.

(Continued on next page)

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 9.2.032
Engineering Applications

DESIGN TEMPLATE PROGRAM

C. R. Caylor
Ohio Department of Highways
Columbus, Ohio

a. Purpose: Computes the design template for any given station.

b. Range: The maximum X value is 1000 feet. The maximum Y value is 10,000 feet.

Accuracy: The coordinates are computed to the nearest tenth of a foot.

Floating/Fixed: Computation is in fixed point arithmetic.

c. Mathematical Method: Trigonometry.

d. Storage Required: 1099 consecutive memory locations.

Speed: Not given.

Relocatability: Program is relocatable by multiples of fifty.

e. Remarks: None.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 9.2.033
Engineering Applications

MOMENT DISTRIBUTION AND INFLUENCE LINE CALCULATION

P. Yeager
L. C. McReynolds
E. D. Lee
Computer Section
Washington State Highway Department
Olympia, Washington

a. Purpose: Computes final end moments in beams and column tops of single story continuous frames. The beams may be integral with the columns. Computes influence line ordinates for loads at all the tenth points or for loads at the .3, .5, and .7 points. These ordinates are the final moments at the beam ends and at the respective points in the span. Shear values are also computed. Information required for input is the distribution coefficients and carry-over factors, fixed end moments if they are to be distributed, and span lengths and load to be used if influence line ordinates are to be computed. When influence line ordinates are to be computed, a table of fixed end moment coefficients must be supplied only if the beams are not prismatic.

b. Range: Will distribute fixed end moments for any single story continuous frame structure with up to 15 spans. This program will also compute influence line ordinates for a structure with up to 5 spans.

Accuracy: Not given.

Floating/Fixed: All data is in fixed point.

c. Mathematical Method: Uses the Hardy Cross method of moment distribution.

d. Storage Required: Program occupies 1869 positions of memory storage.

Speed: Not given.

Relocatability: Program is not relocatable.

e. Remarks: Self-loading five instructions per card deck is available. Written in SOAP.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 9.2.034
Engineering Applications

SUSPENSION BRIDGE ANALYSIS

(Continued on next column)

E. D. Lee
J. Petersen
Computer Section
Washington State Highway Department
Olympia, Washington

a. Purpose: Computes deflections, moments and shears in stiffening truss of a two hinged suspension bridge. Computes cable tensions at supports.

b. Range: Computes values for three span suspension bridge with or without anchor spans, side spans suspended or not suspended.

Accuracy: Not given.

Floating/Fixed: Input and output is in floating point.

c. Mathematical Method: Uses Exact (Sine Series) Method wherein deflected structure is represented by a Fourier series.

d. Storage Required: Program is split into two parts with 1218 locations available in the first part and 49 locations available in the second part.

Speed: Speed is approximately 15 minutes for the first loading and 12 minutes for successive loadings.

Relocatability: Not given.

e. Remarks: Self loading 5 instruction per card deck is available. Written in SOAP using SIR.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 9.2.035
Engineering Applications

APPROXIMATION OF FUTURE TRIP TRANSFERS

E. A. Radsliff
California Division of Highways
Sacramento, California

a. Purpose: The program utilizes the Fratar Method* to compute one or more successive approximations of future trip transfers between zones. Input data consist only of a set of initial trip transfers and (per zone) trip end growth factors. Trip transfers will be approximated for all pairs of zones up to a maximum of 70 zones.

b. Range: Initial and approximated trip transfers have a range up to 9999.9 but any transfer which is initially zero will remain zero. Growth factors may range up to 99.999. Initial or approximate trip ends (per zone) may not exceed 100,000.

Accuracy: Not given.

Floating/Fixed: Fixed point arithmetic is used throughout.

c. Mathematical Method: *The Fratar Method formula was taken from "Vehicular Trip Distribution by Successive Approximation", Thomas J. Fratar, Traffic Quarterly, January 1954.

d. Storage Required: Essentially the entire drum is used by the program. Only 460 locations are used for instructions or constants, but 1488 fixed locations are required for storage of data.

Speed: Time for loading and punching blocks is normal machine speed. Calculation time varies with the number of zones (N) and the number of non-zero initial trip transfers (M). A rough time formula (in minutes) is $\left[(5N^2 + 3M) \div 1,000\right]$ per approximation.

e. Remarks: All data are first loaded and then one or more approximations may be obtained (in succession at the programmer's option). Optional percentage criteria (in terms of approximated trip ends as compared to expected trip ends) are available to define the standard of accuracy of the final approximations.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 9.2.035
Addenda/Errata

"Approximation of Future Trip Transfers," by E.A. Radsliff.

The following additions should be made to the wiring diagram of the 533 control panel on pages 45 and 46 of the program write-up:
Columns 25 and 26 of Read Card A to Storage Entry A, Word 9, positions 6 and 5. Emit zeros to positions 4, 3, 2, and 1.
Wire #9 (a read timed 9) terminates at Storage Entry A, Word 10, position 2.

(Continued on next page)

Wire #8 (a read timed 8) terminates at Storage Entry A, Word 10, position 1.
Wire # 54 (a three-ended wire) leads from Punch Digit Emitter, digit 0.
Wire # 55 leads from Punch Digit Emitter, digit 2.
Wire # 56 (a four-ended wire) leads from Punch Digit Emitter, digit 3.
Wire # 57 (a four-ended wire) leads from Punch Digit Emitter, digit 4.

The following corrections should be made to the same wiring diagram:

Wire # 12 should lead from Read Card A, column 80 to Read Selector Common (location R, 21).
Wire # 13 should lead from digit 2 of Read Digit Selector to Entry A.
Wire # 14 should lead from digit 0 of Read Digit Selector to Entry B.
Wire # 50 should lead from position 2 of Control Information to Punch B.

IBM 650 Library Program Abstracts

File no. 9.2.036
Engineering Applications

GENERAL FREEWAY ASSIGNMENT

M. Brubaker
R. Bieber
California Division of Highways
Sacramento, California

a. Purpose: The purpose of this routine is to compute time and distance on a freeway system and then compare it to an existing system to determine if the proposed freeway system would be adequate.

b. Range: The routine can handle any ten routing cards per routing. Three years of trip data can be handled at one time.

Accuracy: Not given.

Floating/Fixed: The entire routine is processed in fixed point.

c. Mathematical Method: Does not apply.

d. Storage Required: The entire drum is used. 1000 locations are used to store cumulative time and distance between zones. For problems not requiring this many zonal interchanges, additional locations can be made available.

Speed: Not given.

Relocatability: Not given.

e. Remarks: Total vehicle miles and minutes for each alternate processed are punched out at the end of the problem by the use of the end of file card The program was written in SOAP I.

f. 650 System: One 533 with 20 pilot selectors and 20 co-selectors required.

Special Devices: Alphabetic device.

IBM 650 Library Program Abstracts

File no. 9.2.036
Addenda/Errata

"General Freeway Assignment," by M. Brubaker and R. Bieber.

The following additions should be made to the program write-up:

An error has been discovered in the Freeway Assignment Program due to rounding the computed trips assigned to the basic best freeway and second best freeway routes.

In Block 430 of the program the trips assigned to the basic route were computed by multiplying the per cent times the number of trips and rounding the results. The trips assigned to the second best freeway route were obtained in the same manner. Trips assigned to the best freeway route were obtained by subtracting the sum of the basic and second best assignment from the total number of trips. This was done to insure assigning all the trips and never to assign more than the total number of trips. However, if all of the trips fall into the two computed categories and values are such that each computation is rounded up by one half of a trip, the two computed categories have one more than the total trips to be assigned, and the number of trips assigned to the best freeway trips becomes a minus 1. The following corrections should be made in the program to use decimal accumulation and avoid the result stated above.

Delete from the program the following instructions:

Block	Card	Code	Loc.	Instruction
1	36	2	1053	20 1821 1074
430	46	0	1024	69 1027 1030
430	81	0	1071	31 0002 1259
430	91	1	1259	20 1821 1074
430	341	0	1249	45 1102 1103
430	401	0	1103	65 1015 1901
430	411	0	1901	16 1824 1551
430	421	0	1551	16 1822 1752
430	431	0	1752	20 1823 1702
430	441	0	1702	65 1186 1652
430	451	0	1652	16 1826 1602
430	461	0	1602	16 1828 1452
430	471	0	1452	20 1827 1402
430	481	0	1402	65 1146 1352
430	491	0	1352	16 1830 1904
430	501	0	1904	16 1832 1927
430	511	0	1927	20 1831 1877

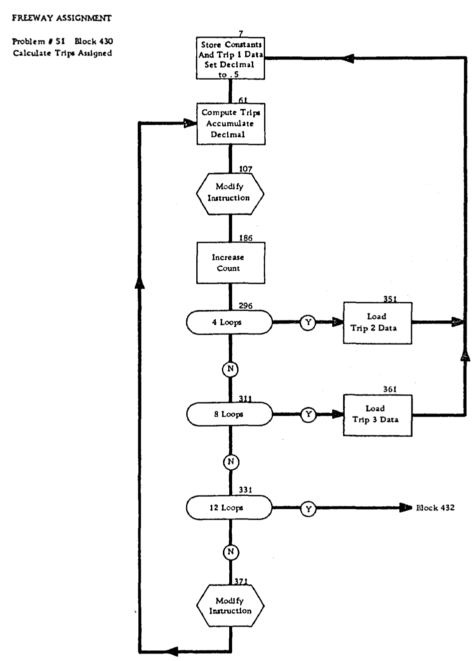
(Continued on next column)

Add to the program the following instructions:

Block	Card	Code	Loc.	Instruction
430	030	0	1024	69 1309 1103
430	035	0	1103	24 1551 1901
430	046	0	1901	69 1027 1030
430	075	0	1071	60 8002 1752
430	081	0	1752	30 0002 1702
430	085	0	1702	15 1551 1652
430	086	0	1652	20 1551 1259
430	091	1	1259	21 1821 1074
001	036	2	1053	21 1821 1074
430	341	0	1249	45 1102 1877

File no. 9.2.036 Cont'd
Addenda/Errata

This is a revision of the block diagram for Block 430 to replace page 31 of the program write-up.



IBM 650 Library Program Abstracts

File no. 9.2.037
Engineering Applications

LOADOMETER W-6 TABLE

J. H. Harbour
California Division of Highways
Sacramento, California

a. Purpose: Edit data and calculate per cent of overload on total weight and each axle of trucks and truck combinations with one or more axles 18,000 pounds or more, and single unit trucks weighing 13 tons or more per California Wheel Base Law and "AASHO", American Association of State Highway Officials, recommendations.

b. Range: A maximum of 7 axles per vehicle.

(Continued on next page)

Accuracy: Per cent violation to 1/10 of one per cent which is converted to code.

Floating/Fixed: Fixed decimal point.

c. Mathematical Method: Arithmetic.

d. Storage Required: 2000-word drum.

Speed: Approximately 700 vehicles per hour.

Relocatability: Not given.

e. Remarks: Minor changes in program may be required subject to changes in State Wheel Base Law and "AASHO", American Association of State Highway Officials, recommendations.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 9.2.038
Engineering Applications

STRESS ANALYSIS OF OPEN-WEB STRUCTURES

C. W. Zahler
United States Steel Corporation

J. E. O'Keeffe
American Bridge Division
Pittsburgh, Pennsylvania

a. Purpose: Several specific computer programs concerned with obtaining the axial stresses in members of an open-web system, together with their relative geometry, provide a basis for a brief sketch of the various phases of development of the system from conception to utilization.

b. Range: Simple web, 99 panels;
Subdivided, 62 panels;
"K" type, 88 panels.

Accuracy: Not given.

Floating/Fixed: Fixed point arithmetic is used.

c. Mathematical Method: The standard formulas are used.

d. Storage Required: The entire drum.

Speed: Not given.

Relocatability: Not relocatable.

e. Remarks: This routine consists of several packages: Load Routine; Indexing Register Simulator; Reaction program; Truss Geometry and Stresses: Simple Web, Subdivided Panel, and "K" System. Mathematical subroutines include:

SINE, COSINE, SINH, COSH, e^x, LOG_e, ARCSINE, ARCTAN, $\sqrt[3]{N}$, $\sqrt{|A|}$.

In the right triangle a, b, c, any of the following are computed, with or without their natural functions:

$\sqrt{a^2+b^2}$, $\sqrt{c^2-b^2}$, $\sqrt{c^2-a^2}$. Also, $\sqrt{a^2+b^2+c^2}$, $\sqrt{c^2-a^2-b^2}$, $\sqrt{a^2+b^2-2ab\cos\phi}$.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 9.2.039
Engineering Applications

DIGITAL TERRAIN MODEL SYSTEM TERRAIN DATA EDIT PROGRAM TD-1

Massachusetts Department of Public Works
C. L. Miller
R. A. Baust
Photogrammetry Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

a. Purpose: The Digital Terrain Model (DTM) System Series of computer programs requires the terrain data to be in a certain format and to meet a set of specifications. This program checks the terrain data to insure that it is in the proper format and meets the required specifications. Error cards are punched to identify terrain data cards and points which are not in proper format or sequence.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

(continued on next column)

c. Mathematical Method: Does not apply.

d. Storage Required: Not given.

Speed: Operates at read speed (200 cards per minute).

Relocatability: Not in relocatable form.

e. Remarks: None.

f. IBM 650 System: One 533 required.

Special Devices: Alphabetic device required.

IBM 650 Library Program Abstracts

File no. 9.2.040
Engineering Applications

DIGITAL TERRAIN MODEL SYSTEM HORIZONTAL ALIGNMENT PROGRAMS HA-1, 2, 3, and 4.

Massachusetts Department of Public Works
C. L. Miller
R. A. Laflamme
Photogrammetry Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

a. Purpose: HA-1, DTM Basic Horizontal Alignment Program:
Computes the geometry of a highway centerline defined by coordinates of P.I.'s and the radii of the curves. Relates the DTM Terrain Data Sections to this centerline and computes the terrain elevation at the centerline for each section.
HA-2, DTM Even Station Interpolation Program:
Takes the centerline terrain elevations (which are on odd centerline stations) and interpolates for elevations on even stations.
HA-3, DTM Parallel Offset Alignment Program:
Takes the same input as HA-1, includes the same output but also computes the data for two parallel offset lines.
HA-4, DTM Special Alignment Geometry Program:
The same as HA-1 except that it computes only centerline geometry. It can be used independently of the DTM System.

b. Range: Maximum number of horizontal curves is 50. Maximum number of points per cross section is 200.

Accuracy: All lengths and distances are computed to three decimal places.

Floating/Fixed: Fixed point arithmetic is used.

c. Mathematical Method: Coordinate transformations and trigonometry are used.

d. Storage Required: HA-1, 2, 3, and 4 are loaded together. There are 200 locations available.

Speed: Not given.

Relocatability: Not given.

e. Remarks: HA-3 and HA-4 are options of HA-1. HA-2 is a separate program but is loaded with HA-1.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 9.2.041
Engineering Applications

DIGITAL TERRAIN MODEL SYSTEM VERTICAL ALIGNMENT PROGRAMS VA-1 and VA-2

Massachusetts Department of Public Works
C. L. Miller
R. A. Laflamme
Photogrammetry Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

a. Purpose: VA-1, Basic Vertical Alignment Program:
This program computes the geometry of the vertical alignment of a highway and computes the profile elevation at each cross section. The input is the profile definition data and the output of the DTM HA-1 program.
VA-2, Highway Profile Geometry Program:
This program computes the geometry of the vertical alignment of a highway and computes the profile elevation at even stations along the alignment. The input is the profile definition data and the increment between even stations. Can be used independently of the DTM System.

b. Range: Maximum number of vertical curves is 98.

(Continued on next page)

Accuracy: All lengths and distances are computed to three decimal places. Grades are computed in decimal form and are carried out to ten decimal places.

Floating/Fixed: Fixed point arithmetic is used.

c. Mathematical Method: Standard parabolic vertical curves are used.

d. Storage Required: VA-1 and VA-2 are loaded together and use 600 locations.

Speed: Not given.

Relocatability: Not in relocatable form.

e. Remarks: None.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 9.2.042
Engineering Applications

DIGITAL TERRAIN MODEL SYSTEM PRELIMINARY EARTHWORK PROGRAM EW-2

Massachusetts Department of Public Works
C. L. Miller
R. A. Laflamme
Photogrammetry Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

a. Purpose: This is the basic program for computing earthwork quantities in location studies. A simplified template is used for the efficient evaluation of a number of trial lines. The input is the template definition data, the DTM terrain data deck, and the output of the DTM VA-1 program. The output is the template definition data for each section and the volumes at each section.

b. Range: Maximum number of points per cross section is 200.

Accuracy: Volumes are computed to the nearest cubic yard.

Floating/Fixed: Fixed point arithmetic is used.

c. Mathematical Method: The average end area method is used to compute the volumes.

d. Storage Required: Program uses 1900 locations.

Speed: Not given.

Relocatability: Not in relocatable form.

e. Remarks: None.

f. IBM 650 System: One 533 is required.

IBM 650 Library Program Abstracts

File no. 9.2.043
Engineering Applications

SAN DIEGO FREEWAY ASSIGNMENT

M. Brubaker
R. Bieber
California State Division of Highways
Sacramento, California

a. Purpose: This routine computes time and distance on a freeway system and compares this data with that of a basic system to determine whether the proposed freeway system would be adequate.

b. Range: Not given.

Accuracy: Not given.

Floating/Fixed: Fixed point arithmetic is used.

c. Mathematical Method: Not applicable.

d. Storage Required: The entire drum is used. Cumulative time and distance between zones are stored in 1299 locations. For a problem not requiring this many zonal interchanges, additional locations can be made available to the routine.

Speed: Not given.

Relocatability: Not relocatable.

(Continued on next column)

e. Remarks: The routine can handle only ten routing cards per routing. Three years of trip data can be handled at one time. Total vehicle miles and minutes for each alternate processed must be punched out on completion of the problem by the use of a special punch routine. The program is written in SOAP I.

f. IBM 650 System: One 533 required.

Special Devices: Alphabetic device, 10 extra pilot selectors (for a total of 20), and 12 extra coselectors (for a total of 20) are required.

IBM 650 Library Program Abstracts

File no. 9.2.043
Addenda/Errata

"San Diego Freeway Assignment," by M. Brubaker and R. Bieber.

The following additions should be made to the program write-up:

An error has been discovered in the Freeway Assignment Program due to rounding the computed trips assigned to the basic best freeway and second best freeway routes.

In Block 430 of the program the trips assigned to the basic route were computed by multiplying the per cent times the number of trips and rounding the result. The trips assigned to the second best freeway route were obtained in the same manner. Trips assigned to the best freeway route were obtained by subtracting the sum of the basic and second best assignment from the total number of trips. This was done to insure assigning all the trips and never to assign more than the total number of trips. However, if all of the trips fall into the two computed categories and values are such that each computation is rounded up by one half of a trip, the two computed categories have one more than the total trips to be assigned, and the number of trips assigned to the best freeway trips becomes minus 1. The following corrections should be made in the program to use decimal accumulation and avoid the result stated above.

Delete from the program the following instructions:

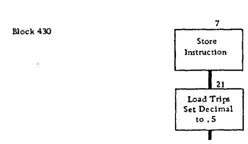
Block	Card	Code	Loc.	Instruction
1	36	2	1603	20 1810 1413
430	46	0	1474	69 1427 1380
430	81	0	1461	31 0002 1509
430	91	1	1509	20 1810 1413
430	341	0	1417	45 1370 1471
430	401	0	1852	65 1565 1902
430	411	0	1902	16 1812 1994
430	421	0	1994	16 1810 1546
430	431	0	1546	20 1811 1496
430	441	0	1496	65 1404 1646
430	451	0	1646	16 1813 1596
430	461	0	1596	16 1815 1746
430	471	0	1746	20 1814 1995
430	481	0	1995	65 1364 1846
430	491	0	1846	16 1816 1996
430	501	0	1996	16 1818 1946
430	511	0	1946	20 1817 1471

Add to the program the following instructions:

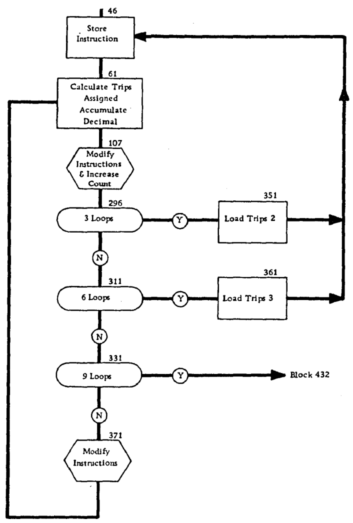
Block	Card	Code	Loc.	Instruction
430	030	0	1474	69 1309 1852
430	035	0	1852	24 1902 1994
430	046	0	1994	69 1427 1380
430	075	0	1461	60 8002 1546
430	081	0	1546	30 0002 1646
430	085	0	1646	15 1902 1596
430	086	0	1596	20 1902 1509
430	091	1	1509	21 1810 1413
001	036	2	1603	21 1810 1413
430	341	0	1417	45 1370 1471

File no. 9.2.043 Cont'd
Addenda/Errata

This is a revision of the block diagram for Block 430 to replace page 12 of the program write-up.



(Continued on next page)



IBM 650 Library Program Abstracts

File no. 9.2.044
Engineering Applications

EARTHWORK DATA CHECK

K. F. Kohler
R. R. DeClark
Bureau of Public Roads
Portland, Oregon

a. Purpose: This program indicates and locates all probable major errors, omissions or deviations contained in design earthwork data. When an error or significant deviation is detected, an error card is punched which indicates and locates the deviation or error.

b. Range: Minor errors are not detected. The break-point between major errors and minor errors may be designated by the design engineer. This program does not contain program stops. The amount of input or output is unlimited. The routine checks Earthwork Design Data Cards in any of the following arrangements:

1. Type "0," "1" or "2" separately
2. Type "0" combined with type "1" or type "2"

Accuracy: Not given.

Floating/Fixed: Fixed point.

c. Mathematical Method: Simple arithmetic is used.

d. Storage Required: The program and data use 1960 storage locations.

Speed: The program operates at approximately 3/4 read speed, depending on the number of points in the section and the number of errors detected.

Relocatability: Not given.

e. Remarks: This program is designed to be used in conjunction with B.P.R. revised version of the IBM Library Program, File No. 9.2.004. Error cards contain the location of the error and a 20-character statement identifying the type of error.

f. IBM 650 System: One 533 required.

Special Devices: Alphabetic device required.

IBM 650 Library Program Abstracts

File no. 9.2.045
Engineering Applications

TALBOT SPIRAL INTERSECTIONS

J. Petersen
Computer Section
Washington Department of Highways
Olympia, Washington

(Continued on next column)

a. Purpose: The basic purpose of this program is to compute the coordinates of the point of intersection of a given line with a line offset a given distance from a Talbot spiral, the radial bearing at this point and the distance along the offset line from the beginning of the spiral. It will also compute the length and bearing of lines joining successive sets of coordinates. The coordinates developed in one problem may be stored for use in later problems.

b. Range: Only one spiral at a time may be used, but an unlimited number of problems based on this spiral may be calculated. An unlimited number of distances and bearing computations is possible.

Accuracy: Distances are given to thousandths of a foot and bearings to seconds.

Floating/Fixed: Input and output are in fixed point; floating point is used within the program.

c. Mathematical Method: Intersection is found by iteration.

d. Storage Required: The program occupies 1762 storage locations.

Speed: The computations for each intersection require approximately 30 seconds. Distance and bearing computations proceed at about 30 per minute.

Relocatability: Not relocatable.

e. Remarks: The program is written in SOAP I form. It uses portions of SOAP I Interpretive Routine, File No. 2.0.001.

f. IBM 650 System: One 533 required.

Special Devices: Alphabetic device required.

IBM 650 Library Program Abstracts

File no. 9.2.046
Engineering Applications

PROFILE GRADE

J. Oakes
Oregon State Highway Department
Salem, Oregon

a. Purpose: This routine computes gradients between PI's and profile grade elevations for either defined incremented stations or selected stations. The program will compute for either plus or minus stationing and in either ascending or descending order. It will handle both horizontal and vertical equations caused by changes in datum or differences in depth of surfacing.

b. Range: The program will handle up to 98 changes of grade.

Accuracy: To hundredths for all factors except grade, which is to ten thousandths. Stationing may be selected to either the nearest foot or the nearest hundredth of a foot.

c. Mathematical Method: Standard.

d. Storage Required: The program requires approximately 1950 storage locations.

Speed: The routine operates at full punch speed.

Relocatability: Not given.

e. Remarks: None.

f. IBM 650 System: One 533 required.

Special Devices: Ten extra pilot selectors (for a total of 20) are required.

IBM 650 Library Program Abstracts

File no. 9.2.047
Engineering Applications

CONTRACT BID COMPUTATIONS

T. L. Yates
Oregon State Highway Department
Salem, Oregon

a. Purpose: This routine checks the contractors' bid extensions and totals. It arranges the job bids in order by amount.

b. Range: Unit bids from \$0.0001 to \$999,999.9999. Item and job totals up to \$9,999,999.99. This routine can handle up to 95 items and 30 bidders per job.

Accuracy: As indicated above.

Floating/Fixed: Not given.

c. Mathematical Method: Does not apply.

(Continued on next page)

d. Storage Required: Requires 1981 storage locations.

Speed: This routine operates at full read and punch speed.

Relocatability: Not given.

e. Remarks: The output from this program can be used as input for the IBM 650 Library Program "Bid Summaries" (File No. 9.2.048).

f. IBM 650 System: One 533 required.

Special Devices: Alphabetic device; one read half-time emitter; 10 extra pilot selectors (for a total of 20); and 8 extra coselectors (for a total of 16) are required.

IBM 650 Library Program Abstracts

File no. 9.2.048
Engineering Applications

BID SUMMARIES

T. L. Yates
Oregon State Highway Department
Salem, Oregon

a. Purpose: This routine is designed to summarize the item and total bids on a job.

b. Range: See IBM 650 Library Program "Contract Bid Computations" (File No. 9.2.047).

Accuracy: Not given.

Floating/Fixed: Not given.

c. Mathematical Method: Does not apply.

d. Storage Required: This routine requires 1945 storage locations.

Speed: Operates at full read and punch speed.

Relocatability: Not given.

e. Remarks: This routine will summarize an 80-item job in one pass or up to 150 items in two passes. The low bidder's unit bid and item bid are both included in the output. All other bidders' item bids are punched. This routine groups the bidders five at a time with the low bidder.

f. IBM 650 System: One 533 required.

Special Devices: Alphabetic device; one read half-time emitter; 10 extra pilot selectors (for a total of 20); and 8 extra coselectors (for a total of 16) are required.

IBM 650 Library Program Abstracts

File no. 9.2.049
Engineering Applications

TIME SERIES TREND EQUATIONS

R. A. Bieber
California Division of Highways
Sacramento, California

a. Purpose: This program is designed to solve the equations $Y = A + Bx$, $\text{LOG } Y = A + Bx$, and $Y = AB^x$ for a value of A and B and using this value determine a Y_c for the years of trend plus some desired years in the future. In addition, a standard estimate of error is determined for each type of trend. The Y's which are calculated may be punched out for each year or for any interval of years desired.

b. Range: The linear equation may be based on increasing or decreasing trends. The semilog equation may be based on increasing or decreasing trends as long as the values of Y do not become negative. The exponential may only be solved for increasing trends.

Accuracy: The log and antilog routines used are accurate to 2×10^{-7} and the square root routine is accurate to 10^{-2}.

Floating/Fixed: DOPSIR, the double-precision floating point routine, is used. All output, however, is in fixed point.

c. Mathematical Method: The linear and semilog equations are solved by the method of least squares and the exponential is solved by a set of normal equations modified for flexibility.

d. Storage Required: The program requires the entire 2000 storage locations.

Speed: The time required for solving the three types of equations is approximately 4-3/4 minutes.

Relocatability: Not relocatable.

(Continued on next column)

e. Remarks: The program has been designed to solve the three equations as a unit or in different combinations.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 9.2.050
Engineering Applications

TREND ANALYSIS AND PREDICTION

R. A. Bieber
California Division of Highways
Sacramento, California

a. Purpose: This routine is designed to reapproximate values A and B for the equation $Y = AB^x$ using an initial approximation obtained by other methods. A standard error of estimate is calculated from calculated Y_c using the new approximations. Y_c for future years is also calculated.

b. Range: The program is not designed to handle decreasing trends.

Accuracy: All output is in fixed point numbers of at most ten figures.

Floating/Fixed: DOPSIR, the double-precision floating point routine, is used for nearly all mathematical operations.

c. Mathematical Method: The method of solution of normal equations is used but with modification as to scaling of the X power. The standard error of estimate is calculated by the normal method.

d. Storage Required: The program, including DOPSIR, requires approximately 1700 storage locations.

Speed: The speed is relatively slow due to the use of DOPSIR. For analyzing 20 years of data plus predicting 30 years, approximately 3 minutes are required.

Relocatability: Not given.

e. Remarks: The program has been designed to handle reapproximations of its own approximations for up to three approximations, or until desired accuracy is obtained. The better the approximation used for input, the better the computed Y's and standard error.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 9.2.051
Engineering Applications

WATER SURFACE PROFILE PARAMETERS

P. D. Doubt
Soil Conservation Service
U. S. Department of Agriculture
Beltsville, Maryland

a. Purpose: This program computes the following:

1) The parameters used in the graphical solution of water surface profiles in natural streams for any discharge
2) Critical discharge
3) Cross-sectional area
4) Top widths
5) Conveyance values based on Manning's formula.

b. Range: Top width of 9999 feet; hydraulic radius of 99 feet. A maximum of 40 points and 6 segments may be used to define the cross section. No two consecutive points defining the cross section may have the same elevation.

Accuracy: Vertical and horizontal distances may be given to the nearest 0.1 of a foot and 1.0 feet respectively.

Floating/Fixed: Not given.

c. Mathematical Method: Escoffier's method is modified to correct for changes in velocity head.

d. Storage Required: The program uses the entire 2000 storage locations.

Speed: The time T in seconds for one cross section is approximately:

$$T = 2a + bc,$$

where a = number of points in cross section;
c = number of elevations for which the computer calculates a set of parameters;

No. of Segments	Values of b
1	2.0
2	3.2
3	4.2
4	5.0
5	5.8
6	6.6

Relocatability: Not relocatable.

e. Remarks: The program is self-restoring and punches codes for obvious errors in input data. NOTE: ONLY the program deck is available in the normal manner through the IBM 650 Program Library. Requests for information regarding the availability of the detailed write-up should be sent to the author.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 9.2.052
Engineering Applications

AUTOMATIC MINIMUM WEIGHT DESIGN OF STEEL FRAMES

R. L. Stone
Division of Applied Mathematics
Brown University
Providence, Rhode Island

a. Purpose: Given the centerline dimensions of a plane structure and the loads acting upon it, this program computes the bending moment distribution which minimizes the structural weight.

b. Range: Frames up to and including 3-bay, 4-storey or 4-bay, 3-storey.

Accuracy: Not given.

Floating/Fixed: Fixed Point.

c. Mathematical Method: A method which was devised by J. Heyman and W. Prager of the Division of Applied Mathematics of Brown University.

d. Storage Required: The entire drum is used.

Speed: Varies considerably with the size of the frame being designed. The following examples are typical:

1. A one-bay, one-storey frame was designed in 3 minutes.
2. A two-bay, two-storey frame was designed in one hour and 45 minutes.
3. A three-bay, three-storey frame was designed in slightly over 4 hours.

Relocatability: Not relocatable.

e. Remarks: The program is completely automatic, requiring no intermediate intervention by the operator. It consists of 15 subroutines (a total of about 2400 instructions).

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 9.2.053
Engineering Applications

BPR REVISION OF OREGON HORIZONTAL ALIGNMENT PROGRAM

K. F. Kohler
C. L. Borstad
Bureau of Public Roads
Portland, Oregon

a. Purpose: This program will compute curve and spiral data, and stationing and coordinates, for curve points of a projected alignment when the coordinates of the P. I.'s are scaled from a detail map and the degree of curve and length of spirals are assigned.

b. Range: Stationing (SSSS + SS.SS), all distances, and coordinates are full normal range and to two decimal places; angles (DDDMMSS) and bearing (DDMMSS) are either as indicated or selectable to the nearest 30 seconds or minute.

Accuracy: Consistent with normal manual methods.

Floating/Fixed: Computations are in floating point; input and output are in fixed point.

c. Mathematical Method: Based on Talbot Spiral using "Arc" definition of circular curve.

d. Storage Required: Approximately 1888 storage locations are used.

Speed: Computing time is approximately 18 seconds per simple curve and 25 seconds per spiraled curve.

e. Remarks: The program is written in SIR (2.0.001).

f. IBM 650 System: One 533 required.

Special Devices: Alphabetic device is required.

IBM 650 Library Program Abstracts

File no. 9.2.054
Engineering Applications

LAND AREA - SURVEY TRAVERSE

(Continued on next column)

A. L. Stewart
IBM, Tulsa, Oklahoma

R. J. Jacobs
Sunray Mid-Continent Oil Company
Tulsa, Oklahoma

a. Purpose: This program calculates area and traverse data for the typical land survey. Input used is standard surveying notation, i.e., metes and bounds, and is in the form of one card per course. Distance may be in either feet or varas. The survey may be a closed traverse or may have one unknown side. Results are punched one traverse per card. If it is a closed traverse, the following information is punched: identification, bearing and length of error of closure, number of measured courses, ratio of precision, and area in acres (after balancing). The adjusted bearing and length of each course may also be obtained if desired. If the traverse contains an unknown course, the bearing and length of that course and the area of the traverse including that course are punched in addition to identification and number of measured courses.

b. Range: The program handles any traverse with up to 200 courses.

Accuracy: Distances are given to thousandths of feet or varas and bearings to hundredths of seconds. Area, in acres, is computed to four decimal places. Subroutine functions are computed to nine decimal places.

Floating/Fixed: Not given.

c. Mathematical Method: Balancing is achieved by means of the compass rule and area is calculated by double-meridian distances (DMD). Library subroutines used are from IBM Technical Newsletter No. 9 for sine, cosine, and arctangent. A trace subroutine (IBM Bulletin No. 135) is also included.

d. Storage Required: This program, including subroutines, requires about 1000 storage locations. There are 650 more storage locations reserved for tables.

Speed: Approximately 3000 courses per hour.

Relocatability: The program is considered optimized and is not in relocatable form.

e. Remarks: To obtain correct areas, the courses must be in order; and in any case all the cards for a given traverse must be together. Except for double punches and blank columns, there should be no foreseeable machine stops. Error cards are punched and the program proceeds to the next traverse automatically.

f. IBM 650 System: One 533 required.

Special Devices: Alphabetic device is required.

IBM 650 Library Program Abstracts

File no. 9.2.055
Engineering Applications

GEORGIA EARTHWORK PROGRAM

W. L. Anderson
T. R. Smith
R. M. Pryor, Jr.
State Highway Department of Georgia

H. Wesson
R. Arbuckle
IBM, Atlanta, Georgia

a. Purpose: This program is designed to calculate the following:

For the Design Problem:

Cut, fill, fill plus shrinkage volumes
Mass ordinates
Slope selection
Slope stake offset and elevation
Summarization of cut and fill volumes at five station intervals

For the Final Pay Problem:

Cut, fill, fill plus shrinkage volumes
Mass ordinates
Borrow pits

b. Range: Not given.

Accuracy: Not given.

Floating/Fixed: Fixed decimal.

c. Mathematical Method: The average end-area method.

d. Storage Required: Approximately 1,200 storage locations are used for the program and approximately 600 for the tables.

(Continued on next page)

Speed: Eight to 15 minutes per mile.

Relocatability: Not given.

e. Remarks: None.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 9.2.056
Engineering Applications

THREE-POINT SOLUTION

D. Geister
Oregon State Highway Department
Salem, Oregon

a. Purpose: This program is designed to compute the coordinates of a point by the Three-Point method. It can handle from three to nine known points computing a solution for every combination of three known points. The selection of the most desirable solution is left to the engineer submitting the data.

b. Range: From three to nine known points are acceptable in the input data. The output will include every combination of three points.

Accuracy: Not given.

Floating/Fixed: Floating decimal, using SIR.

c. Mathematical Method: Three-point solution; see the program write-up for further details.

d. Storage Required: 1,700 storage locations.

Speed: Not given.

Relocatability: Not given.

e. Remarks: Subroutines used in SIR are Float, Fix, Sin, and Cos. For best results, angles greater than 20^{o} should be used. Three-point problems in which all points including unknown are on a circle have an infinite number of solutions, any one of which the program may produce as its result.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 9.2.057
Engineering Applications

MOMENT AND REACTION INFLUENCE LINE ORDINATE FOR SYMMETRICAL 3-SPAN OR 4-SPAN CONTINUOUS GIRDER BRIDGES

J. W. Chambers
C. Cook
B. Williams
Bridge Design Division
Alabama State Highway Department
Montgomery, Alabama

a. Purpose: This program calculates moment and reaction influence line ordinate for symmetrical 3-span or 4-span continuous girder bridges with constant moment of inertia, or for symmetrical 3-span or 4-span continuous concrete girder bridges with parabolic haunches at the intermediate supports (with limitations as stated in program write-up).

b. Range: See the program write-up.

Accuracy: All machine calculations are rounded to five decimal places.

Floating/Fixed: Fixed decimal.

c. Mathematical Method: A variation of the slope-deflection principle.

d. Storage Required: Not given.

Speed: Not given.

Relocatability: Not given.

e. Remarks: None.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 9.2.058
Engineering Applications

STRAIGHT LINE BRIDGE GRID SYSTEM

D. L. Herke
Ohio Department of Highways
Columbus, Ohio

(Continued on next column)

a. Purpose: This program computes the necessary information needed for detailing a tangent bridge. The information calculated includes the following:

1. The station of a point.
2. The P. G. elevation of a point.
3. A longitudinal distance back to the preceding point.
4. A skewed distance along the centerline of a substructure element, from one point to the next succeeding point.
5. A final surface elevation.
6. A total skewed distance from a point to the centerline of survey.

b. Range: The maximum number of points on any substructure element is 20. Any number of substructure elements are allowed.

Accuracy: All calculations are accurate to at least three decimal places.

Floating/Fixed: Fixed decimal.

c. Mathematical Method: Elementary arithmetic, algebra and trigonometry.

d. Storage Required: The program requires the first 725 drum storage locations; subroutines included require about 350 additional locations.

Speed: The time required by the program is approximately as follows:

58 + 0.5n seconds, where n is the number of points to be computed.

Relocatability: Not given.

e. Remarks: Some precautions which should be observed are:

1. Negative information must be identified by a negative overpunch in the units position of the appropriate input word.
2. A plus sign need not be punched for any value other than in the first word of data cards 3 and 4 (column 8). In these words, the overpunch serves to identify the card as having ten words of information in it.
3. Of course, one cannot exceed the problem format. Any D_1 distance cannot exceed 99.999 feet.

f. IBM 650 System: One 533 required.

Special Devices: None required.

IBM 650 Library Program Abstracts

File no. 9.2.059
Engineering Applications

CIRCULAR CULVERT ANALYSIS

R.N. Boden
Ohio Department of Highways
Columbus, Ohio

a. Purpose: This program determines the proper method of analysis for a culvert acting under a given set of conditions and determines the most economical size of circular section.

b. Range: Maximum design discharge is 9999 cfs; maximum length of conduit is 999 feet. Circular pipe sizes analyzed by the program range from 12 in. to 108 in.

Accuracy: Not given.

Floating/Fixed: Fixed decimal arithmetic is used.

c. Mathematical Method: Primarily, algebra and trigonometry. Manning's Equation is used to compute the hydraulic values of conduits flowing full. Chezy's Formula is the basis for computing the hydraulic elements of partially full conduits.

d. Storage Required: 959 drum storage locations are reserved for tables, subroutines and loading routines; 1034 locations are required for the program. This leaves seven remaining storage locations; however, additional drum storage space may be found within the area reserved for the Square Root Subroutine.

Speed: This is a function of the type of analysis chosen by the program to compute the hydraulic elements of the conduit.

Relocatability: Not relocatable.

e. Remarks: The program is primarily designed for checking culvert designs; however, an additional feature is included whereby a culvert may be designed providing certain conditions exist. SOAP symbolic deck listing is included.

f. IBM 650 System: One 533 required.

Special Devices: Alphabetic device. However, the program can very easily be revised to operate without this device.

IBM 650 Library Program Abstracts

File no. 9.2.060
Engineering Applications

3-SPAN CURVED CONCRETE SLAB BRIDGE PROGRAM

(Continued on next page)

D. L. Herke
Ohio Department of Highways
Columbus, Ohio

a. Purpose: This program is designed to generate and compute a station number; a profile grade elevation; an X and Y coordinate; and a final surface elevation for a number of specified and given points on the abutments and piers of a 3-span curved concrete slab bridge.

b. Range: The range of the important portion of the input data is as follows:

For $R_1 - R_6$, incl., 0.01 ft. $\leq R \leq$ 316226.00 ft.

$0^\circ - 1'05'' \leq D \leq 89^\circ - 59'59''$,
where D = Degree of Curvature

For $S_1 - S_2$, incl., $0.000 \leq S \leq 99.999$

For θ, $0 < \theta < 89^\circ 59'59''$

Accuracy: The accuracy of the station, the profile grade and the final surface elevations calculations are to ±0.01 of a foot. The X and Y coordinates are accurate to at least three decimal places.

Floating/Fixed: Computations are made in fixed decimal arithmetic.

c. Mathematical Method: Primarily, trigonometry is used. In Block 21 of the flow diagram, there is a formula stated as $Y_k = T_r \sqrt{1 - P^2}$. There were several methods of computing Y at this point. This method was chosen mainly for its ease of handling and its relative simplicity. Another way of accomplishing the same task might be to obtain P as the quotient of TX ÷ TR, convert that to an angle θ in degrees, convert θ in degrees to θ in radians, obtain the cosine and multiply by a particular radius.

There are two methods for computing the bridge limit on the center line of survey. The method that was used is discussed more fully in Section V of the write-up. The other method is similar to that used for the inner and outer guard rail lengths and is based on the fact that $S = R\theta$. Using this, we may compute B. L. Survey = $(\theta_1 - \theta_{23})R_1$. This is obviously the easier of the two but was discarded in lieu of the standard method to produce a more accurate answer.

IBM 650 Library Program Abstracts

File no. 9.2.061
Engineering Applications

PROFILE GRADE

S.E. LaMacchia
H.R. Sharp
Ohio Department of Highways
Columbus, Ohio

a. Purpose: This program computes elevations along the profile grade of a proposed highway for both tangent sections and vertical curves.

b. Range: The maximum number of station equations and odd stations (not even multiples of 25) combined is 600. The maximum number of PVI points is 100.

Accuracy: Percent grade is accurate to the nearest 0.001 ft. Other values are accurate to the nearest 0.01 ft.

Floating/Fixed: Fixed decimal.

c. Mathematical Method: Simple mathematics.

d. Storage Required: 1954 locations.

Speed: Not given.

Relocatability: Not relocatable.

e. Remarks: None.

f. IBM 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 9.2.062
Engineering Applications

DIGITAL TERRAIN MODEL SYSTEM FOUR POINT POLYNOMIAL INTERPOLATION PROGRAM DA-2

Massachusetts Department of Public Works
C.L. Miller
R.B. Doggett
Photogrammetry Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

a. Purpose: This program interpolates centerline terrain elevations on even stations from a profile given on odd stations. Four point polynomial

(Continued on next column)

interpolation is used giving a better representation of the terrain than straight line interpolation (used in the DTM HA-2 Program, IBM 650 Library Program File Number 9.2.040).

b. Range: 1. The increment between even stations may be any positive, non-zero number.

2. A profile having any number of points may be used.

Accuracy: The output has as many significant digits as the input.

Floating/Fixed: Fixed decimal arithmetic is used.

c. Mathematical Method: Aitken's method of iteration is used to compute the polynomial.

d. Storage Required: About 200 locations are required for program and storage. However, the program is spread over locations 0000 to 1300 and uses the read and punch areas in the 1950 band.

Speed: The interpolation of a point requires 1.4 seconds. Therefore 43 points per minute are computed and punched.

Relocatability: Not relocatable.

e. Remarks: The program has been written to use a standard DTM card format and the standard DTM control panel. However, the program is not dependent on control panel wiring and any card format may be used providing a corresponding control panel is used.

f. IBM 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 9.2.063
Engineering Applications

DIGITAL TERRAIN MODEL SYSTEM PROFILE SMOOTHING PROGRAM DA-3

Massachusetts Department of Public Works
C.L. Miller
R.B. Doggett
Photogrammetry Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

a. Purpose: The DA-3 program applies curve smoothing formulas to terrain profiles obtained from DTM programs HA-1, 2, or 3 (IBM 650 Library Program File Number 9.2.040). The output of the DA-3 program is a smoothed profile which can then be used for selecting a vertical alignment. This program can also take as input its own output so that any particular profile can be resmoothed as many times as desired. Either the 7 points or 11 points smoothing formulas may be selected.

b. Range: No practical restrictions.

Accuracy: The input data are treated as integers. Therefore the output has the same scaling and significant figures as the input.

Floating/Fixed: Fixed decimal arithmetic is used.

c. Mathematical Method: Standard smoothing formulas using a third degree polynomial over 7 or 11 points are used.

d. Storage Required: The program uses approximately 1000 locations.

Speed: The program requires approximately 6 seconds per profile point. Assuming points at 100 foot intervals, the program will smooth 12 miles of profile per hour.

Relocatability: Not relocatable.

e. Remarks: This program operates in conjunction with 9.2.040 DTM Horizontal Alignment Program and is one of a series of programs in the Digital Terrain Model System.

f. IBM 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 9.2.064
Engineering Applications

CONTINUOUS BEAM DESIGN PROGRAM

J.C. Porter
Nebraska Department of Roads
Lincoln, Nebraska

a. Purpose: This program calculates moments and shears in a 2- to 5-span continuous or framed structure.

(Continued on next page)

b. Range: This program was written for bridges having spans of from 15 to 200 feet.

Accuracy: Moments are generally accurate to 0.1 ft-kip. Shears are generally accurate to 0.1 kip.

Floating/Fixed: Fixed decimal.

c. Mathematical Method: Influence lines are used to calculate end moments, and each span is then treated as a free body.

d. Storage Required: 2000 locations.

Speed: 15 to 20 minutes per span.

Relocatability: Not relocatable.

e. Remarks: This program was written for bridge structures using AASHO loading and specifications. It is recommended that this program be used in conjunction with the Washington State Highways Department's "Moment Distribution and Influence Line Calculation" program, IBM 650 Program Library File Number 9.2.033.

f. IBM 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 9.2.065
Engineering Applications

GEODIMETER COMPUTATIONS

P.E. Mishler
California Division of Highways
Sacramento, California

a. Purpose: This program takes the readings from the Model #3 Geodimeter and a vertical angle from a theodolite, computes a slope distance and reduces this distance to horizontal and vertical components.

b. Range: Not given.

Accuracy: Computes to nearest 0.01 ft.

Floating/Fixed: Fixed decimal arithmetic.

c. Mathematical Method: The mathematics used follows closely the hand calculated procedure making numerous decisions following standard rules of the problem.

d. Storage Required: 415 drum storage locations exclusive of the read and punch locations.

Speed: The program will compute approximately 29 problems per minute.

Relocatability: Not given.

e. Remarks: The program utilizes the IBM 650 Program Library SIN routine.

f. IBM 650 System: One 533 required.

Special Devices: Alphabetic device was used, but is not necessary.

IBM 650 Library Program Abstracts

File no. 9.2.066
Engineering Applications

CONTINUOUS BRIDGE ANALYSIS

T. L. Yates
Oregon State Highway Department
Salem, Oregon

a. Purpose: This program encompasses three independent routines used in the analysis and design of continuous beam type structures. The three routines are: (1) Analysis of Continuous Beams and Frames, (2) Live Load and Total Moments Due to H-S Loading, and (3) Deflections.

b. Range: Two to five span structures are accommodated.

Accuracy: In calculating dead load moments, an error of approximately 1/3% exists.

Floating/Fixed: Not given.

c. Mathematical Method: Principle of Mueller-Breslau and numerical procedure of Newmark.

d. Storage Required: All but six storage locations are used in the routine Live Load and Total Moments Due to H-S Loading.

Speed: A complete frame analysis, including total moments and deflections, requires approximately 15 minutes per span.

(Continued on next column)

Relocatability: Not relocatable.

e. Remarks: Although the three routines were developed separately, they are specifically designed such that a part or all of the output from one can be used as input to another.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 9.2.067
Engineering Applications

COMPUTER ANALYSIS OF CONTINUOUS BEAMS AND FRAMES

E. D. Lee
Washington State Highway Department
Olympia, Washington

a. Purpose: This program analyzes a single story frame with from one to five spans when given the frame dimensions and the H-S wheel load. Output is influence lines for end moments, moments at tenth points and shears at supports for loads at the tenth points. Dead load moments and shears are computed. Moment curve due to unit cantilever moment at either end is computed. Live load moments due to an H-S truck are computed and combined with dead load moments to give the total moment curve.

b. Range: One to five span structures.

Accuracy: Does not apply.

Floating/Fixed: Not given.

c. Mathematical Method: Principle of Muller-Breslau that if any function--such as shear, bending moment, torsion, etc., is allowed to produce freely a corresponding unit deformation, the deflected load line of the structure will represent the influence line for that function to an exact scale. Nathan N. Newmarks' numerical procedure for computing beam deflections was used.

d. Storage Required: Each program requires more than 2000 locations.

Speed: Not given.

Relocatability: Not relocatable.

e. Remarks: This program is a modification of "Continuous Bridge Analysis" by L.H. Bush, Oregon State Highway Department, Salem, Oregon. There is a program deck for each one, two, three, four and five span structure. A bootstrapping procedure is followed wherein one portion of the program is read in and used and then replaced with additional program instructions until the problem is completed.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 9.2.067
ERRATA

CONTINUOUS BEAMS AND FRAMES

Washington State Highway Commission

An error has been detected in one of the program decks of the Continuous Beams and Frames program (9.2.067). This error affects cantilever moments in a three-span beam program. Make the follwoing changes in Part A of the three-span program:

NEW			OLD	
Inst. #			Loc. of Inst.	Instruction
1540	STL K2	STL C1	1532	20 0522 1582
1542	MPY K2	MPY C1	1632	19 0522 0988

IBM 650 Library Program Abstracts

File no. 9.2.068
Engineering Applications

FRAME CONSTANTS

E. D. Lee
Washington State Highway Department
Olympia, Washington

a. Purpose: Given span lengths and variation in section, this program will compute the following: carry-over, stiffness, and distribution factors around each joint; concentrated and uniform load fixed end moment coefficients for each span.

b. Range: One to five span for joint distribution factors; any number of spans for beam constants.

Accuracy: Not given.

(Continued on next page)

Floating/Fixed: Not given.

c. Mathematical Method: Nathan N. Newmarks' numerical procedure for computing beam deflections was used.

d. Storage Required: 1699 storage locations were used.

Speed: Not given.

Relocatability: Not given.

e. Remarks: This program is an extension of the program "Computer Analysis of Beams and Frames," File #9.2.067, and uses the same input form and wiring panels.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 9.2.069
Engineering Applications

OVERHAUL PROGRAM

Kathy Brown
Charlene Travis
S. Ray Cason
Dept. of Highways
Olympia, Washington

a. Purpose: To compute overhaul quantities.

b. Range: 123 even stations for each haul area.

Accuracy: 1 Unit (100 cubic yard stations of overhaul).

Floating/Fixed: Fixed decimal arithmetic is used.

c. Mathematical Method: Does not apply.

d. Storage Required: 1933 drum storage locations are used.

Speed: Approximately 50 stations per minute.

Relocatability: Not relocatable.

e. Remarks: 600 ft. used for freehaul areas.

f. IBM 650 System: One 533 required.

Special Devices: Alphabetic device required.

IBM 650 Library Program Abstracts

File no. 9.2.070
Engineering Applications

STAGE CONSTRUCTION PROGRAM

G. J. Kellenbenz
Washington State Highway Dept.
Olympia, Washington

a. Purpose: Given the cross-section template and catch points, this program will calculate a new cross-section card giving the cross-section readings outside the catch points, the catch points and template readings in elevations.

b. Range: Will handle 100 cross-section readings, 100 template readings and give 150 points on new cross-sections.

Accuracy: Not given.

Floating/Fixed: Not given.

c. Mathematical Method: Not given.

d. Storage Required: This program uses 1028 drum storage locations.

Speed: Punches approximately 50 cards per minute.

Relocatability: The program is written in SOAP II and is relocatable.

e. Remarks: Input and output cards are of the type used by the Washington State Highway Department.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 9.2.071
Engineering Applications

W-6 TABLE SUMMARY

(Continued on next column)

T. L. Yates
State Highway Department of Oregon
Salem, Oregon

a. Purpose: This program summarizes truck weight violation data from the W-6 table in accordance with Bureau of Public Roads requirements.

b. Range: The program as written, will handle a maximum of 999 vehicles; it can be readily expanded, however.

Accuracy: Not given.

Floating/Fixed: Fixed decimal arithmetic is used.

c. Mathematical Method: Does not apply.

d. Storage Required: 500 storage locations.

Speed: Operates at full read speed.

Relocatability: Not given.

e. Remarks: Input to this program consists of output cards from the California "Loadometer W-6 Table" program (IBM 650 #9.2.037).

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 9.2.072
Engineering Applications

DTM RECONNAISSANCE EARTHWORK PROGRAM EW-1

Massachusetts Department of Public Works
C. L. Miller
L. E. Nihen
Photogrammetry Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

a. Purpose: This program provides for rapid numerical evaluation of a large number of different horizontal alignments during the reconnaissance stage of location. The input to the program is (1) three parallel ground profiles to define the terrain (2) VPI data to define the highway profile and (3) template specification data. The output from the program is (1) computed highway profile earthwork volume data. The special feature of the program is the use of three parallel terrain profiles in place of multiple point cross-sections, resulting in high speed continuous processing with an earthwork accuracy consistent with the data sources and requirements of reconnaissance studies.

b. Range: No practical restrictions.

Accuracy: Distances and elevations punched with three decimal places. Volumes to nearest cubic yard.

Floating/Fixed: Fixed decimal arithmetic is used.

c. Mathematical Method: Standard highway geometry.

d. Storage Required: The program uses approximately 1700 storage locations.

Speed: Running time is approximately 33 sections per minute. If the sections are at 200 foot intervals, the program will compute approximately 75 miles of profile and earthwork per hour. Program operates at punch speed.

Relocatability: Not relocatable.

e. Remarks: This program operates in conjunction with 9.2.040 DTM Horizontal Alignment Program and is one of a series of programs in the Digital Terrain Model System. However, program may also be used on non-DTM projects.

f. IBM 650 System: One 533 required.

Special Devices: Alphabetic device is used to punch error cards.

IBM 650 Library Program Abstracts

File no. 9.2.073
Engineering Applications

GENERAL PURPOSE POLYNOMIAL INTERPOLATION PROGRAM DA-5

Massachusetts Department of Public Works
C. L. Miller
R. B. Doggett
Photogrammetry Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

a. Purpose: The DA-5 program is a general purpose polynomial interpolation routine intended for use in obtaining elevations at even increments from profiles, or cross sections, having points at random increments. The program uses the general computational methods of the "DTM System Four Point Polynomial Interpolation Program DA-2" (File Number 9.2.062) but differs from that program in that it accepts input data in the form of 7 points per card.

(Continued on next page)

b. Range: 1. The increment between even stations may be any number greater than zero.

2. A profile having any number of points may be used and as many profiles as desired may be processed in the same run.

Accuracy: Since the program treats the input data as integers, the output has as many significant figures as the input.

Floating/Fixed: Fixed decimal arithmetic is used.

c. Mathematical Method: Aitkin's method of iteration is used to compute the interpolating polynomial.

d. Storage Required: Approximately 250 locations are required for the program and storage.

Speed: The program will compute approximately 47 points per minute.

Relocatability: Not relocatable.

e. Remarks: The program has been written for a utility (80-80) control panel. The board must have the facility of setting word size equal to zero if the word (10 columns) is blank; this is necessary for words 3 through 8.

f. IBM 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 9.2.074

PROFILE COMPARISON AND STATISTICAL ANALYSIS PROGRAM DA-1

C. L. Miller - Project Director
R. A. Laflamme - Programming Supervisor
D. F. Rehberg - Programmer
Photogrammetry Laboratory
Department of Civil and Sanitary Engineering
Massachusetts Institute of Technology
Cambridge, Mass.

a. Purpose: Compares elevations obtained from contour maps to field data on the same profile. Four point polynomial interpolation is used to obtain the map elevation at the same point as the field data. Differences between the two elevations and a statistical analysis of the differences are computed for each profile individually and for all profiles collectively.

b. Range: (1) A map data profile cannot exceed 600 points.
(2) The field data profile will be computed for only those points which are beyond the first two and before the last two map data points.

Accuracy: (1) Differences have as many significant digits as the input data.
(2) Statistics are rounded to two decimal places.

Floating-Fixed: Fixed.

c. Mathematical Method: Aitken's method of iteration is used to compute the polynomials.

d. Storage Required: 600 locations are reserved for the map profile and the program occupies the remaining 1400 locations.

Speed: Differences are computed in 2 seconds, therefore 30 points per minute are compared and punched. Profile or map statistics require 25 seconds, independent of the number of points in the profiles.

Relocatability: Not relocatable.

e. Remarks: Input uses eight ten digit words, however, the output requires special control panel wiring. Output is designed for listing on a 407, with an 80 - 80 board.

f. 650 System: Minimum 650.

Special Devices: Alphabetic Device.

IBM 650 Library Program Abstracts

File no. 9.2.075

COMPUTATION OF BRIDGE SCREED ELEVATIONS

Z. L. Moh
C. E. Cooper
Bridge Bureau
State Highway Department of Indiana
Indianapolis 4, Indiana

a. Purpose: This program computes the elevations for setting screeds for concrete slabs on continuous steel beam or steel girder bridges.

b. Range: Elevations are given at ten foot intervals along four screed lines. Successive spans are considered one at a time with no limitation on the number of spans.

(Continued on next column)

Accuracy: In ordinary cases the elevations are correct to within one or two thousandths of a foot.

Floating/Fixed: Input - floating, Output - fixed. SIR II floating point is used in the program.

c. Mathematical Method: Conjugate Beam method. Constant segment method, polynomial interpolation.

d. Storage Required: 1130 Locations.

Speed: Depends on the properties of bridges. A typical constant I bridge with three spans, 60': 72': 60', requires about 72 seconds. See writeup for approximate formulas.

Relocatability: Not relocatable.

e. Remarks: Input data includes coefficients for the restraining end moments for each span. If these coefficients are not available, e.g. from design computations, they may be determined by use of an accompanying routine.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 9.2.076

TRAFFIC SUMMARY

Thomas L. Yates
Oregon State Highway Department
Data Processing Divison
Salem, Oregon

a. Purpose: This program actually summarizes the count made my Highway Department permanent recorder installations and as the ultimate goal produces factors for expanding monthly ADT and AWT totals to annual ADT. In addition, the percentage of annual ADT for the first and tenth highest 24 hours and the first, tenth, twentieth, thirtieth, and fiftieth highest hours are computed.

b. Restrictions, Range: Range and accuracy are not applicable. Fixed point is used.

c. Method: No unusual mathematical methods were used.

d. Storage Requirements: The program utilizes about 1890 drum locations.

e. Remarks: The program was written as three separate programs and was condensed into one deck. In the accompanying write-ups each program is described individually. Because the programs are controlled from the console, precautions must be taken with regard to console setting and card sort.

f. IBM 650 System: Equipment Required is a minimum 650.

IBM 650 Library Program Abstracts

File no. 9.2.077

TALBOT SPIRAL INTERSECTIONS

Jon Petersen
Computer Section
Washington Department of Highways
Olympia, Washington

a. Purpose: The basic purpose of this problem is to compute the coordinates of the point intersection of a given line or circular curve with a spiral offset a given distance from a Talbot spiral, the radial bearing at this point and bearing the distance along the offset spiral. It will also compute the length and bearing of lines joining successive sets of coordinates. Coordinates, distance, and bearing developed in one problem may be sorted for use in later problems.

b. Restrictions, Range: Distances are given to thousandths of a foot and bearings to seconds. Program uses fixed point.

c. Method: Intersection is found by iteration.

d. Storage Requirements: Occupies 1849 positions of memory storage and is not relocatable. Program is written in SOAP II. Each intersection requires about 7 seconds. Distances and bearing computations proceed at about 80 per minute.

e. Remarks: Program is written for IBM Type 650 Processing Machine. Only one spiral at a time may be used, but an unlimited number of problems based on this spiral may be calculated. An unlimited number of distance and bearing computations are possible.

f. IBM 650 System: A 650 with alphabetic device is used.

IBM 650 Library Program Abstracts

File no. 9.2.078

ROADWAY TEMPLATE GENERATOR

(Continued on next page)

Felix D. Geissler
Pennsylvania Department of Highways
North Office Building
Harrisburg, Pennsylvania

a. Purpose: This program prepares and punches roadway template design cards for input to most earthwork programs when furnished a standard template or correction, survey offset, median width and slopes and one or more of the following grade profile output cards for: Right roadway, left roadway, median ditch, right outside ditch, left outside ditch.

b. Range: Up to 72 points on the output template and up to 8 points per card as chosen from 100 standard half-section templates of up to 9 points each. If a standard half-section contains from 10 to 19 points it occupies two consecutive template number locations, 20 to 29 points three etc. reducing the passable 100 by a corresponding amount. ((ie) 50 at 9 + 15 at 19 +4 at 3 +2 at 4 = 100)
Accuracy: Horizontal offset to 0.1 feet.
Vertical offset to either 0.01 or 0.1 feet as specifield.
Floating/Fixed: Fixed decimal.

c. Mathematical Method: Elementary algebra.

d. Storage Required: Template storage 0 to 1000; Program with read, punch and load routine 992 locations above 1000.
Speed: Punches about 70 cards per minute depending on the number of template points.
Relocatability: Not relocatable.

e. Remarks: A number of one and two card modifications are included which provide for the generation of almost any road template design from two or more land roadways, through depressed or raised medians defined by slopes or elevations to completely separate roadways.

f. IBM 650 System: One 533 or 537 required.

Special Devices: None required.

IBM 650 Library Program Abstracts

File no. 9.2.079

GENERAL FREEWAY ASSIGNMENT, STOCKTON REVISION

S. F. Persselin
California Division of Highways
1120 N Street
Sacramento, California

a. Purpose: The purpose of this program is to compute time and distance on a freeway system and then compare it to an existing system to determine if the proposed system would be adaquate.

b. Restrictions, Range: Fixed point arithmetic is used.

c. Method: N/A.

d. Storage Requirements: 1000 locations are used to store time and distance between access numbers. 88 locations are used to store accumulated time and distance for city street and freeway routes. 72 locations are used for storage of segment ramps for punchout. Other temporary storage requires approximately 60 locations. The program is written in SOAP I and may be resoaped.

e. Remarks: Each input card may have a maximum of 6 path segments. Only 18 segments may be stored for punchout. If more than 18 segments are read, the normal calculations will still be made but only 18 segments will be punched The additional output must be reproduced from a combination of the input and one of the punched output for that routing. Three years of trip data can be handled at one time.

f. IBM 650 System: 2000-word 650 with alphabetic device, negative shift, 20 pilot selectors and 20 co-selectors.

IBM 650 Library Program Abstracts

File no. 9.2.080

TRACING A MINIMUM PATH BETWEEN
ZONE CENTROIDS OVER A ROAD NETWORK

Marwin Brubaker
California Division of Highways
1120 N Street
Sacramento, California

a. Purpose: The purpose of the program is to obtain mechanical routings as input to a freeway assignment program in place of the present manual methods. Also to obtain the time or distance between zone centroids for use in forecasting trips between zones.

b. Restrictions, Range: The program uses fixed point arithmetic. Accuracy is not a problem.

c. Method: The mathematical method is a minimum path algorithm which checks all possible routes between a pair of zones for a road network and selects the minimum path between zones using time, distance or some other value for each segment of the road network.

d. Storage Requirements: All locations of a 2000-word drum are used except 7. The program is in SOAP format and completely relocatable. The speed depends upon the number of nodes in the road network. If a maximum No. of nodes (699) are being used, the building of the tree takes about 10 minutes and the punchout of the paths takes an average of 12 minutes per tree.

(Continued on next column)

Total running time may be obtained by multiplying the time by the number of zones in the system. By comparison if the number of nodes is 300 the tree will take 4 minutes and the punchout an average of 1 minute. If there are substantially fewer than 699 nodes, a big increase in speed can be obtained by reducing the number of locations reserved in the tables and reSOAPing to fit the size of the problem.

e. Remarks: The table of reference allows for a backlog of 150 nodes which seems to be sufficient, but will cause a machine stop if inadequate. Zone nodes must be identified. Nodes must be numbered on the map so that going from a link described by consecutive node numbers to a link described by nonconsecutive node numbers and vice versa constitutes a turn for which a penalty will be assessed in determining the route. This is to avoid unnecessary jogging in the selection of the path. Through a grid type network it is inevitable that some penalties will be assessed where they should not be and vice versa. All link values must be greater than zero and less than 100. Links with larger values must be split.

f. IBM 650 System: A minimum 650 with a 2000-word drum is required. The program as written makes use of the split shift device to increase speed and save locations. The split shift instructions may be replaced with a resultant loss of speed and number of nodes that can be processed.

IBM 650 Library Program Abstracts

File no. 9.2.081

FREEWAY ASSIGNMENT

S. F. Persselin
Calif. State Div. of Highways
1120 N Street
Sacramento, Calif.

a. Purpose: Freeway Assignment. The purpose of this program is to compute time and distance on a freeway system and then compare it to a basic system to determine if the proposed system would be adequate.

b. Restrictions, Range: Fixed point arithmetic is used.

c. Method: Not applicable.

d. Storage Requirements: 1400 locations are used to store time and distance between access numbers and an additional 44 locations are used to store time and distance between zones. Speed is approximately 2500 input cards per hour. The program is written in SOAP I and may be resoaped.

e. Remarks: Each input card can have a maximum of 6 path segments. There is no restriction as to the number of input cards per zonal interchange. Three years of trip data can be handled at one time.

f. IBM 650 System: 2000 word 650 with alphabetic device, negative shift, 20 pilot selectors and 20 co-selectors.

IBM 650 Library Program Abstracts

File no. 9.2.082

TREE OUTPUT TO FREEWAY INPUT

S. F. Persselin
California Division of Highways
1120 N Street
Sacramento, California

a. Purpose: The routine converts a path defined by node numbers to a path which is defined by access numbers and turning codes. The purpose of this routine is to provide a transition from the California Minimum Path Program to the California Freeway Assignment Program.

b. Restrictions, Range: There is no restriction as to the number of path nodes in any interchange. An input card may have a maximum of 21 path nodes, and an input card a maximum of six entry-exit ramps. A node may have a maximum of 4 access points. The program accommodates as many as 699 nodes and 1400 access points.

c. Method: The principle involved is one of search and compare.

d. Storage Requirements: Table storage requires 1,186 locations. Other program and temporary storage requirements use an additonal 500 locations. Speed is approximately 1,650 input cards per hour. The program is written in SOAP I terminology and can be relocated.

e. Remarks: The program contains an error punch routine which identifies the error and the input card thereby eliminating machine stops during processing.

f. IBM 650 System: A basic 650 with special shift is used.

IBM 650 Library Program Abstracts

File no. 9.2.083

TRAVERSE ADJUSTMENT

S. F. Persselin
California Division of Highways
1120 N Street
Sacramento, California

(Continued on next page)

a. Purpose: This routine adjusts traverses by the compass or the transit rule, or both, as requested by the engineer. Input is in the form of one course per card and output is also in the form of one course per card. Areas for closed traverses may be obtained.

b. Restrictions, Range: Each traverse may have a maximum of 98 regular courses. All linear measurements are given to thousandths of feet and bearings are computed to seconds. All trigonometric functions are computed to nine decimal places.

c. Method: The trigonometric functions used are from Technical Newsletter No. 9. Area is calculated using the criss-cross method.

d. Storage Requirements: One hundred locations each are required for storage of unadjusted latitude departure, and distance. Three hundred locations are required for storage of the description. Program and temporary storage requirements use approximately 800 more locations. Speed is approximately 2300 courses per hour. The program is written in SOAP I form.

e. Remarks: No provision has been made for computing area of circular segments because no provision has been made to keep certain courses constant.

f. IBM 650 System: A 650 with half-time emitters and alphabetic device is used.

IBM 650 Library Program Abstracts

File no. 9.2.084

REVISED TRAVERSE AND HORIZONTAL ALIGNMENT

S. F. Persselin
J. Vliet
California Division of Highways
1120 N. Street
Sacramento, California

a. Purpose: The routine will calculate traverses with two unknowns or with no unknowns in each traverse. Input is in the form of one course per card. Results are punched one course per card and show identification, distance, bearing, latitude, departure, and coordinates for regular courses and also closure error. Areas for closed figures and segment areas are computed. Although two solutions are mathematically possible for some combinations of unknowns within a single traverse, only real solutions are presented as output. The routine will also compute horizontal circular curve problems having either the ending station or the radial bearing to the ending station unknown. Factors in any one horizontal curve or traverse problem may be stored for use in a later problem. Only factors which are known in a traverse may be stored for recall within the same traverse. Bearings stored as interdependency factors can be used as base lines for deflection.

b. Range: Each traverse may have a maximum of 20 regular courses.

Accuracy: Distances are given to thousandths of feet and bearings to seconds. Functions are computed to nine decimal places. Area is calculated to square feet and thousandths of acres.

Floating/Fixed: Does not apply.

c. Mathematical Method: Library subroutines are from Technical Newsletter #9 for sine, cosine, and arctangent. Area is calculated using the criss-cross method.

d. Storage Required: One hundred ninety storage locations are required for regular table storage. Eighty locations are required for interdependency table storage. Other program and temporary storage requirements use the remainder of the two thousand drum locations.

Speed: Speed is approximately two thousand courses per hour. The program is considered optimum and should not be relocated although the program is in SOAP I terminology.

e. Remarks: The program has several routines which test for invalid data

IBM 650 Library Program Abstracts

File no. 9.2.084

in the various problem types, and when errors are detected, coded stops will occur.

f. IBM 650 System: A 650 with alphabetic device and read half-time emitter is used.

IBM 650 Library Program Abstracts

File no. 9.2.085

MODEL 4 GEODIMETER

Virgil T. Greenfield
Division of Highways
Planning Survey Department
Division of Highways
Sacramento, California

a. Purpose: To take readings from the Model 4 Geodimeter and compute the slope distance between two points. Using the vertical angle measured

(Continued on next column)

with a Theodolite, or the known difference elevation, it will reduce this slope distance to horizontal and vertical components.

The program may also be used to reduce any known slope distance in meters or feet to horizontal and vertical components. In this case also, either the vertical angle or difference elevation must be used.

b. Restrictions, Range: Fixed point. Computed to 1/100th foot.

c. Method: The mathematics used closely follows the hand calculated procedure making numerous decisions following the standard rules of the program. IBM Library SIN routine is utilized.

d. Storage Requirements: Uses approximately 905 locations including table areas. Will process approximately twenty-five input problems per minute.

e. Remarks: Blocks 160 and 170 of program are tolerance tests and the limits used as constants meet requirements of this organization but may not be required by other users.

f. IBM 650 System: Alphabetic device and special shift utilized although not necessary. Otherwise minimum 650.

IBM 650 Library Program Abstracts

File no. 9.2.086

DTM ZONE-COST EVALUATION PROGRAM EA-2

C. L. Miller
L. E. Nihen
D. E. Weisberg
Civil Engineering Computer Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

a. Purpose: The EA-2 program is used to evaluate land or other zonal costs, whenever the area of interest can be divided into classified zones. The most apparent use of this program is the evaluation of right-of-way costs for various highway alignments. The input to the program is zone type and cost data presented at DTM scan lines and right-of-way limits. The output is the amount and the cost of ten different classes of land falling within the right-of-way limits.

b. Range: 650 scan lines.

Accuracy: Areas to nearest thousandth of acre and cost to nearest cents.

c. Mathematical Methods: Plane geometry.

d. Storage Required: Entire drum is used.

Relocatability: Not relocatable

e. Remarks: This program operates in conjunction with 9.2.040 DTM Horizontal Alignment Program and is one of a series of programs in the Digital Terrain Model System.

f. 650 System: Minimum 650

Special Devices: Alphabetic device is used to punch "Total" card.

650 LIBRARY PROGRAM ABSTRACT — FILE NUMBER 9.3.001

DETERMINATION OF COEFFICIENTS FOR THE BENEDICT EQUATION OF STATE

C. R. Hobby
University of Houston
Computing and Data Processing Center
Houston, Texas

a) Determination of Coefficients for the Benedict Equation of State.

b) Floating point (SOAP - SIR)

c) Special least square fitting originally developed by Brough, H. W., Schlinger, W. G., and Sage, B. H., Industrial and Engineering Chemistry, 43, p. 2442, November, 1951.

d) Entire drum is used.
Speed: (7N + 140) seconds for first set of coefficients, (1.5N + 140) for succeeding sets,
2N seconds for statistical summary.
N = the number of data points.

e) Does not apply.

f) Minimum 650.

IBM 650 Library Program Abstracts

File no. 9.3.002
Engineering Applications

THERMODYNAMIC PROPERTIES AND PHASE BEHAVIOR OF LIGHT HYDROCARBON MIXTURES

W. Edwards
E. I. Organick
L. Larrey
Computing Center
University of Houston
Houston, Texas

a. Purpose: Computes density, compressibility factor, enthalpy, entropy, and equilibrium ratios of single and two phase systems.

b. Range: Handles mixtures with up to nine components.

Accuracy: Not given.

Floating/Fixed: Single precision floating point with input and output data supplied in fixed point (Humble floating point interpretive routine).

c. Mathematical Method: Rigorous thermodynamic solution based on:

1. Benedict, Webb, Rubin Equation of State for pure components and mixtures; and
2. Zero pressure thermal properties of pure components.

d. Storage Required: Approximately 100 unused drum locations.

Speed: Speed depends upon number of phases, number of components, and on option to compute enthalpy and entropy.

Relocatability: Program is non-relocatable.

e. Remarks: None.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 9.3.003
Engineering Applications

CALCULATION OF THE LEAST-SQUARES BEST HALF-WAVE POTENTIAL AND SLOPE OF A POLAROGRAPHIC WAVE

D. L. McMasters
W. B. Schaap
Indiana University
Bloomington, Indiana

a. Purpose: This program calculates the half-wave potential and slope of a polarographic wave,

$$E = E_{1/2} + \frac{0.0591}{n} \log \left(\frac{i_d - i}{i}\right),$$

by the method of least squares using current-voltage data taken from a polarogram.

b. Range: This program is set up to analyze only polarographic reduction waves.

Accuracy: Not given.

Floating/Fixed: Floating decimal arithmetic is used in the Bell Labs System.

c. Mathematical Method: See a. above.

d. Storage Required: Most of the locations from 0100 through 0400 are used by the entire program.

Speed: The entire routine requires just 15 seconds for each complete calculation.

Relocatability: The program would be difficult to relocate.

e. Remarks: This program, written in the Bell Labs Interpretive System (see TNL No. 11), was designed for polarograms recorded by the Sargent Model XXI Visible Recording Polarograph; however, with only a few obvious and minor changes in the recording of the data (and not in the program), this program can be adapted to other manually and electronically recorded polarograms.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 9.3.004
Engineering Applications

PLATE-TO-PLATE CALCULATIONS

(Continued on next column)

J. H. Erbar
R. N. Maddox
Oklahoma State University
Stillwater, Oklahoma

a. Purpose: This program will determine the separation that can be obtained from a distillation column. The calculations are based on a given number of stages, reflux ratio, distillate rate, feed plate location, and feed composition.

b. Range: Not given.

Accuracy: Not given.

Floating/Fixed: Input and output are in fixed point notation. Calculations are carried out in floating decimal notation.

c. Mathematical Method: The conventional relative volatility method of Lewis and Matheson is used in this program.

d. Storage Required: This program uses approximately 1500 storage locations scattered over the entire drum.

Speed: With heat balances, the speed is approximately 0.6 seconds per component-tray per trial. Without heat balances, the speed is approximately 0.3 seconds per component-tray per trial.

Relocatability: Not in relocatable form.

e. Remarks: The program is limited to a maximum of 20 components and 98 theoretical trays. It is further limited to a single feed stream, two-product system.

f. IBM 650 System: One 533, automatic floating decimal arithmetic feature, IAS, and indexing registers.

IBM 650 Library Program Abstracts

File no. 9.3.005

MOMENTS OF INERTIA POLYATOMIC MOLECULES

George J. Janz
Yukio Mikawa
Department of Chemistry
Rensselaer Polytechnic Institute
Troy, New York

a. Purpose: The product of the three principal moments of inertia is computed for a rigid polyatomic molecule, provided the location of the constituent atoms are known with the reference to an arbitrary Cartesian coordinate system and atomic weights of the components are given.

b. Restrictions, Range: Providing the molecule may be assumed rigid, any type of molecular system can be treated. The floating decimal form is used in the whole computation.

c. Method: The product of the three principal moments of inertia is computed by the Hirschfelder's[1] method.

d. Storage Requirements: The program uses 595 storages including the storage routine, and the floating decimal sub-routine and instructions for the program

The time required for the computation depends upon the number of atoms, being approximately expressed by 3_n seconds where n is the number of atoms.

e. Remarks: It is also possible to calculate each of the three principal moments of inertia from the intermediate results of this computation, by using the additional program.[2]

f. IBM 650 System: Minimum IBM 650.

1. J. O. Hirschfelder; J. Chem. Phys. 8, 431 (1940)
2. G. J. Janz and Y. Mikawa; Molecular Spectroscopy, Part II, IBM 650 Library Program.

IBM 650 Library Program Abstracts

File no. 9.3.006

STATISTICAL THERMODYNAMIC PROPERTIES

George J. Janz
Yukio Mikawa
Department of Chemistry
Rensselaer Polytechnic Institute
Troy, New York

a. Purpose: The thermodynamic functions: $(H^o - H^o_o)/T$, C^o_p, $-(F^o - H^o_o)T$ and S^o are computed from the fundamental vibrational frequencies, the product of the inertia, symmetry number and molecular weight of the polyatomic molecule.

(Continued on next page)

b. Restrictions, Range: The program calculates the above properties of any polyatomic non-linear molecular system in the ideal gaseous state for the rigid rotator - simple bivrator model. The contributions for hindered internal rotation cannot be gained by this program. The mathematical accuracy is ± 0.00001 unit.

c. Method: The calculations of the exponential and the logarithmic functions are made by the use of the sub-routine.

d. Storage Requirements: The number of storages used for the whole computation is 504. When the number of the fundamental frequencies is nine, the time required for the computation for an assigned temperature is 1.2 sec.

e. Remarks: Either the vibrational contribution or the sum of the translational and rotational contributions may be calculated separately.

f. IBM 650 System: Minimum, IBM 650.

650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 9.4.001

ELECTRICAL POWER SYSTEM TRANSIENT STABILITY CALCULATIONS

J. E. Rowe and J. L. Gabbard, Jr.
Union Carbide Nuclear Co., Oakridge, Tenn.

November 1, 1956

a) It is possible to make the transient stability calculations for any system that can be represented by 19 equivalent machines or less. However, if the number of equivalent admittances required to represent the network does not exceed 200, a program limit of approximately 50 machines is possible (a 30 machine system has been studied). Induction machines as well as synchronous machines can be handled.

b) Uses fixed decimal arithmetic.

c) Uses transient stability theory, symmetrical component theory, and network theory. Makes use of Starr's equivalent circuit for the n - terminal network expressed in matrix form and as admittances rather than impedances. Calculations are made in the per unit system and care must be exercised in selecting the system base in order to avoid field excessions with the fixed decimal program. The transient stability differential equations are solved using the method of 1st order forward differences.

d) Uses 718 words plus data and output. Time approximately 1 1/2 - 2 1/2 hours depending on variables.

e) Contains an excellent flow chart.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 9.4.002

NETWORK REDUCTION

P. E. Scott and E. M. Kidd
Union Carbide Nuclear Co., Oak Ridge, Tenn.

October 19, 1956

a) A network reduction program - discribes an automatic method of reducing an electrical power network to a smaller equivalent network.

b) Limitations as to size of matrix to be handled are $n \leq 20$, $n^2 + nb \leq 800$

n = order of M b = order of K

Uses floating point arithmetic. The matrix of coefficients for the entire system is partitioned into M and K which represent those junctions to be eliminated and those to remain respectively.

c) Matrix theory and network theory.

d) Approximate time $(.576n^3 + 1.273nb + .726)$ seconds storage required · 460 words plus data and output.

e) Number of output cards = $1 + b(b+1)/2$
Has an excellent flow chart. Applicable to linear, bilateral, passive networks

f) Minimum 650.

IBM 650 Library Program Abstracts

File no. 9.4.003
Engineering Applications

FIFTY BUS LOAD FLOW PROGRAM

R. J. Brown
W. F. Tinney
Bonneville Power Administration
Portland, Oregon

a. Purpose: This program is designed to solve electric utility power network flow problems for systems of no more than 50 busses and seven lines per bus.

b. Range: The scaling was determined experimentally to accommodate the range of data in problems solved at Bonneville. This scaling may not be satisfactory for all other systems. A power base of 1 pu = 100 MVA is used.

Accuracy: Not given.

Floating/Fixed: Arithmetic is in fixed point.

c. Mathematical Method: The Gauss-Seidel method is used.

d. Storage Required: The program uses almost all drum locations.

Speed: Approximately one hour is required for an average system.

Relocatability: Program is not relocatable.

e. Remarks: Considerable study is necessary for effective operation of the system.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 9.4.004
Engineering Applications

IMPROVED DIGITAL SHORT CIRCUIT SOLUTION OF POWER SYSTEM NETWORKS

M. J. Lantz
Bonneville Power Administration
Portland, Oregon

a. Purpose: Precalculates short circuit currents at various possible locations in the system.

b. Range: Solves a 20 x 20 matrix which is equivalent to a network having 45 impedance elements.

Accuracy: Not given.

Floating/Fixed: Floating point.

c. Mathematical Method: Loop equations are used to reduce matrix size.

d. Storage Required: Not given.

Speed: Solution time per fault is approximately $.0025\ N^3$ minutes, where N is the matrix size.

Relocatability: Not given.

e. Remarks: None.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 9.4.005
Engineering Applications

99-BUS LOAD FLOW PROGRAM

W. F. Tinney
Bonneville Power Administration
Portland, Oregon

a. Purpose: Solves AC load flow problems for power systems with up to 99 busses and 199 branches.

b. Range: As above.

Accuracy: Any degree of precision desired.

(Continued on next page)

Floating/Fixed: Fixed point arithmetic is used.

c. Mathematical Method: The nodal iterative method of solution is used.

d. Storage Required: Almost entire drum.

Speed: A function of desired precision. Approximately 0.9 seconds per bus per iteration, exclusive of input and output time. One-half to one and one-half hours over-all computing time for full capacity problem.

Relocatability: Non-relocatable.

e. Remarks: Input data are prepared and punched from convenient standard forms. Output consists of complete load flow information including bus voltage and angles, real and reactive flow into and out of each branch, losses in each branch, and total system losses.

f. 650 System: One 533 required.

Special Devices: Alphabetic device.

IBM 650 Library Program Abstracts

File no. 9.4.006
Engineering Applications

PROBABILITY OF LOSS OF LOAD

H. D. Limmer
Public Service Electric & Gas Co.
Newark, New Jersey

a. Purpose: Calculates the probability of loss of load (due to lack of sufficient generation or interconnections) of a power system.

b. Range: Will handle at least 50 machines.

Accuracy: Not given.

Floating/Fixed: Not given.

c. Mathematical Method: Based on method outlined in AIEE paper 58-139, published in Power Apparatus and Systems, August 1958, pp. 544-550.

d. Storage Required: Not given.

Speed: Running time varies with size of system. A 35-machine system takes about 4 hours. Program can be re-run in 4 minutes if only the characteristics of the load or firm interconnection capacity are changed.

Relocatability: Not in relocatable form.

e. Remarks: None.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 9.4.007
Engineering Applications

CALCULATION OF ELECTRIC POWER SYSTEM SHORT-CIRCUIT CURRENTS

L. W. Coombe
The Detroit Edison Company
Detroit, Michigan

a. Purpose: This program computes the total fault current and the currents in the lines connected to the faulted bus. The real and imaginary components and the magnitude of the currents are punched out together with the X/R ratios. The input data can be arranged so that the location of the fault can be changed automatically.

b. Range: The program will accommodate networks of up to 96 buses and/or 150 lines.

Accuracy: Depends on the convergence tolerance specified.

Floating/Fixed: Fixed point arithmetic is used.

c. Mathematical Method: A nodal analysis is used to form a set of simultaneous equations with complex coefficients. These equations are formed by the program and solved by the Gauss-Seidel iteration method with acceleration.

d. Storage Required: Not given.

Speed: Requires approximately 0.85B seconds per iteration, where B is the number of buses. The number of iterations required depends on the system and accuracy desired, usually ranging between 6 and 60 iterations per fault.

Relocatability: Not given.

e. Remarks: A routine is included to convert the form of the input from impedances to admittances. The program may also be used to determine system driving-point and transfer admittances (equivalent circuits). It does not handle mutual impedances.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 9.4.008
Engineering Applications

OVERHEAD ELECTRICAL DISTRIBUTION SYSTEMS ANALYSIS

J. B. Jones
F. J. Farese
IBM, Houston, Texas

G. W. Oprea
Houston Lighting and Power Company
Houston, Texas

a. Purpose: This program calculates voltage drops at various load points along a given circuit, based on total loading of circuits, physical and electrical design, and customer demand at designated load points.

b. Range: Maximum of 40 load points per circuit.

Accuracy: Not given.

Floating/Fixed: Fixed point arithmetic is used.

c. Mathematical Method: Does not apply.

d. Storage Required: The entire drum is required for instructions and data.

Speed: About 3 seconds per point.

Relocatability: Not relocatable.

e. Remarks: Both absolute and SOAP listings are included.

f. IBM 650 System: One 533 required.

Special Devices: Alphabetic device required.

IBM 650 Library Program Abstracts

File no. 9.4.009
Engineering Applications

ECONOMIC CONDUCTOR STUDY

K. F. Thomas
Consumers Power Company
Jackson, Michigan

a. Purpose: This program is designed to determine the economic conductor size for a proposed electrical transmission line.

b. Range: $\pm A_1 \times 10^{a_1}$, where $1 \leqq A_1 < 10$ and $-50 \leqq a_1 \leqq 49$.

Accuracy: Eight decimal digits.

Floating/Fixed: Bell Labs Floating Decimal Interpretive System (TNL # 11) is used.

c. Mathematical Method: The equations used in calculating the electrical characteristics of transmission lines are those equations commonly used to calculate impedances, sending-end and receiving-end power, etc., based upon a symmetrical pi equivalent circuit.

d. Storage Required: This program uses 1253 storage locations.

Speed: The running time for one conductor size is approximately 100 seconds.

Relocatability: Not given.

e. Remarks: Card format, control panel and operating instructions are as prescribed by the interpretive system used (see par. b. above). An exception is that the Programmed switch is set to the "Run" position.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 9.4.011
Engineering Applications

CORRECTION OF COAL MOISTURE MEASUREMENTS

N. Savage
The Detroit Edison Company
Detroit, Michigan

a. Purpose: This program calculates the constants of a linear equation which relates percentage moisture in coal at two different locations in a power plant. Then, for 120 equal increments of percentage moisture at one

(continued on next page)

location (X), the corresponding values of percentage moisture at the other location (Y) are calculated.

b. Range: The input data consists of up to 39 pairs of measured values of percentage moisture in coal. All measurements are considered to be of equal weight in the computation.

Accuracy: The output consists of corresponding values of (X) and (Y) with (X) ranging from 0.10 to 12.00 in increments of 0.10.

Floating/Fixed: The input and output data are in fixed point decimal form. Computations are performed in the G. E. floating decimal mode.

c. Mathematical Method: The Method of Least Squares is used. The equation found is of the form: $Y = A_0 + A_1X$.

d. Storage Required: The program, including data storage, uses locations 0000-0607.

Speed: For 12 pairs of input data, total machine time is approximately 1.5 minutes.

Relocatability: Not given.

e. Remarks: The program includes an interpretive routine to perform the floating decimal arithmetic. The number of values, increment size, and range of the output data can be easily modified.

f. IBM 650 System: One 533 required.

File no. 9.4.012

IBM 650 Library Program Abstracts

30 SERIES BUS LOAD FLOW PROGRAM

Carlos O. Love
Texas Power & Light Co.
P. O. Box 6331
Dallas 22, Texas

a. Purpose: Studies service conditions on radial and series distribution systems and supplements system load flow studies.

b. Restrictions, Range: 30 buses maximum including source bus. Calculation and punch time is approximately 6 seconds/bus/problem with a tolerance of 0.30%.

c. Method: Per unit notion on an equivalent single phase system is used for all internal calculations. Input and output data are noted in standard electrical units. Iterative solution.

d. Storage Requirements: Complete 2000 drum locations are required for program and data.

e. Remarks: Only three phase loads may be considered. May be used to supplement system load flow studies. The absolute and SOAP deck listings are included.

f. IBM 650 System: Basic IBM 650, standard 80 column, 8 word panel.

File no. 9.4.013

IBM 650 Library Program Abstracts

RADIAL SHORT CIRCUIT PROGRAM

Carlos O. Love
Texas Power & Light Co.
P. O. Box 6331
Dallas 22, Texas

a. Purpose: Computes three phase, phase-to-phase, and phase-to-ground short circuit currents on a radial or tree system.

b. Restrictions, Range: Up to 80 fault points per problem.

c. Method: Based on mathematical system of symmetrical components.

d. Storage Requirements: Approximately 1900 drum locations are required for program and data. Average calculation time is 4 seconds/bus/problem.

e. Remarks: The absolute and SOAP deck listings are included.

f. IBM 650 System: Standard 80 column, 8 word panel.

650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 9.5.001

CALCULATION OF PIPING SYSTEM EXPANSION STRESSES

M. Alfieri, B. Whipple, P. O'Neill
General Dynamics Corp., Electric Boat Division, Groton, Conn.

a) Calculates piping systems with three anchors and no intermediate constraints or the equivalent case of two anchors with one constraint.

b) Input-output is in fixed decimal form.

c) The Kellog method is used.

d) The program is divided into three parts with a total of 2500 instructions. The three parts are processed as one complete operation and the entire drum is used.

e) A write-up of this program is in Technical Newsletter No. 10, pp. 195-213. Operator's notes, deck listing and description, and 533 wiring instructions are available from the 650 Program Library.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER** 9.5.002

PIPE STRESS ANALYSIS

W. S. Pickrell
J. H. Rogers
L. S. Woo
IBM, Los Angeles

a) Computes the bending moment, torsional moment, bending stress, torsional stress, and the resulting combined stress at each end and the midpoint of every bend or elbow in a piping system. Also, the three moments and three forces acting at each anchor are computed..

b) Either two or three anchor problems with no intermediate restraints may be analyzed. The piping system may include any number of members in any arrangement in space. There may be any changes in section or material within the system and the branches may be at different operating temperatures. All computations are performed in floating point while both the input and output are in fixed point form.

c) The Kellogg Method is used for the calculations, while the stresses and the anchor reactions are computed according to the ASA Pressure Piping Code.

d) The program consists of two parts, each of which uses the entire drum. An average two anchor problem is completed in approximately six minutes, while the average three anchor problem uses approximately twelve minutes of machine time.

e) Part I of the program is loaded on the drum and intermediate results for all problems to be analyzed are punched. These are used with Part 2 of the program and the final answers for all problems are punched. Two test problems and detailed instructions as to how to prepare the input data are included in the write-up.

f) Minimum 650.

File no. 9.5.003
Engineering Applications

IBM 650 Library Program Abstracts

KINEMATIC SYNTHESIS OF PATH GENERATING MECHANISMS

G. N. Sandor
TIME, Inc.
Springdale, Connecticut

(Continued on next page)

F. Freudenstein
Columbia University
New York 27, New York

a. Purpose: Given five points on a desired path, the program calculates the dimensions of pivoted four-link mechanisms in the plane to generate a path through these five points. It is programmed in the Bell L_2 System, IBM 650 Program Library File Number 2. 0. 008.

b. Range: Values of $r < 10$ for the polar coordinates of given path points.

Accuracy: Better than 10^{-5} at the five prescribed points.

Floating/Fixed: Floating point arithmetic is used.

c. Mathematical Method: The computations are made with complex numbers.

d. Storage Required: Together with the Bell L_2 System, the program occupies the entire drum with few gaps.

Speed: The existence of solutions is ascertained in about 2 minutes. The calculations take 3 to 4 minutes per solution for the 2 or 12 solutions. Computation of the generated path takes 7 seconds per degree of driver crank rotation, or a maximum of 42 minutes.

Relocatability: Not in relocatable form, except for two subroutines and a library routine for operations with complex numbers.

e. Remarks: The program automatically calculates all existing solutions (0, 2, or 12 linkages), selects one on the basis of a quality index and computes its generated path. An auxiliary program computes the generated path of any pivoted four-link mechanism.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 9. 5. 004
Engineering Applications

STRAIN ROSETTE DATA REDUCTION

J. A. Stone
L. S. Weinstein
IBM, Boston

a. Purpose: This program reduces the data taken from delta or rectangular rosettes. The normal input is in strain in micro inches per inch. Provision is made for computing strains in the form $y = A (x+B)$, where y is the strain, x is the data, and A and B are constants. The output is the maximum stress, minimum stress, shear stress, and angle to the principle axis.

b. Range: This routine will compute up to a stress level of 500, 000 PSI.

Accuracy: Stresses to ± 2 PSI and the angle to $\pm$ 0. 01 degrees.

Floating/Fixed: Computation is done in fixed point form.

c. Mathematical Method: A seven-term approximation is used for the arctangent. Newton's method is used to evaluate the square root. The first value of the iteration is obtained from a table included in the program.

d. Storage Required: The program occupies locations 0000-0400.

Speed: Using the normal input the speed is 100 reductions per minute. With modified input, speed is greater than 85 per minute.

Relocatability: May be relocated except for storage locations 0000-0004.

e. Remarks: The program is self-loading.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 9. 5. 005
Engineering Applications

EVALUATING COMPRESSOR PERFORMANCE

H. W. Evans
R. L. Smith
R. A. Semrad
Sinclair Oil and Gas Company
Tulsa, Oklahoma

a. Purpose: Sinclair's purpose in writing a compressor program is to enable engineers to design for maximum efficiency of compressor application with a minimum of engineering time in each new compressor application. A method of computing data for horsepower and capacity curves has been developed which presents a wide range of operating characteristics of the compressor in question for engineering analysis.

b. Range: Not given.

Accuracy: Not given.

(Continued on next column)

Floating/Fixed: The Bell Labs Interpretive System described in IBM Technical Newsletter No. 11 is used.

c. Mathematical Method: See pages 8 through 14 of the write-up.

d. Storage Required: Including the interpretive system, the program requires 2000 storage locations.

Speed: The average is one minute for each set of operating pressures.

Relocatability: Not relocatable.

e. Remarks: The stop most frequently encountered is 7777. This is caused by cards missing or out of order in the input deck.

f. IBM 650 System: One 533 is required.

IBM 650 Library Program Abstracts

File no. 9. 5. 006

CAM LEADER CO-ORDINATE ROUTINE
(CALCOR)

Marie T. Connolly
Henry M. Scaletti
United Shoe Machinery Corporation
Research Division
Engineering Department
Beverly, Massachusetts

a. Purpose: Calculates the cam leader follower roll center x and y co-ordinates for any angular position of the cam from the outer most position of the roll. This subroutine is designed for use with the interpretive system developed at Bell Telephone Laboratories and described in IBM Technical Newsletter #11.

b. Restrictions, Range: Floating point input and modified floating point output. The modified floating point output is in the form kn^e where k is a constant (1 or 10); n is the actual result; and e is the exponent of k (50 or 51). In this way, when listing the results, k and e are suppressed by panel wiring, and n will be obtained in a fixed point form.

c. Method: Standard equations are used.

d. Storage Requirements: The entire routine of 24 decks occupies about 600 locations. However, the program is so constructed that only those decks which are pertinent to the individual problem need be used. The interpretive system occupies locations 1000-1999. It takes approximately 2 to 4 seconds to calculate the co-ordinates for each degree of cam rotation.

e. Remarks: A conditional stop may be programmed at the conclusion of each throw to facilitate the removal of the output cards and to assist in monitoring the progress of the 650 through the problem. See write-up or IBM Technical Newsletter # 11 for explanation of this stop.

f. IBM 650 System: Basic 650.

650 LIBRARY PROGRAM ABSTRACT — FILE NUMBER 9. 6. 001

WELL BORE DEVIATION RECORD

J. T. Ahlin and G. E. Mitchell
IBM, Houston

May 1, 1956

a) Given the distances, bearings, and inclinations at various stations in a well bore, this routine computes the well bore deviation record, the depth and horizontal components of the bottom hole, and the x, y, and z components and coordinates for each station.

b) Angle data are to either the nearest second or the nearest hundredth of minute; distance data in the form xxxxx. xx feet.

c) Does not apply.

d) Storage required is about 500 locations between 0000 and 0999. Speed is about 60 stations per minute.

e) None.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 9.6.002

P-V-T DATA CALCULATIONS

A. Cohen
IBM, NY DPC

a) Program uses the Benedict equation to compute the density roots, entropies, enthalpies and other quantities for methane, ethane, propane, butane and pentane at pre-selected temperatures and pressures given in either English or c.g.s. units.

b) Fixed point arithmetic with different scaling for English and c.g.s. units. Accuracy depends on quantity considered.

c) Uses Benedict equation. Exponential and logarithmic routines are employed.

d) Program scattered optimumly over the whole drum. A temperature-pressure combination takes 3-4 seconds, depending on number of iterations required.

e) None.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT FILE NUMBER 9.6.003

EQUILIBRIUM FLASH CALCULATION

M. E. Klecka
R. Y. Seaber
Shell Oil Company
Houston Research Laboratory
Houston, Texas

a) Calculates isothermal equilibrium flash vaporizations where the feed composition and K values are specified.

b) A maximum of 30 components can be used. Floating point arithmetic is employed, and closure accuracy is ± 0.0001 mole fraction, based on the liquid product from the flash stage.

c) Conventional isothermal equilibrium flash calculation equations are used.

d) 1400 locations are used for program and data. The time per calculation depends upon number of components and the system but is generally 3-6 minutes per completed calculation.

e) Three check features are incorporated into the program:
1. The system must be above the bubble point.
2. The system must be below the dew point.
3. The sum of the mole fractions of the feed must equal 1.

A violation of any one of the above conditions will cause rejection of the particular problem by the machine. The name card identifying the problem will be punched followed by another card which gives the reason for rejection.

f) 650 equipped with alphabetic device.

IBM 650 Library Program Abstracts *File no.* 9.6.004
Engineering Applications

ABSORBER CALCULATION

J. M. Morris
Warren Petroleum Corporation
Tulsa, Oklahoma

a. Purpose: This program computes the lean oil rate to the absorber necessary to absorb a predetermined percent extraction of a key component. It also calculates a complete material and heat balance for the absorber.

(Continued on next column)

b. Range: This program is designed for a bubble cap or perforated tray absorber with multicomponent feed, and is based on a desired percent extraction of a key component. The range of the rich oil temperature is 0° F to 115° F. The K equilibrium data and the enthalpy of hydrocarbon vapor which are functions of pressure, are in tables from 200 to 900 psia at 50 psia increments.

Accuracy: Not given.

Floating/Fixed: Fixed decimal.

c. Mathematical Method: Warren Petroleum Corporation's method of absorber calculation is used.

d. Storage Required: The program is run in two sections using approximately 1,000 locations for instructions and 1,600 locations for tables.

Speed: The time required for one calculation is approximately ten minutes.

Relocatability: Not given.

e. Remarks: None.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts *File no.* 9.6.005
Engineering Applications

OPTIMUM SEPARATOR PRESSURE

John M. Tyler
Cities Service Research & Development Co.
Tulsa, Oklahoma

a. Purpose: To determine optimum separator pressure for a series separation consisting of two separators and one stock tank.

b. Range: Not given.

Accuracy: Optimum pressure is determined with a precision of one psi. Actual accuracy depends on the accuracy of the K values.

Floating/Fixed: Floating point arithmetic is used.

c. Mathematical Method: Not given.

d. Storage Required: All storage locations other than 1400-1499 are utilized.

Speed: 13 minutes to 1 hour depending on accuracy of first estimates.

Relocatability: Not given.

e. Remarks: The computing time is determined by the first estimate for the separator pressures. As the user acquires familiarity with the program his estimate will become better, thereby reducing computing time. Output may be modified so that a special character device is not necessary.

f. IBM 650 System: One 533, automatic floating decimal arithmetic feature, indexing registers.

Special Devices: Special character device required unless output is modified (see remarks).

IBM 650 Library Program Abstracts *File no.* 9.6.006
Engineering Applications

POROSITY CALCULATION FROM RADIOACTIVITY LOG INTERPRETATION

Charles D. Woodard
Sunray Mid-Continent Oil Company
Tulsa, Oklahoma

a. Purpose: This program calculates the following from the neutron curve of the radioactivity log and the water saturation curve (water saturation vs. subsea depth): Interval feet, porosity, porosity feet, (1-CW) determined from the water saturation vs. subsea depth curve, hydrocarbon porosity feet, and average hydrocarbon porosity.

b. Range: The total interval being evaluated must be less than 10,000 feet. A maximum of fifty points may be used to define the water saturation vs. subsea depth curve.

Accuracy: Not given.

Floating/Fixed: Fixed decimal arithmetic is used.

c. Mathematical Method: The evaluation of the water saturation curve is determined by a linear interpolation of the curve points.

d. Storage Required: This program requires 700 drum storage locations.

Speed: Not given.

Relocatability: Not relocatable.

(Continued on next page)

e. Remarks: This program is considered optimum.

f. IBM 650 System: One 533 required.

Special Devices: Alphabetic device required.

IBM 650 Library Program Abstracts

File no. 9.6.007
Engineering Applications

SUCKER ROD PUMP DESIGN

H. E. Osborne & C. E. Thomas
Core Laboratories, Inc.
Dallas, Texas

a. Purpose: The program calculates the design features of a sucker rod pump to fit a set of conditions by investigating the effect of changing each of the variables throughout its full range of possibilities.

b. Range: Not given.

Accuracy: Not given.

Floating/Fixed: Input is in fixed decimal, internally converted to floating decimal.

c. Mathematical Method: Coberly's formula for over-travel, Mills' formula for peak polished rod load, and Slonneger's formula for favorable pumping speeds of straight rod strings are used.

d. Storage Required: Not given.

Speed: Up to 300 cases may be computed in an hour.

Relocatability: Not given.

e. Remarks: Theoretical producing rate, actual plunger strokes, load stress, peak polished rod load, peak torque and counter balance are computed and punched out. Optimal output is provided through conditional punch features to determine the percent of each rod size to allow equal stress at the top of each section of the rod string.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 9.6.008
Engineering Applications

RESIDUALS AND DERIVATIVES OF GRAVITY

J. E. Ward
Atlantic Refining Co.
Dallas, Texas

a. Purpose: This program computes several residuals and second derivatives of gravity at each regularly spaced grid intersection where sufficient data exists.

b. Range: Maximum size of each map is limited to 100 rows by 9999 columns.

Accuracy: Not given.

Floating/Fixed: Not given.

c. Mathematical Method: Not given.

d. Storage Required: The program requires 1472 drum locations, of which 700 are for map storage, 505 for program instructions, 100 for temporary storage, and the remaining 167 are for constants, corrections, read and punch, etc.

Speed: Average running time for each datum point is .014 minutes. A map of 70 rows by 70 columns should run in about 11 hours.

Relocatability: Not given.

e. Remarks: Input data is punched into cards as four-digit positive values at each intersection, up to 10 per card. Output results are punched one card per grid intersection with six residuals and four derivatives at this point if all necessary data exist.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 9.6.009
Engineering Applications

GRID SYSTEM VOLUME DETERMINATION

O. F. Shinn
Cities Service Oil Company (Del.)
Bartlesville, Oklahoma

a. Purpose: This routine computes sand volumes and accumulates volume totals by lease or company.

b. Range: The program will handle up to 400 leases.

Accuracy: Not given.

Floating/Fixed: Fixed decimal arithmetic is used.

c. Mathematical Method: The program multiplies grid size times percent of grid within the lease times thickness.

d. Storage Required: 910 words.

Speed: 100 grids per minute.

Relocatability: Not given.

e. Remarks: None.

f. IBM 650 System: One 533 and indexing registers required.

IBM 650 Library Program Abstracts

File no. 9.6.010

THE BUCKLEY-LEVERETT, WELGE CALCULATIONS

C. R. McEwen
R. A. Rogers
Union Oil Company of California
Research Laboratory
Brea, California

a. Purpose: This program is a method of predicting the recovery of oil when it is being displaced by gas or water.

b. Range/Restrictions: Essentially the only data necessary are the relative permeability ratio-vs-saturation relation (usually called "kg/ko" or "kw/ko" curves) and the saturations of oil, gas, and water at the beginning of the drive.

c. Mathematical Method: Given in writeup.

d. Storage Required: N/A

e. Remarks: This program makes use of the SIR interpretive routine to permit the computer to perform floating point arithmetic.

f. IBM 650 System: Basic

IBM 650 Library Program Abstracts

File no. 9.6.011

CALCULATION OF RATE OF RETURN USING THE IBM 650 COMPUTER

E. S. Smith
Union Oil Research Laboratory
Brea, California

a. Purpose: This program may be used to calculate the rate of return of an investment. In essence, a discount or interest rate is found which will make the present worth of the future income equal to the investment.

b. Range/Restrictions: Trouble may occur if the sign of the cash flow changes more than once during the life of the investment. Cash flows must be in floating point notations (5010000000=1.0)

c. Mathematical Method: N/A

d. Storage Requirements: N/A

Speed: A result of 7.00% was obtained for a test problem in less than three minutes of computer time.

e. Remarks: This program uses the SIR interpretive routine translated by 1100 locations.

f. IBM 650 System: One 533 is required.

IBM 650 Library Program Abstracts

File no. 9.6.012

FIVE LAND SURVEYING PROGRAMS

Shell Oil Company
Houston, Texas

a. Purpose: To convert hand calculations on land surveying problems for use with the IBM 650.

b. Range Accuracy: Self checks are built into the programs.

c. Mathematical Methods: Given in write-up.

d. Storage Requirements, Speed, Relocatability: N/A

e. Remarks: None

f. IBM 650 System: 650 with alphabetic device and a 533.

IBM 650 Library Program Abstracts

File no. 9.6.013

A PROGRAM FOR PARTITIONING OF ARBITRARILY SHAPED AREA

D. C. Schiller
Shell Oil Company
Houston, Texas

a. Purpose: Given an area bounded by straight lines with known intersections, the program will partition it with a horizontal line (parallel to the X-axis) into any desired ratio.

b. Range Accuracy: N/A

c. Mathematical Method: Given in write-up.

d. Storage Requirements; speed: Not given

e. Remarks: Two limitations exist. First, no more than 99 intersections can be counted around any area. Second, the area in square varas and the distance in varas may not exceed 99,999,999.99.

f. IBM 650 System: N/A

IBM 650 Library Program Abstracts

File no. 9.6.014

A PROGRAM FOR THE GAUSS-SOUTHWELL RELAXATION METHOD

H. C. Carney
D. C. Schiller
Shell Oil Company
Houston, Texas

a. Purpose: To illustrate a method used to solve the systems of simultaneous equations derived in the adjustment of survey nets such as found in land and geophysical surveys.

b. Range: The method will be applicable to other systems if the conditions of sparseness and convergence are met.

c. Mathematical Method: N/A

d. Storage Requirements: The complete system and needed control words use $(4n+m \leq 1750)$ storage spaces where M is the number of off diagonal elements.

e. Remarks: The program is divided into three parts.

IBM 650 Library Program Abstracts

File no. 9.6.015

CALCULATING PERFORMANCE CHARACTERISTICS OF RECIPROCATING COMPRESSORS WITH AN ELECTRONIC COMPUTER

G. H. Holliday
W. L. Coultas
R. A. Lawson
Shell Oil Company
Los Angeles, California

a. Purpose: A method is described for calculating performance characteristics of reciprocating compressors with an electronic computer. The performance characteristics calculated include interstage pressures, capacity, brake horsepower, and frame loading. One-, two- and three-stage compressors operating either singly or in parallel (common interstange cooler) can be analyzed. For parallel systems the characteristics are determined separately for each compressor. Allowances are made for gas injection or removal between stages and for condensation losses due to interstage cooling.

b. Restrictions, Range: Not given.

c. Method: The computer method, by using more exact thermodynamic equations than are readily handled with manual calculation methods, obtains better correlation between calculated performance and actual performance.

d. Storage Requirements: Approximately ten minutes are required to solve the interstage pressures and to compute the corresponding values of capacity, brake horsepower, and frame loading for a three-stage compressor operating at a specified suction pressure, and cylinder clearance setting.

e. Remarks: The calculation method is not directly applicable for compressor design; however, a design can be obtained by a cut and try technique.

f. IBM 650 System: IBM 650.

IBM 650 Library Program Abstracts

File no. 9.6.016

LEAST SQUARES DETERMINATION FOR A VELOCITY FUNCTION WITH LINEAR INCREASE OF VELOCITY

E. J. Assiter
D. H. Eckhardt
W. Williams
Mobil De Venezuela
Caracas, Venezuela

a. Purpose: This program makes use of velocity functions and computes the velocity parameters (V_o, α) which will allow to best fit the velocity data in a least squares sense.

b. Range: Not given.

c. Accuracy: Not given.

Mathematical Method: Least squares.

d. Storage: Not given.

e. Remarks: None

f. 650 System: J33, 6J3 (Floating Point & Index Registers), on-line 407.

IBM 650 Library Program Abstracts

File no. 9.6.017

RAY TRAJECTORY MIGRATION

Look to the next page

E. J. Assiter
D. H. Eckhardt
W. Williams
Mobil De Venezuela
Caracas, Venezuela

a. Purpose: This program was written to allow reflection seismologists to perform ray trajectory migration, using a reference chart instead of the conventional wave-front chart.

b. Range: Not given.

Accuracy: Not given.

c. Mathematical Method: Laws of Reflection.

d. Storage: Not given.

e. Remarks: None

f. 650 System: 653 (core and indexing) 533 on-line 407.

IBM 650 Library Program Abstracts

File no. 9.6.018

SEISMOGRAM SYNTHESIS FROM CONTINUOUS INTERVAL VELOCITY (CVL)

E. J. Assiter
D. H. Eckhardt
W. Williams
Mobil De Venezuela
Caracas, Venezuela

a. Purpose: This program is designed to perform the convolution of the three major components of a seismogram: (1) Seismic pulse, (2) Instrument Impulse Response, (3) Interval velocity function (CVL). In addition, a six trace seismogram is plotted, on line, by the IBM 407.

b. Range and Accuracy: Not given.

c. Mathematical Methods: Not given.

d. Storage: Not Given.

Speed: Not Given.

e. Remarks: None

f. 650 System: 533, 653 (core and indexing), on line 407.

IBM 650 Library Program Abstracts

File no. 9.6.019

NORMAL MOVEOUT COMPUTATIONS FOR LINEAR INCREASE OF VELOCITY WITH DEPTH

E. J. Assiter
D. H. Eckhardt
W. Williams
Mobil De Venezuela
Caracas, Venezuela

a. Purpose: This program solves the "Moveout Equation" for the case of circular ray paths.

b. Range: Not given.

Accuracy: Not given.

c. Mathematical Method: Solution of moveout equation.

d. Storage: Not given.

e. Remarks: None

f. 650 System: 533, 653 (Index Registers).

IBM 650 Library Program Abstracts

File no. 9.6.020

LEAST SQUARES DETERMINATION OF THE VELOCITY FUNCTION FOR REFRACTION TIME-DEPTH DATA

E. J. Assiter
D. H. Eckhardt
W. Williams
Mobil De Venezuela
Caracas, Venezuela

a. Purpose: This program is designed to compute the refraction (V_o, a) and plot a time-distance curve for these parameters. Since there exist relationships between the refractive (V_o, a)'s and the reflections (V_o, a)'s it is very useful for velocity determination to be used with the reflection seismograph.

b. Range and Accuracy: Not given.

c. Mathematical Methods: Least squares.

d. Storage: Instructions are stored in 0400 to 0800.

Speed: Not given.

e. Remarks: None.

f. 650 System: 533, 653 (core and indexing registers).

IBM 650 Library Program Abstracts

File no. 9.6.021

TIME DOMAIN FILTERING OF SEISMOGRAMS

E. J. Assister
D. H. Eckhardt
W. Williams
Mobil De Venezuela
Caracas, Venezuela

a. Purpose: This program is designed to perform the convolution of the two major factors in the filtering of a time series: (1) Weighting function (or filter response); (2) Time series (Digitized Seismic Trace). In addition, a six trace seismogram is plotted, on line, by the IBM 407.

b. Range: Maximum length is 100 digitized amplitudes.

Accuracy: not given.

c. Mathematical Method: Time series.

d. Storage Required: Not given.

Speed: Not given.

e. Remarks: None.

f. 650 System: 533, 653 (core or indexing), on line 407.

IBM 650 Library Program Abstracts

File no. 9.6.022

UNIT OPERATIONS SIMULATOR

(Continued on next page)

Bonner and Moore Engineering Associates
Houston, Texas

a. Purpose: The simulator is a series of thirteen subroutines for making certain chemical engineering calculations involving vapor - liquid separations with heat and material balances. Its purpose is to permit a process design engineer to write a computer program to simulate the design of many types of equipment and combinations of equipment where vapor - liquid equilibrium and heat and material balance are the unit operations involved.

b. Restrictions, Range: Up to approximately 25 component systems may be handled by reassembly of the program.

Accuracy: Does not apply.

Floating/Fixed: Fixed point.

c. Method: Standard chemical engineering formulas are used.

d. Storage Requirements: 630 drum locations are available for the executive program with the 10 component system; while with 20 components 480 drum locations are available.

e. Remarks: The ID-3 Interpretive System is an integral part of the Unit Operations Simulator and must be used to write the executive program instructions.

f. IBM 650 System: Basic 650 Required.

IBM 650 Library Program Abstracts

File no. 9.7.001
Engineering Applications

GAS NETWORK ANALYSIS PROGRAM

F. L. Duffy
The Cincinnati Gas & Electric Co.
Cincinnati, Ohio

a. Purpose: This program provides a very flexible method for computing the solution of low, intermediate or high pressure gas networks. Variations in network conditions to arrive at the optimum system development may be entered with a minimum of effort.

b. Range: Networks with 1800 main sections may be analyzed and any flow formula which can be reduced to the form

$$h \text{ (or } P_a \text{ or } P_1^2 - P_2^2) = ALQ^2$$

can be used. The main length and flow may be in any units whatsoever.

Accuracy: The network may be balanced to a predetermined limit of accuracy.

Floating/Fixed: Computations are in a fixed point.

c. Mathematical Method: Iterative procedure based on a modified Hardy-Cross Method is used.

d. Storage Required: Storage varies for the separate sections of the program. Maximum storage requirement is 125 locations.

Speed: Speed is dependent on accuracy desired.

Relocatability: Not given.

e. Remarks: There are some limitations on size and length; see program write-up.

f. 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 9.7.002
Engineering Applications

HYDRAULIC NETWORK ANALYSIS

(Continued on next column)

J. W. Hamblen
Q. B. Graves
Oklahoma State University
Stillwater, Oklahoma

a. Purpose: This program determines the final flows, Q, and the corresponding head losses, H, in each pipe of a hydraulic network after a K-value and an assumed initial flow, Q, have been arrived at from basic information on pipe sizes, roughness, lengths, junctions, inflows, and outflows.

b. Range: Maximum of 123 circuits and/or 520 pipes.

Accuracy: Not given.

Floating/Fixed: Floating point is used throughout.

c. Mathematical Method: The Hardy Cross method is used.

d. Storage Required: For maximum size problem, the program requires the entire drum and IAS.

Speed: Approximately one second per pipe per iteration.

Relocatability: Not relocatable.

e. Remarks: None.

f. IBM 650 System: One 533, automatic floating decimal arithmetic feature, IAS, and indexing registers.

IBM 650 Library Program Abstracts

File no. 9.7.003
Engineering Applications

HARDY-CROSS SOLUTION OF WATER FLOW NETWORK

C. G. Fultz
A. A. Lea
IBM, Atlanta, Georgia

a. Purpose: This program solves for flow in a water network. Given the initial estimates of the flow in each pipe, the routine produces a corrected flow for the system.

b. Range: A network of up to 99 loops, containing up to 199 pipes, can be handled by this program. The pipes may be up to 99,999 yards in length and of any diameter.

Accuracy: The user may control the accuracy of the solution.

Floating/Fixed: Fixed decimal arithmetic is used.

c. Mathematical Method: Hardy-Cross.

d. Storage Required: Virtually the entire drum is used.

Speed: Approximately one second per pipe per iteration, plus two minutes for read-in, punchout and initialization.

Relocatability: Not relocatable.

e. Remarks: If the initial estimate of flow is too poor, the Hardy-Cross method will not converge, in which case the program stops.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 9.7.004
Engineering Applications

BACKWATER CURVE ANALYSIS

(Continued on next page)

E. V. Griffith
IBM, Lansing, Michigan

a. Purpose: Starting at a given point in a river or stream it is desired to determine water surface elevations at points upstream for a given sized flood. This program analyzes the stream, section by section, computes various hydraulic elements, balances energies, and gives water surface elevations at each section moving upstream.

b. Range: See the program write-up.

Accuracy: Elevations are given to nearest 0.01 ft., energies are balanced to a tolerance of 0.05 ft. This tolerance may be varied, however.

Floating/Fixed: Fixed decimal arithmetic.

c. Mathematical Method: Manning's formula is used for friction losses, and orifice and WEIR formulas are used for losses through bridges. An iterative technique is used to balance energies.

d. Storage Required: The program occupies 1200 drum locations between 0000 and 1499. Tables of data are stored in locations 1700 to 1897.

Speed: Varies with the type of data, from about 5 to 25 sections per minute.

Relocatability: Not relocatable.

e. Remarks: The input involves a table of widths versus elevations to define each cross section, and special cards to define bridges and branch streams. The program will handle overbank areas separately, branch streams flowing in or out, and bridge sections, including cases where water flows over bridge embankments. Provision is made for changing roughness coefficients and bridge contraction coefficients at any point in the analysis.

f. IBM 650 System: One 533 required.

Special Devices: Alphabetic device is required only if alphanumeric identification is desired.

IBM 650 Library Program Abstracts

File no. 9.7.005
Engineering Applications

LIQUID VOLUMES IN FLAT END HORIZONTAL CYLINDRICAL TANKS

A. J. Sadler
Vestal, Incorporated
St. Louis, Missouri

a. Purpose: This program calculates the volume of liquid, at height of liquid h, contained in a flat-end horizontal cylindrical tank.

b. Range: Depends on system of units selected to measure dimensions of tank.

Accuracy: Greatest possible error = 0.23%.

Floating/Fixed: Fixed decimal arithmetic is used.

c. Mathematical Method: Does not apply.

d. Storage Required: 110-120 storage locations.

Speed: About 5 minutes for a tank 90" in diameter and 170" in length.

Relocatability: Not given.

e. Remarks: None.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 9.7.006

GAS FLOW ANALYSIS

(Continued on next column)

G. Hamilton Harbison
Philadelphia Gas Works
Division of United Gas Improvement Company
Philadelphia, Pennsylvania

a. Purpose: This routine computes, by means of successive corrections, the distribution of flow in a gas distribution network.

b. Restrictions, Range: The program can be used for low pressure system networks consisting of up to 599 separate mains, or allowing for mains common to more than one loop, a total of 900 representations of mains. Resistance coefficients are calculated for gas of 0.65 specific gravity.

Accuracy: Undistributed pressure drop within any one loop less than .004 in, flow correction factor for any single loop less than .005 Mcf per hour.

Floating/Fixed: Fixed point arithmetic is used.

c. Method: Procedure of successive corrections (slightly modified Hardy Cross Method) is used.

d. Storage Requirements: Maximum storage requirement for the program is 333 locations.

Speed: Speed depends on the number of internal iterations required.

Relocatability: Not relocatable.

e. Remarks: Resistance constants are calculated and stored in table form for main diameters of 4 to 42 inches, inclusive. The length of mains, in feet, must be within certain limits (See program write-up).

f. IBM 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 9.7.007

FLUID FLOW DISTRIBUTION: HARDY CROSS METHOD

Wm. F. Atchison, Head
Rich Electronic Computer Center
Georgia Institute of Technology
Atlanta 13, Georgia

a. Purpose: The program will compute the approximate distribution of fluid flows in pipe networks.

b. Restrictions, Range: The program utilizes a floating point representation, hence no range limitations exist. Systems with a maximum of 375 pipe sections may be analyzed, and there is no limit on the number of pipe sections in each loop.

c. Method: The Hardy Cross Method of successive corrections is used. Energy loss calculations are based on the Darcy-Weisbach equation for energy loss in a straight pipe.

d. Storage Requirements: Does not apply.

Speed: The computer requires approximately 2 seconds per loop per iteration.

e. Remarks: Tolerance. Computations are terminated when all corrections applied to the network during one iteration cycle are within a prescribed tolerance. It is also possible to halt computations after any complete iteration cycle.

f. IBM 650 System: Minimum 650.

IBM 650 Library Program Abstracts

File no. 9.7.008

A GAS NETWORK ANALYSIS PROGRAM WITH AUTOMATIC RECYCLING (IBM 650)

Arthur James
Public Service Electric and Gas Company
Newark, New Jersey

a. This program was written to solve gas network problems for the Public Service Electric and Gas Company. The program, using the modified Hardy Cross technique, will be used to supplement the studies being made on the McIlroy Pipeline Network Analyzer. This presentation discusses and exemplifies the intermediate or high pressure network.

(Continued on next page)

b. A comparison of the largest correction (Q) with the desired limit of accuracy, causes the program to perform additional iterations or punch results. This feature permits the problem to be solved during other than prime machine time. A punch of the largest (Q) at the end of each iteration provides a check on convergence. When the desired accuracy is obtained, flows and pressure drops are punched for all pipes in the network - including dead-end pipes.

c. The modified Hardy Cross Method is used in the program. This technique is used throughout the industry. The Spitzglass co-efficients, which are supplied with the program deck, may be changed easily.

d. The program was arbitrarily limited to 400 drum locations, providing 1600 locations for data storage. These locations are normally reserved for 700 pipe sections and 900 items of loop data. Division of the 1600 locations may be altered to specific problem requirements.

The program was written in machine language and may not be relocated. Optimum locations were initially assigned.

e. Remarks: None

f. The program was written for the basic 650. Wiring is for the 533.

IBM 650 Library Program Abstracts

File no. 9. 8. 001
Engineering Applications

ROOT AND GAIN LOCUS

R. D. Blosser
F. A. Vandenberg
Firestone Tire & Rubber Co.
Los Angeles, California

a. Purpose: This program determines the transient behavior of a control system as a result of changes in loop gain, component time constants, and stabilizing network configurations.

b. Range: Degree of forward and feedback loop must be less than 14.

Accuracy: Seven significant figures.

Floating/Fixed: Polynomial coefficients: floating decimal. Gain values: fixed decimal.

c. Mathematical Method: Root Locus: C. J. Savant; Root Extraction: Milne.

d. Storage Required: The program occupies approximately 1500 drum storage locations.

Speed: Requires 45 to 90 seconds for each value of gain for a first order over a quartic.

Relocatability: Not given.

e. Remarks: The program is self-loading. It does not always work for multiple roots. Transfer functions must be linear polynomials with constant coefficients.

f. IBM 650 System: One 533 required.

Special Devices: None required.

IBM 650 Library Program Abstracts

File no. 9. 8. 002

BPR PARALLAX REDUCTION PROGRAM

K. F. Kohler, Highway Engineer
R. R. DeClark, Engineering Tech.
L. D. Tingey, Photogrammetric Engineer
Department of Commerce
Bureau of Public Roads
Region 8
Portland, Oregon

a. Purpose: Reduces distances manually scaled from aerial vertical photographs to actual elevations and distances.

b. Range: Control Stationing (SSS+SS.SS), and Elevations (EEEE.EE). Cross section topog Rods (RRR.R), Distance (DDD.D), Stations (SSSS+SS) and Base Elevation (EEEE.EE).

Accuracy: Consistent with manual methods.

Floating/Fixed: Fixed.

Subroutines: None.

(Continued on next column)

c. Mathematical Method: Employs aerial survey parallax computation methods as used on "BPR Parallax Computation Sheet", Form PR-471 (Revised 1958).

d. Storage Required: Approximately 970 storage locations are used.

Speed: Operates at approximately 9/10 full read speed depending on the number of points in the section.

e. Remarks: Program is written in SOAP II.

f. IBM 650 System: Basic 650 with Alphabetic Device is used.

650 LIBRARY PROGRAM ABSTRACT — FILE NUMBER 10. 1. 001

LINEAR PROGRAMMING

H. F. Smith
IBM, Chicago

a) Solves a linear programming problem.

b) All numbers are of the form xxxx. xxxxxx. An M by N system may be solved where $M \leq 30$, $N \leq 59$ and $M(N+1) < 1400$ (these values pertain to the system after the slack vectors and artificial vectors have been adjoined).

c) Method not given.

d) The entire drum is used. Time required is approximately .09 MN seconds for one iteration.

e) Input consists of matrix elements, cost coefficients, indices of basis, and constants. At the end of each iteration the program punches out the number identifying the variables in the basis, the values of these variables, the value of the functional, and an iteration count.

f) Minimum 650.

IBM 650 Library Program Abstracts

File no. 10. 1. 001
ADDENDA

LINEAR PROGRAMMING

H. F. Smith

Linear programming always maximizes the objective function. Most usually this means maximizing a profit function. In this case each variable in the initial program--each structural variable--is assigned a positive unit profit. However, it may be desirable to use cost as the objective and minimize a cost function. Minimizing a function is the same as maximizing the negative of the function. Hence to minimize a cost function, each structural variable must be assigned a negative unit cost. Whether unit profits or costs are used, artificial variables are always assigned large negative values, and slacks are given positive zero values in the objective function.

On page 5 of the writeup in the typical matrix layout, the values 3.19, 2.16, 4.24 and 3.60 in the first line represent unit profits. If they are to represent unit costs, they must be made negative.

Experience has shown that artificial cost coefficients which are about 10 times as large as the largest structural cost or profit coefficient are sufficiently large to prevent the artificial variable from appearing in the optimal solution. An artificial cost of 100 times as large as indicated in section A(2) of the writeup may cause overflow stops.

The program stops with 0000 in the address lights rather than 0350 as stated in section E.

The program is mathematically correct in the way it solves Linear Programming problems. However, there is a cumulative rounding error in this program as in any iterative process.

(Continued on next page)

By changing one instruction it is possible to reduce this cumulative rounding error below its present level.

The instruction in location 0068 now reads: 30 0003 0129. It should be changed to read 20 0069 0172.

This change may be made in the following manner.

1. Place a correction card just before the last card of part 5 of the program deck. Part 5 consists of those cards in the program deck which follow the matrix elements and which precede the constants.
2. The correction card contains:

Column	1-10	11-20	21-80	1, 10, 20, 30, 40, 50, 60, 70, 80
Content	00 0068 0001	20 0069 0172	Zero	12 punch

Naturally this change is only of consequence when the right hand positions of the data fields contain significant digits.

IBM 650 Library Program Abstracts — *File no.* 10.1.001 ERRATA

LINEAR PROGRAMMING BY H. F. SMITH

On Page 2, Section B. Scaling....., the third sentence now reads

"The cost coefficients must be scaled so they are all less than 1."

This sentence should be changed to read:

All cost coefficients except the artificial cost coefficients must be scaled so they are less than 1."

650 LIBRARY PROGRAM ABSTRACT — **FILE NUMBER** 10.1.002

LINEAR PROGRAMMING

L. S. Woo
IBM, Los Angeles

March 23, 1956

a) Solves a linear programming problem.

b) A maximum of 97 equations, not including the objective functions, is possible. The number of variables is unlimited. Input is 10 digit fixed-point numbers which are converted to double precision floating-point numbers for the calculations.

c) Method is Recursive Generation of Vectors for the Modified Simplex Method as described by Kurt Eisemann.

d) The entire drum is used. Timing varies from 4 minutes per iteration for the first 10 up to 13 minutes per iteration for the 31st through 40th.

e) A SOAP symbolic deck listing is included in addition to an absolute deck listing of the assembled program.

f) Alphabetic device if the SOAP symbolic version is used.

650 LIBRARY PROGRAM ABSTRACT — **FILE NUMBER** 10.1.003

TRANSPORTATION PROBLEM

S. Poley
IBM, New York

May 17, 1956

a) Solves the transportation problem, i.e., given the requirements at m destinations, and amounts available at n origins, and the cost of shipment from any origin to any destination the program will determine the minimal mode of transportation of a homogeneous product.

(Continued on next column)

b) All input data are restricted to a maximum size of five digits and all operations are in fixed-point. An approximation to the maximum number of destinations, m, and origins, n, is $5m+6n<2300$ with $n<100$.

c) Method is essentially the same as the iterative-method proposed by A. Charnes and W. W. Cooper in "Management Science," October, 1954.

d) The entire drum is used. Time estimates not given.

e) Provision is made for alternate solutions which yield the same minimum total cost. A SOAP symbolic deck listing with a sample absolute deck listing is included.

f) Alphabetic device if the SOAP symbolic version is used.

ERRATA — 650 Library Program - File No. 10.1.003

"Transportation Problem," by S. Poley

It has been discovered that the copies of the program deck for Program III (Alternate Optima) of the Transportation Problem furnished by the 650 Program Library prior to February 28, 1958, contain several erroneous cards. The corrections are too numerous to list here; 650 users who expect to run this part of the program may obtain corrected copies of the deck from the library in the usual manner.

The program listing contained in the detailed write-up is correct as issued.

650 LIBRARY PROGRAM ABSTRACT — **FILE NUMBER** 10.1.004

LINEAR PROGRAMMING

J. W. Davis and D. H. Brown
Esso Standard Oil, Baton Rouge, Louisiana

March 29, 1956

a) Solves a linear programming problem.

b) Fixed decimal arithmetic of the form xxxxx.xxxxx is used. Up to 40 equations and any number of variables may be handled.

c) The modified simplex method is used.

d) The program is divided into four parts. Storage required is approximately 211, 57, 44, and 114 locations respectively. The parts occupy the same area of the drum and are read in only when needed. Timing information not given.

e) Information on alternate optima or near optima is supplied by the program.

f) Minimum 650.

650 LIBRARY PROGRAM ABSTRACT — **FILE NUMBER** 10.1.005

LINEAR PROGRAMMING

R. L. Graves
Standard Oil, Indiana

a) Solves a minimizing linear programming problem.

b) A maximum of 33 equations in 1000 variables can be accommodated. All numbers are in floating-point form.

(Continued on next page)

c) The dual and direct forms of the revised simplex method are used.

d) The entire drum is required. About 26 minutes are required for a 22 x 46 system.

e) A modified Trimble-Kuble interpretive system is used for the floating-point arithmetic, see Technical Newsletter No. 8.

f) Minimum 650

IBM 650 Library Program Abstracts

File no. 10. 1. 006
Management Science

LINEAR PROGRAMMING CODE FOR THE AUGMENTED IBM 650

O. R. Perry
IBM, Los Angeles 5, California

J. S. Bonner
Bonner & Moore Engineering Associates
Houston 11, Texas

a. Purpose: This routine provides a method to find optimal solutions for relatively large linear programming problems with flexibility of input and detailed results, while maintaining simplicity and speed in operation.

b. Range: The size of the problem which can be handled is restricted by the following relationship:

$(M + 2)\ (N - M + 2) \leqq 1900$, where:

M is the number of restrictions;
N is the number of independent variables, including slacks and artificials.

Accuracy: Single precision.

Floating/Fixed: Floating decimal arithmetic is used.

c. Mathematical Method: Composite Algorithm; reverts to Simplex Algorithm when feasibility has been achieved.

d. Storage Required: This routine uses the entire drum; however, if the problem is less than maximum size a large portion of the drum will be available for other use.

Speed: Computing speed depends on several factors. As an example, in a problem where M = 17 and N = 57, the speed is approximately 20 seconds per iteration.

Relocatability: Not in relocatable form.

e. Remarks: Input and output are in fixed point with automatic conversion to floating point for computation. The ability to make changes in the problem specifications without repetition of preliminary iterations is provided. Shadow prices and ranges on shadow prices and cost coefficients are provided.

f. IBM 650 System: One 533, automatic floating decimal arithmetic feature, IAS, and indexing registers.

IBM 650 Library Program Abstracts

File no. 10. 1. 007
Management Science

RENT OR BUY ANALYSIS

L. Quinto
S. Freid
IBM, White Plains, New York

A. Fields
The Service Bureau Corporation
New York City

C. Burrill
New York University
New York City.

a. Purpose: This program is designed to assist management in making a rent or buy decision on a capital investment. It will compute a rate of return from one to fifteen years. The Present Value Method is utilized because it considers the time distribution of an irregular pattern of savings occurring in the future. In addition to industrial corporations this program will make special evaluations for utilities, banks, insurance companies and nonprofit organizations. The program will also evaluate new assets and assets purchased under a special option plan. While the program description refers specifically to the purchase of IBM data processing equipment it is sufficiently general to be easily adapted for any type of capital asset.

b. Range: Not given.

Accuracy: Not given.

(Continued on next column)

Floating/Fixed: Not given.

c. Mathematical Method: See IBM General Information Manual, form E20-4040.

d. Storage Required: Not given.

Speed: Not given.

Relocatability: Not given.

e. Remarks: None.

f. IBM 650 System: One 533 required.

Special Devices: None.

IBM 650 Library Program Abstracts

File no. 10. 1. 008

THE SYMMETRIC METHOD OF LINEAR PROGRAMMING

L. E. Winslow
Marquette University
Milwaukee 3, Wisconsin

a. Purpose: This routine solves a linear programming problem using the Symmetric Method which eliminates slack and artificial vectors.

b. Range: The size of the problem which can be handled is restricted by the following relationship:

$(M + 1)\ (N + 1) \leqslant 1300$, $M \leqslant 50$, and $N \leqslant 50$ where:

M is the number of independent variables;
N is the number of restrictions.

Accuracy: Single Precision.

Floating/Fixed: The Wisconsin Floating Decimal routine is used.

c. Mathematical Method: Symmetric Method Algorithm.

d. Storage Required: This routine uses the entire drum; however, if the problem is less than maximum size a large portion of the drum will be available for other use.

Speed: Computing speed depends on several factors; however, it averages approximately $(N + 1)\ (M + 1)/4$ seconds per iteration.

Relocatability: Not in relocatable form.

e. Remarks: If the program is resoaped, the writeup includes a copy of the SOAP deck, the range is:

$(M + 1)\ (N + 1) + M + N \leqslant 1400.$

At times this allows a larger program to be run than the above restrictions indicate.

f. IBM 650 System: One 533 is required.

IBM 650 Library Program Abstracts

File no. 10.1.009

LINEAR PROGRAMMING FORCED INVERSION
CODE FOR THE AUGMENTED 650

F. P. Fisher
Western Region Programming System
3424 Wilshire Blvd.
Los Angeles, California

a. Purpose: The program is designed for use with the Linear Programming Code for the Augmented 650. It has the following features as compared to existing codes for the 650: (1) Allows the analyst to pre-select the final fasis variables. If a proper selection is made, the number of iterations required to obtain an optimal solution may be greatly reduced. As a result, loss of significance due to round off may also be improved. (2) Is completely compatible with the existing version of the Linear Programming Code for the Augmented 650.

b. Accuracy: Single precision floating point.

c. Method: Selected variables are forced into the final basis by a modified simplex procedure. If optimality has not been achieved, the composite algorithm is utilized to complete the solution.

d. Storage Requirements: The entire storage will ordinarily be required. However, on problems less than the maximum size, storage will be available for other purposes.

e. Remarks: None

f. Equipment Specifications: Basic 650 with index registers, floating point and IAS.

IBM 650 Library Program Abstracts

File no. 10.1.010

LINEAR PROGRAMMING FORCED INVERSION VECTOR PARTITIONING CODE FOR THE AUGMENTED 650

F. P. Fisher
International Business Machines Corporation
Western Region Programming Systems
3424 Wilshire Blvd.
Los Angeles, California

a. Purpose: The program is designed for use with the Linear Programming Code for the Augmented 650. It has the following features:
1. Is completely compatible with the existing versions of Linear Programming and Vector Partitioning Codes for the Augmented 650.
2. Allows the analyst to pre-select the final basis variables. Selected non-basis vectors in the matrix are forced into the basis and non-basis vectors outside the machine are updated and placed in the matrix if they are in the Forced Inversion directory.
3. Experience has indicated, if a proper selection is made, the time to complete a partitioned problem can be reduced to one-third of the former time.

b. Accuracy: Single precision floating point.

c. Method: Vectors outside the matrix during inversion are updated by the inverse of the previous basis. Updated vectors that are in the Forced Inversion directory are placed into the matrix and other vectors are punched out in the updated form. Forced Inversion continues until all vectors have been forced into the basis. The problem is then checked for optimization by the conventional simplex and partitioning programs.

d. Storage Requirements: The entire storage will ordinarily be required.

e. Remarks: None

f. Equipment Specifications: Basic 650 with index registers, floating point and IAS.

IBM 650 Library Program Abstracts

File no. 10.2.001
Management Science

THE CORNELL RESEARCH SIMULATOR

R. W. Conway
B. M. Johnson
W. L. Maxwell
Cornell University
Ithaca, New York

a. Purpose: To simulate the operation of a system that consists of a network of queues.

b. Range: The minimum number of operations per job with the basic program is seven.

Accuracy: Not given.

Floating/Fixed: Not given.

c. Mathematical Method: Not given.

d. Storage Required: One hundred eight storage locations are available for records of jobs in process.

Speed: Its speed depends largely upon characteristics and dimensions of the system under consideration. Depending upon these factors the simulator will have an average processing time of from one to twenty seconds per job.

Relocatability: Not given.

e. Remarks: The CORE Simulator is intended to be a research device rather than the basis of a routine operating procedure for a production control operation. As such, flexibility and susceptibility to modification were considered more important in its construction than speed of operation for a particular situation. Although dimensional limitations of the program will preclude its use for direct one-four-one representation of most manufacturing shops, the Simulator can be used to study the operating characteristics of such shops by considering systems which are dimensionally smaller but logically similar.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 10.2.002
Management Science

TOLERANCE SIMULATION PROGRAM

J. E. Monsma
IBM Corporation
Peoria, Illinois

a. Purpose: This program is intended to aid in the choice of tolerance values for a manufactured item. Assembly of the item is simulated within the computer.

(Continued on next column)

b. Range: Assemblies of up to 50 independent dimensions may be studied. Fifty locations are available for building histograms.

Accuracy: Does not apply.

Floating/Fixed: Fixed decimal arithmetic is used.

c. Mathematical Method: The program uses the Monte Carlo method.

d. Storage Required: The routine assumes the use of the entire drum. Locations 0700-1499 are available for the sub-program.

Speed: The speed of the program varies greatly with the size of the program. One thousand gear assemblies have been done in less than 30 minutes.

Relocatability: Not relocatable.

e. Remarks: The "construction" of a group of mathematical models of the assembly is monitored by this program. The user must supply a sub-program describing the assembly under study and the distributions of given dimensions.

f. IBM 650 System: One 533 required.

650 LIBRARY PROGRAM ABSTRACT

FILE NUMBER 10.3.001

LINEAR DECISION RULE FOR PRODUCTION AND EMPLOYMENT SCHEDULING

W. Folsom
C. C. Holt
Industrial Administration
Carnegie Institute of Technology
Pittsburgh, Pa.

a) Calculates optimal linear rules for making decisions on aggregate production and employment utilizing quadratic cost functions.

b) Floating decimal point.

c) The mathematical methods are described in papers appearing in "Management Science" Volume 2, No. 1 and 2, October 1955, January 1956.

d) The program requires the following decks:

(1) The Wolontis System* deck
(2) Complex Operations deck
(3) Arctan Relocated deck (decks 2 and 3 developed by Dr. P. Marcus, C. I. T.)
(4) The Linear Decision Rule Program deck

These programs are not relocatable.
All four decks are supplied in a single package.

e) Standard Wolontis* 533 and 402 boards are used.

f) Minimum 650.

* Bell Laboratories Interpretive System described in IBM Technical Newsletter No. 11.

IBM 650 Library Program Abstracts

File no. 10.3.002
Management Science

PRODUCTION LINE BALANCING

T. E. Daum
Westinghouse Electric Corp.
Mansfield, Ohio

J. W. Burgeson
IBM, Akron, Ohio

a. Purpose: Given the times and precedence relationships between basic jobs on a zoned assembly line, and given the production rate desired, this routine assigns jobs to operators in such a manner as to minimize the total number of operators required.

b. Range: Maximum of 95 "can do" jobs per line. Maximum of 50 jobs per zone. Maximum of 24 jobs per operator.

(Continued on next page)

Accuracy: Does not apply.

Floating/Fixed: Not given.

c. Mathematical Method: An approximation method is employed, which may not give a minimum figure in all cases. The exact method of computation has been programmed but is prohibitively long in machine time. The method employed has shown a substantial savings over hand methods. The total idle time on the entire line has been exceeded by the maximum allowable operator time in 90% of the cases run to date.

d. Storage Required: The routine takes up the entire drum and IAS.

Speed: For a job-operator ratio of about 6:1, speeds of 0.4 to 0.8 minutes per operator have been attained.

Relocatability: Not relocatable.

e. Remarks: In using the program, the production line is divided into physical "zones." An operator will not be assigned to jobs in more than one zone. Jobs are subdivided into two types, "must do" and "can do." A "must do" job can be performed in only one particular zone, while a "can do" job might be performed in one of several zones. The routine decides the best zone for each "can do" job.

f. IBM 650 System: One 533, indexing registers, and IAS.

IBM 650 Library Program Abstracts

File no. 10.3.003
Management Science

2DT: A TWO-DIMENSIONAL TRIM ROUTINE

J. W. Burgeson
G. Kenny
IBM, Akron, Ohio

a. Purpose: This program assigns to any given rectangular "stock" piece a layout pattern for smaller rectangular pieces to be cut.

b. Range: The program can handle only one stock piece at a time, but up to 350 unique sizes of pieces to be cut, up to 999 of each. On sample programs the routine has given patterns with as little waste as 1.4%. The program does well with as few choices as 50 pieces of five unique sizes.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: An approximation method is used.

d. Storage Required: The entire drum.

Speed: Averages about five minutes per run.

Relocatability: Not relocatable.

e. Remarks: None.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts

File no. 10.3.004
Management Science

PRODUCTION DAY CALENDAR

R. L. Freeman
Portsmouth Naval Shipyard
Portsmouth, New Hampshire

a. Purpose: This program is written to be used as a subroutine for scheduling events which are based upon normal productive working days.

b. Range: The sample calendar is for a five-year period beginning January 1958 and ending December 1962.

Accuracy: Does not apply.

Floating/Fixed: Fixed decimal.

c. Mathematical Method: Table lookup method is used.

d. Storage Required: The calendar requires 242 storage locations, and the program requires 203 locations.

Speed: Not given.

Relocatability: Relocatable. See program write-up.

e. Remarks: The program is built around two features of the IBM 650: TLU and Branch on Distributor codes. For correct input, error designations

(Continued on next column)

are provided which do not stop the 650 but allow the programmer to take such action as is necessary. The range of the calendar may be extended merely by relocating either the program or the table.

f. IBM 650 System: One 533 required.

Special Devices: Alphabetic device required for the SOAP I version.

IBM 650 Library Program Abstracts

File no. 10.3.005

LESS

Frederick Backer, Jr.
IBM Applied Science
Dallas, Texas

a. Purpose: The program is designed to answer the question, "At what time and how fast should each and every job be done so as to complete the project at a minimum cost or in a specified time?"

b. Range/Restrictions: The program must start at 001 and a maximum of 500 jobs can be used.

Floating/Fixed: Not given.

c. Mathematical Method: N/A

d. Storage Required: The second and third tables can occupy 500 positions of memory (locations 0801-1300, 1301-1800 respectively).

e. Remarks: None

f. IBM 650 System: One 533 is required.

IBM 650 Library Program Abstracts

File no. 10.3.006

MAN - SCHEDULING

H. N. Perk
Texas Division
The Dow Chemical Company
Freeport, Texas

a. Purpose: The "LESS" program assumes that the only restriction on starting a job is that every job that precedes it in the arrow diagram has been completed. "Man - scheduling" adds a further restriction in that the total usage of manpower of all jobs in process at any one time cannot exceed specified maximum limits. Limits on 10 classes, or crafts, can be specified.

b. Range: Does not apply.

Accuracy: Does not apply.

Arithmetic: Fixed point.

c. Mathematical method: The program is a continuous updating of job priorities and rearrangement of queues of waiting jobs in progress.

d. Approximately 1600 drum locations are used.

Running Time: Running time depends on how tight manpower availability restrictions are set. A test problem of 79 jobs ran 5 minutes with unlimited availabilities and 25 minutes when availabilities were at minimum values.

e. Remarks: None.

f. IBM 650 System: Basic 650.

IBM 650 Library Program Abstracts

File no. 10.3.007

LESS - Phase IA - Node-Numbering

Frederick Backer, Jr.
IBM
Dallas, Texas

a. Purpose: The 650 program LESS requires as input a set of "legally" numbered jobs. This program accepts an arbitrarily numbered arrow diagram and produces as output a set of numbered jobs acceptable to the LESS program.

b. Range: Fixed point.

c. Mathematical Method: The method used is an algorithm by Backer described in a paper "LESS - Phase IA".

d. Storage Required: Essentially the entire drum is used. 300 nodes were numbered in 18 minutes. The program is not relocatable.

(Continued on next page)

e. Remarks: The program handles projects of 300 jobs or less, a severe limitation imposed by minimum machine considerations.

f. IBM 650 System: Minimum 650

File no. 10.3.008

IBM 650 Library Program Abstracts

G&L POST-PROCESSOR

R. G. Chamberlain
Giddings & Lewis Machine Tool Company
Fond du Lac, Wisconsin

a. Purpose: Routine is designed to convert numerical-control tool center information into the particular language required by the G&L (Concord) interpolator-Director. It translates special functions and standstill commands in correct sequence; punches magnetic tape footage at tape stops; and approximates circular arcs by tangents or cards. Provision is made for minimizing overshoot. Output is compatible with 9207 Translator.

b. Range: Accuracy: Range of numbers must not exceed Numericord magnitude and form (xxx.xxx$\frac{0}{5}$). Calculations are performed in fixed points.

c. Mathematical Methods: Not applicable except that approximation of circular arcs is performed by matrix algebra.

d. Storage Requirements: Approximately 855 locations are required. Routine is non-relocatable.

e. Remarks: None.

f. Equipment Required: Indexing registers.

File no. 10.3.009

IBM 650 Library Program Abstracts

LEAST COST ESTIMATING & SCHEDULING - SCHEDULING PHASE ONLY (LESS)

M. C. Frishberg
Special Representative
Manufacturing Industries
3424 Wilshire Blvd.
Los Angeles, California

a. Purpose: The program, having been given information about the relationship and duration of individual jobs in a project, computes project duration and develops a schedule for the project.

b. Restrictions, Range: Since integers are operated on throughout in fixed point, and then only by addition and subtraction, accuracy is assured.

c. Method: The algorithm is due to James E. Kelley, Jr., Mauchly Associates, Ambler, Pennsylvania.

d. Storage Requirements: Almost the entire drum is used. Data (one card per job) is read at 533 read speed, schedule computations vary with project size and complexity, and the schedule is punched at punch speed (one card per job). A project of 93 jobs scheduled in 30 seconds.

e. Remarks: Projects are limited to 500 jobs or less; durations limited to four digits or less.

f. IBM 650 System: Basic 650 with 533 (80 - 80 board); 407 off line for arranging and listing output.

650 LIBRARY PROGRAM ABSTRACT — FILE NUMBER 11.0.002

THREE DIMENSIONAL TICK-TACK-TOE

H. F. Smith, Jr.
Watson Laboratory
New York 25, N. Y.

a) This program is a demonstration routine for the IBM 650; it permits a human opponent to compete with the 650 in a three-dimensional version of the children's game of tick-tack-toe, or crisscross. Plays are made by entering in the storage entry switches the coordinates of a cell in a cube of order 4 and depressing the program start key; the machine will reply and stop, awaiting the opponent's next play.

b) Does not apply.

c) Does not apply.

(Continued on next column)

d) The program uses approximately 1700 storage locations.

e) None.

f) Minimum 650.

File no. 11.0.005
Demonstration Programs

IBM 650 Library Program Abstracts

HUMAN REACTION TIME DEMONSTRATION ROUTINE

B. M. Taylor, Jr.
North Carolina State College
Raleigh, North Carolina

a. Purpose: This program permits an operator to test his reaction time by awaiting, for rectangularly-distributed random waiting times, a signal from the console cuing the operator to press the program reset key. The program start key is used to initiate a new trial. A card is punched for each trial, recording a serial number, the random waiting time in hundredths of a second, and the reaction time in ten-thousandths of a second. The reaction time is also displayed on the console.

b. Range: Does not apply.

Accuracy: Does not apply.

Floating/Fixed: Does not apply.

c. Mathematical Method: Uses the "Random Number Program," written by Dr. Arnold Grandage, and published by North Carolina Institute of Experimental Statistics.

d. Storage Required: The program uses the first, third, fifth, and seventh read bands, and the first 3 storage locations of the 1977 punch band.

Speed: Does not apply.

Relocatability: Not given.

e. Remarks: The program deck consists of four cards.

f. IBM 650 System: One 533 required.

File no. 11.0.006

IBM 650 Library Program Abstracts

GENERAL PURPOSE CALENDAR PROGRAM

N. Jaspen
National League for Nursing, Inc.
New York 19, New York

a. Purpose: This program has been designed to calculate the following:

1) The day of the week corresponding to any date in the Gregorian calendar.
2) The difference in days between two dates.
3) The date that is a given number of days before or after a given date.

b. Range: The program has been written on the assumption that the year can be expressed in four digits, ranging from 0001 to 9999 AD.

Accuracy: Exact, using the conventions explained in the write-up when applying the formulas.

Floating/Fixed: Fixed point.

c. Mathematical Method: Formulas are used rather than tables.

d. Storage Required: Approximately 300 storage locations.

Speed: Read-punch speed.

Relocatability: Relocatable.

e. Remarks: The conventions used in applying the formulas are explained in the program write-up.

f. IBM 650 System: One 533 required.

IBM 650 Library Program Abstracts File no. 11.0.007

COMPUTER AUTOMATED MUSIC

Norman V. Plyter
University of Rochester Computing Center
IBM Applied Science
Rochester, N. Y..

a. Purpose: The CAM program is a two phase program to produce actual musical tones via a Digital to Audio Converter connected to the operating lights of the IBM 650 console. The first Phase, the CAM Compiler, codes each note into an appropriate language for Phase II, the CAM Tune Program. Once coded, Phase II, a short program in IAS, is sufficient to produce the song again and again. The tone produced resembles a woodwind or bagpipe sound and is completely successful in reproducing the musical score selected. Percussion effects, such as 407 type-bars slamming to simulate drum beats or cymbal crashes can be incorporated into the selection to enhance the musical effect.

b. Range: About one and a half octaves are available from high C through middle C down to G and any score in this range or which may be transposed into this range is applicable. The musical score may contain up to 2000 notes.

c. Mathematical Method: Length of time to complete multiply operation determines spacing of pulses to Data Address Light.

d. Storage Required: Entire Drum, IAS, Index Registers.

e. Remarks: None

f. Equipment: IBM 650 System including IAS and Index Registers Digital to Audio Converter (Heathkit).

650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER 12.0.001**

DEBUGGING PROGRAMS

A. M. Pietrasanta
IBM, New York

October, 1956

This paper describes a complete, automatic debugging procedure designed to provide the maximum amount of information about a malfunctioning program in the minimum amount of programmer and machine time. The following routines are used in the debugging procedure and complete information about them is given: Flow Tracer, Snapshot Tracer, Symbolic Seven-Per-Card Punch, all by S. Poley; Symbolic Tracing Routine by W. P. Heising and S. Poley; and Stop Codes by F. J. Chrinko.

The above routines, except the last one, are written in SOAP symbolic form, and are designed to be used by the SOAP programmer most effectively. The routines, however, can be used by the non-SOAP, or absolute, programmer, but a rudimentary knowledge of the SOAP system is necessary.

650 LIBRARY PROGRAM ABSTRACT **FILE NUMBER 12.0.003**

FLOW DIAGRAMMING FOR THE IBM 650

B. Dimsdale
A. K. Charnow
I. M. Sobul
Service Bureau Corporation
Los Angeles, California

This paper describes a flow diagramming technique for the IBM 650. The method is an adaptation of the von Neumann-Goldstine system, and is designed primarily for mathematical and scientific problems.

IBM 650 Library Program Abstracts File no. 12.0.004 Unclassified

GO SOAP II

F. D. Greenley
P. L. Overmire
American Trust Company
San Francisco, California

GO SOAP II is a 407 pre-assembly procedure which makes the benefits of SOAP II available to those using a 650 system without the alphabetic device. The procedure requires a 407 with summary punch. No changes from SOAP II are necessary. (See SOAP II Reference Manual, C28-4000; formerly 32-7646)

IBM 650 Library Program Abstracts File no. 12.0.005 Unclassified

402 CONTROL PANEL FOR SOAP II, 8-WORD LIST, AND 650 LOAD CARDS

Mrs. Margaret Crawley
Computer Laboratory
The University of Oklahoma
Norman, Oklahoma

This paper describes the control panel wiring, function, and application of a control panel for the IBM 402 Accounting Machine designed for listing SOAP II input and output, 650 load cards, and eight-word output cards.

IBM 650 Library Program Abstracts File no. 12.0.006 Unclassified

650 SOAP CONTROL PANEL WIRING SUGGESTION

O. A. De Vito
R. E. Van Allen
General Electric Company
Schenectady 5, New York

This paper describes additional wiring to the IBM 533 SOAP II control panel to detect double punches and blank columns when assembling a 650 program using SOAP II.

IBM 650 Library Program Abstracts File no. 12.0.007

AUTOMATIC INFORMATION RETRIEVAL PROGRAM

J. T. Ahlin
Manager, DP Information Retrieval
IBM
112 E. Post Rd.
White Plains, N. Y.

a. Performs literature searches on punch card decks representing library information or document collections which have been encoded by Coordinate Indexing techniques. Uses the Inverted File organization with fourteen document numbers per card. A maintenance program produces new and updates old Keyword Cards automatically.

b. Does not apply.

c. Boolean Operatives used in the document number comparisons.

d. The entire drum storage is required.

e. Self-loading. Recommended background reference: "An Introduction to Information Retrieval". IBM Form number, E20-8044

f. Minimum 650 with a digit selector.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 058UAINV1 AVAILABLE PRIOR TO JANUARY 1962

MATRIX INVERSION
INVERTS A MATRIX STORED IN CORE STORAGE. USES AN ELIMINATION METHOD. THE STARRING ELEMENT IS THE LARGEST IN THE COLUMN, BUT THE COLUMNS ARE USED IN ORDER FROM LEFT TO RIGHT. THE ORIGINAL MATRIX IS DESTROYED, AND IS REPLACED IN STORAGE BY THE INVERSE. THE ROUTINE REQUIRES 171 CELLS PLUS 2N&8 COMMON. A 61 BY 61 MATRIX CAN BE INVERTED IN A 4096 WORD MACHINE IN ABOUT 100 SECONDS.

0704 069LAS816 AVAILABLE PRIOR TO JANUARY 1962

FLOATING EXPONENTIAL
EVALUATES FLOATING E TO FLOATING X FOR X ABSOLUTE LESS THAN OR EQUAL TO 87.3. ACCURATE TO & OR -3 IN EIGHTH DECIMAL DIGIT. TSX SEQUENCE WITH ERROR RETURN FOR X OUT OF RANGE. USES 63 STORAGE CELLS &5 COMMON.

0704 069LAS820 AVAILABLE PRIOR TO JANUARY 1962

FLOATING NATURAL LOGARITHM
COMPUTES FLOATING NATURAL LOG OF FLOATING X FOR X GREATER THAN ZERO. TSX SEQUENCE WITH ERROR RETURN FOR AN X OF ZERO OR LESS. ACCURATE TO & OR -3 IN EIGHTH SIGNIFICANT DECIMAL DIGIT. MAXIMUM TIME ABOUT 2.22 MILLISECONDS. USES 39 STORAGE CELLS &3 COMMON./CORR-- 171

0704 073UACSH2 AVAILABLE PRIOR TO JANUARY 1962

READ BCD TAPE OR ON-LINE CARD READER
READS EITHER BCD TAPE /WITH REDUNDANCY CHECKING/ OR HOLLERITH PUNCHED CARDS, AS DETERMINED BY SENSE SWITCH. INFORMATION READ IS STORED IN CORE IN BCD FORM. ROUTINE REQUIRES 167 CELLS PLUS 9 COMMON.

0704 073UADBC1 AVAILABLE PRIOR TO JANUARY 1962

DECIMAL, OCTAL, BCD LOADER
USED WITH UA TSM 2 OR UA CSH 2. CONTROLS TAPE PROGRAM UA TSM 2 OR TAPE OR CARD PROGRAM UA CSH 2 TO READ BCD INFORMATION INTO CORE. CONVERTS THIS INFORMATION TO BINARY, - FIXED OR FLOATING DECIMAL NUMBERS BEING CONVERTED TO FIXED OR FLOATING BINARY NUMBERS, AND DECIMAL OR OCTAL INTEGERS BEING CONVERTED TO BINARY INTEGERS. ALSO READS AND STORES HOLLERITH LABELS, COMMENTS, ETC. INPUT CARD FORMAT IS VARIABLE. LOADING MAY BE CONTROLLED BY TRANSFER CARDS. ROUTINE REQUIRES 372 CELLS PLUS 24 COMMON. CORR.--089

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 085CLMAD1 AVAILABLE PRIOR TO JANUARY 1962

MATRIX ADDITION
ADDS TWO MATRICES STORED ROW-WISE IN FLOATING POINT, EACH REAL OR COMPLEX. EACH ROW PRECEDED BY HEADING WORD. REQUIRES 211 STORAGES PLUS 12 COMMON.

0704 085CLMBH1 AVAILABLE PRIOR TO JANUARY 1962

MATRIX HEADING REMOVAL
SHIFTS ELEMENTS OF REAL OR COMPLEX MATRIX SO HEADINGS ARE ELIMINATED, RESULTING ELEMENTS STORED CONSECUTIVELY. REQUIRES 45 STORAGES PLUS 4 COMMON.

0704 085CLMCP1 AVAILABLE PRIOR TO JANUARY 1962

MATRIX PUNCH
CODED BY NA. PUNCH DECIMAL CARDS ON-LINE OR PREPARE BCD TAPE FOR TAPE PUNCH UNIT. CARDS ACCEPTABLE TO CL MCR1. REQUIRES 400 STORAGES PLUS 65 COMMON.

0704 085CLMEX1 AVAILABLE PRIOR TO JANUARY 1962

MATRIX EXPAND
SHIFTS ROWS OF REAL OR COMPLEX MATRIX TO GIVE STORAGE FOR HEADINGS, AND FORMS HEADINGS. ELEMENTS IN CONSECUTIVE LOCATIONS IN ROW ORDER. REQUIRES 66 STORAGES PLUS 4 COMMON.

0704 085CLMIN1 AVAILABLE PRIOR TO JANUARY 1962

MATRIX INTERCHANGE OF ROWS AND COLUMNS
INTERCHANGE, DELETE, INSERT ROWS OR COLUMNS. EITHER REAL OR COMPLEX. EACH ROW PRECEDED BY HEADING WORD. CL MTX1 MUST BE USED. REQUIRES 281 STORAGES PLUS 26 COMMON. CORR. -- 159.

0704 085CLMIV1 AVAILABLE PRIOR TO JANUARY 1962

MATRIX INVERSE
CODED BY NA. INVERTS REAL SQUARE MATRIX. REQUIRES 320 STORAGES PLUS 21 COMMON.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 085CLMK01 AVAILABLE PRIOR TO JANUARY 1962

K TIMES UNIT MATRIX
CODED BY NA. FORMS UNIT MATRIX, MULTIPLIES BY REAL OR COMPLEX SCALAR. RESULT HAS HEADINGS. REQUIRES 67 WORDS PLUS 1 COMMON. CORR/ 330

0704 085CLMLP1 AVAILABLE PRIOR TO JANUARY 1962

MATRIX LOOP TEST
EXAMINES PSEUDO-INSTRUCTIONS OF CL MLD1 AND CL MST1 AND GIVES BRANCH BASED ON LAST ROW OF EACH MATRIX BEING LOADED OR STORED. REQUIRES 26 STORAGES PLUS 1 COMMON.

0704 085CLMMP1 AVAILABLE PRIOR TO JANUARY 1962

MATRIX MULTIPLICATION
MULTIPLIES TWO MATRICES, REAL OR COMPLEX, STORED ROW-WISE IN FLOATING POINT. RESULT IN C.S. EACH ROW PRECEDED BY HEADING WORD. REQUIRES 336 STORAGES PLUS 16 COMMON.

0704 085CLMPR1 AVAILABLE PRIOR TO JANUARY 1962

MATRIX PRINT
CODED BY NA. PRINT MATRICES FROM C.S. ON ON-LINE OR OFF-LINE PRINTER. INDICATIVE SPECIFIED BY CALLING SEQUENCE. REQUIRES 563 STORAGES PLUS 25 COMMON.

0704 085CLMSB1 AVAILABLE PRIOR TO JANUARY 1962

MATRIX SUBTRACTION
SUBTRACTS TWO MATRICES STORED ROW-RISE IN FLOATING POINT, EACH REAL OR COMPLEX. EACH ROW PRECEDED BY HEADING WORD. USES CL MAD1. REQUIRES 32 STORAGES PLUS THOSE IN CL MAD1.

0704 085CLMTR1 AVAILABLE PRIOR TO JANUARY 1962

MATRIX TRANSPOSE
TRANSPOSE REAL OR COMPLEX MATRIX, ONE ROW AT TIME IF DESIRED. IF COMPLEX, EITHER CONJUGATE OR NON-CONJUGATE TRANSPOSE. REQUIRES 111 STORAGES PLUS 3 COMMON.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 085CLMTX1 AVAILABLE PRIOR TO JANUARY 1962

INTERPRETATION MATRIX ABSTRACTION
INTERPRETS MATRIX PSEUDO-INSTRUCTIONS AND TRANSFERS TO CORRECT SUBROUTINE. READS FROM DRUM TO C.S. IF NECESSARY. REQUIRES 44 STORAGES PLUS 2 COMMON IF READ DRUM, 24 STORAGES IF DRUM NOT READ.

0704 108RSLPS1 AVAILABLE PRIOR TO JANUARY 1962

LINEAR PROGRAMING SYSTEM V
USES MODIFIED SIMPLEX METHOD WITH PRODUCT FORM OF INVERSE, WILL SOLVE PROBLEMS HAVING 255 EQUATIONS AND ANY NUMBER OF VARIABLES. CODE IS COMPLETE WITH SIDE ROUTINES TO AID COMPLICATED BACKUPS. SPECIAL FEATURES INCLUDE PAREMETRIC LINEAR PROG, MULTIPLE OPTIMISING FORMS, & SUNDRY PARTITIONING AND RESTART DEVISES. I/O IS FIXED PT, CALC IS DBL PREC FL PT. STANDARD SHARE BOARDS ARE USED. ID ON BINARY CARDS IS INDICATIVE OF FUNCTION AND IS NOT RSPLS.
CORR./ 161,254,306,328,348,380,666.

0704 110GLDEV1 AVAILABLE PRIOR TO JANUARY 1962

DETERMINANT EVALUATION
EVALUATES BY GAUSS ELIMINATION METHOD THE DETERMINANT OF A REAL OR COMPLEX MATRIX OF ORDER N IN SINGLE OR DOUBLE PRECISION. DESIGNED FOR USE WITH GL DPA1. NORMAL TSX SEQUENCE. USES 191 STORAGES.

0704 110GLDPA1 AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT DOUBLE PRECISION ABSTRACTION
ALLOWS A SET OF 20 MACHINE LANGUAGE OPERATIONS WHICH CAN BE EXECUTED IN SINGLE PRECISION WITH NEGLIGIBLE LOSS OF TIME OR IN A DOUBLE PRECISION MODE UNDER CONTROL OF SENSE SWITCH 1. NORMAL TSX SEQUENCE. USES 275 STORAGES.

0704 110GLROP1 AVAILABLE PRIOR TO JANUARY 1962

NEWTONS METHOD FOR FINDING ROOTS OF POLYNOMIALS
COMPUTES ROOTS OF A REAL OR COMPLEX POLYNOMIAL OF ORDER K IN SINGLE OR DOUBLE PRECISION. DESIGNED FOR USE WITH GL DPA1. CALLING SEQUENCE SPECIFIES CONVERGENCE FACTOR. USES 376 STORAGES PLUS 4/K&1/ COMMON FOR SINGLE PRECISION OR 8/K&1/ COMMON FOR DOUBLE PRECISION.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 116CLASC1 AVAILABLE PRIOR TO JANUARY 1962

ARC SINE AND ARC COSINE
ARCSIN AND ARCCOS OF FLOATING POINT ARGUMENT. SQUARE ROOT ROUTINE USING 3 COMMON MUST BE ASSEMBLED CONCURRENTLY. REQUIRES 71 STORAGES PLUS 7 COMMON.

0704 116CLDDI2 AVAILABLE PRIOR TO JANUARY 1962

DIVIDED DIFFERENCE INTERPOLATION
FINDS FUNCTIONS Y FOR ARGUMENTS X USING TABLE OF DIVIDED DIFFERENCES FORMED BY CL DDT1. REQUIRES 136 STORAGES PLUS 14 COMMON.

0704 116CLDDT1 AVAILABLE PRIOR TO JANUARY 1962

DIVIDED DIFFERENCE TABLE FORMATION
FORMS DIVIDED DIFFERENCE TABLE UP THROUGH B-TH ORDER, B-1 TO B-7, FROM TABLE OF ARGUMENTS AND FUNCTIONS. REQUIRES 91 STORAGES PLUS 6 COMMON. USED WITH CL DDI2

0704 116CLDET1 AVAILABLE PRIOR TO JANUARY 1962

DETERMINANT AND EIGENVECTOR FOR REAL MATRIX
REQUIRES 151 STORAGES PLUS 12 COMMON. CORR.-- 131.

0704 116CLDET2 AVAILABLE PRIOR TO JANUARY 1962

DETERMINANT AND EIGENVECTOR FOR COMPLEX MATRIX.
CALCULATES EIGENVECTOR ONLY IF DESIRED. REQUIRES 293 STORAGES PLUS 17 COMMON. CORR. -- 131.

0704 116CLINT1 AVAILABLE PRIOR TO JANUARY 1962

INTEGRAL EVAL., TRAPEZ. RULE /EQU. INTERVALS/
INTERVAL AND VALUES OF FUNCTION IN FLOATING POINT. REQUIRES 29 STORAGES PLUS ONE COMMON.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 116CLSME3 AVAILABLE PRIOR TO JANUARY 1962

SIMULTANEOUS REAL EQUATIONS
K VECTOR SOLUTIONS OF N SIMULTANEOUS EQUATIONS. REQUIRES 124 STORAGES PLUS 7 COMMON.

0704 116CLTAN1 AVAILABLE PRIOR TO JANUARY 1962

TANGENT
TAN X FOR X IN RADIANS. REQUIRES 63 STORAGES PLUS 4 COMMON.

0704 121GMHAS1 AVAILABLE PRIOR TO JANUARY 1962

HARMONIC ANALYSIS SUBROUTINE
GIVEN A TABLE OF Y IN AN INTERVAL, WHERE Y EQUALS F OF X, WHICH CORRESPOND TO A SET OF EQUALLY SPACED VALUES OF X, HAS1 COMPUTES THE COEFFICIENTS OF A TRIGONOMETRIC SERIES. IN PARTICULAR, THE AMPLITUDE AND PHASE ANGLE OF EACH HARMONIC IS COMPUTED. REQUIRES 330 PROGRAM CELLS AND ANSWERS AND COMMON. CORR./ 186, 453

0704 122PKANIP AVAILABLE PRIOR TO JANUARY 1962

AITKENS INTERPOLATION FOR N EQUAL INTERVALS
A FLOATING POINT INTERPOLATION ROUTINE USING AITKENS METHOD FOR EQUAL INTERVALS OF THE ARGUMENT. MAY BE USED FOR ANY ORDER OF INTERPOLATION. AITKENS METHOD AFFORDS A MORE CONCISE FORMULATION THAN OTHER EQUIVALENT POLYNOMIAL METHODS.

0704 139CLRAN1 AVAILABLE PRIOR TO JANUARY 1962

RANDOM NUMBER GENERATOR
CALCULATES A RANDOM NUMBER. REQUIRES 28 STORAGES. CORR/ 187

0704 141LAS885 AVAILABLE PRIOR TO JANUARY 1962

SOLUTION OF GENERAL MATRIX EQUATION AX - B.
GIVEN AN ARRAY OF M COLUMNS AND N ROWS, M GREATER THAN N, OF ELEMENTS STORED ROW-WISE AT L WHERE A IS NXN AND B IS NXM-N, S 885 FINDS THE SOLUTION MATRIX, X, OF DIMENSION NXM-N. THE SOLUTION MATRIX IS STORED ROW-WISE AT L. THE PROGRAM IS GENERALLY MOST USEFUL WHEN B IS A COLUMN MATRIX SO THAT X IS THE SOLUTION TO A SYSTEM OF N LINEAR EQUATIONS IN N UNKNOWNS, OR WHEN B IS THE IDENTITY MATRIX SO THAT X IS THE INVERSE OF A, OR TO GET BOTH THE SOLUTION AND THE INVERSE. S 885 USES 203 CELLS AND 6 COMMON.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 116CLINT3 AVAILABLE PRIOR TO JANUARY 1962

INTEGRAL EVAL., SIMPSONS RULE /EQU. INTERV./
INTERVAL AND VALUES OF FUNCTION IN FLOATING POINT. REQUIRES 64 STORAGES PLUS 2 COMMON.

0704 116CLLSQ1 AVAILABLE PRIOR TO JANUARY 1962

LEAST SQUARES POLYNOMIAL FIT
FIT POLYNOMIALS OF ORDER ONE THROUGH SEVEN TO N GIVEN POINTS BY METHOD OF LEAST SQUARES. ORDER AND SPACING IMMATERIAL. POINTS, IN FLOATING POINT, NEED NOT ALL BE DISTINCT. REQUIRES 586 STORAGES PLUS VARIABLE COMMON.

0704 116CLLSQ3 AVAILABLE PRIOR TO JANUARY 1962

LEAST SQUARES SOL. OF SIMULTANEOUS EQUATIONS
SOLVE M SIMULTANEOUS EQUATIONS IN N UNKNOWNS SO SOLUTION IS BEST POSSIBLE FIT TO ALL POINTS BY METHOD OF LEAST SQUARES. POINTS IN FLOATING POINT. REQUIRES 268 STORAGES PLUS VARIABLE COMMON. CORR./479

0704 116CLREL AVAILABLE PRIOR TO JANUARY 1962

RELATIVIZE SYMBOLIC DECK
CONSISTS OF TWO DECKS DESIGNATED BY REL1 AND REL2. REPRODUCE SYMBOLIC DECK WITH LOCATION SYMBOLS RELATIVE TO FIRST. OUTPUT IS TO TAPE FOR OFF-LINE PUNCHING ONLY. USAGE SIMILAR TO SAP IN MANY RESPECTS. USES CORE AND TAPES 1 AND 6, AND TAPE 4 IF INPUT FROM TAPE. REVISED DIST. 236

0704 116CLSME1 AVAILABLE PRIOR TO JANUARY 1962

SIMULTANEOUS REAL EQUATIONS, DETERMINANT
K VECTOR SOLUTIONS AND DETERMINANT OF N SIMULTANEOUS EQUATIONS. REQUIRES 429 STORAGES PLUS 1. CORR.-- 222,479

0704 116CLSME2 AVAILABLE PRIOR TO JANUARY 1962

SIMULTANEOUS EQUATIONS COMPLEX
K VECTOR SOLUTIONS OF N SIMULTANEOUS EQUATIONS. REQUIRES 304 STORAGES PLUS 21 COMMON.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 141LAS887 AVAILABLE PRIOR TO JANUARY 1962

INTEGRATION OF SPECIAL FORM OF 2ND ORDER EQU.
FOR DIFFERENTIAL EQUATIONS OF SECOND ORDER WITH FIRST DERIVATIVE ABSENT. ROUTINE MUST HAVE A PROGRAM AVAILABLE TO CALCULATE THE VALUE OF THE SECOND DERIVATIVE. STARTING CONDITIONS FOR THE INTEGRATION MUST BE AVAILABLE. S 887 USES 80 CELLS AND 1 WORD FOR COMMON.

0704 144PKNIDA AVAILABLE PRIOR TO JANUARY 1962

DIFFERENTIAL EQUATION SOLVING SYSTEM
SOLVES A SYSTEM OF ORDINARY DIFFERENTIAL EQUATIONS. ANY NUMBER OF EQUATIONS,OF ANY ORDER,LINEAR OR NON-LINEAR MAY BE SOLVED. A SERIES OF TSX LINKAGES WITH SEVERAL PARTS OF THE ROUTINE IS NECESSARY. MILNES FORMULAS ARE USED AFTER A SPECIAL SET OF STARTING FORMULAS COMPUTES THE FIRST 4 POINTS. REQUIRES 1494 STORAGE CELLS. CORR/ 195, 269

0704 148NYCRV1 AVAILABLE PRIOR TO JANUARY 1962

CHARACTERISTIC ROOTS AND VECTORS
COMPUTES IN FIXED POINT SINGLE PRECISION ALL CHARACTERISTIC ROOTS AND VECTORS OF A REAL SYMMETRIC MATRIX. USES A MODIFIED JACOBI ITERATIVE METHOD. ACCEPTS EITHER 10 DIGIT DECIMAL INPUT DATA HAVING 10 DECIMAL PLACES OR 35 BIT ABSOLUTE BINARY DATA HAVING 35 BINARY PLACES WHICH ARE SO SCALED THAT NEITHER THE NORM NOR THE TRACE OF THE MATRIX EXCEEDS 1. PRINTS INPUT MATRIX ELEMENTS, CHARACTERISTIC ROOTS AND VECTORS. ALSO PUNCHES THE OUTPUT IF DESIRED

0704 176NAPREA AVAILABLE PRIOR TO JANUARY 1962

PRE-ASSEMBLY PROGRAM
DOES BOOKKEEPING WORK FOR NORTH AMERICAN TAPE ASSEMBLY SYSTEM

0704 197WKLIN1 AVAILABLE PRIOR TO JANUARY 1962

LAGRANGIAN INTERPOLATION SUBROUTINE
COMPUTES Z EQUALS F OF X OR Z EQUALS F OF X AND Y. TABLE VALUES AT EQUAL INTERVALS OF X AND Y. ALL FLOATING POINT. EXTRAPOLATES FOR Z OUTSIDE TABLE. TIMING INDEPENDENT OF TABLE SIZE OR LOCATION OF POINT. REQUIRES 121 STORAGE CELLS PLUS 17 COMMON.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 204GSIN02 AVAILABLE PRIOR TO JANUARY 1962

SCHENECTADY DECIMAL INPUT PROGRAM-VARIABLE FORMAT
DECIMAL C&&RACTE- C-M&&N&O&-NOO N V&-&&&-E &---&OO &-E -& &
FROM CARD READER OR TAPET CONVERTED TO APPROPR9ITE BINARY
FORM, AND STORED IN CORE STORAGE. BLOCKS OF FLOATING POINT
DATA, FIXED POINT DATA, BINARY CODED DECIMAL DATA, AND/OR
ACTUAL DECIMAL INSTRUCTIONS MAO BE READ.
USES SENSE SWITCH 2 FOR CARD OR TAPE INPUT OPTION.
579 STORAGE CELLS & 114 OP CODE TABLE & 40 ERASABLE

0704 204GSOUTR AVAILABLE PRIOR TO JANUARY 1962

GS REVISION OF GL OUT2
DIFFERS FROM GL OUT2 IN FOLLOWING WAYS---
TAPE OR PRINTER OUTPUT CONTROLLED BY SENSE SWITCH 3,
NO ECHO-CHECKING, LESS FLEXIBLE SPACE CONTROL, PRINTS OUT
ERROR IN CALLING SEQUENCE, PUNCHES TAPE ERROR STATISTICS,
PRINTS FLOATING POINT OUTPUT WITH EXPONENT FOLLOWING NUMBER.
406 CELLS OF STORAGE & 51 ERASABLE

0704 206NYINP1 AVAILABLE PRIOR TO JANUARY 1962

INPUT PROGRAM UNDER SENSE SWITCH CONTROL
READS DECIMAL, OCTAL OR BCD INFORMATION FROM A BCD TAPE OR
PUNCHED CARDS, CONVERTS TO BINARY AND STORES THE RESULTS IN
CORE STORAGE. THIS IS A PACKAGED PROGRAM INCORPORATING UADBC1
AND UACSH2. IT USES 572 LOCATIONS.

0704 206NYINP2 AVAILABLE PRIOR TO JANUARY 1962

INPUT PROGRAM UNDER SENSE LIGHT CONTROL
READS DECIMAL,OCTAL OR BCD INFORMATION FROM A BCD TAPE OR
PUNCHED CARDS, CONVERTS TO BINARY AND STORES THE RESULTS IN
CORE STORAGE. THIS IS A PACKAGED PROGRAM INCORPORATING UADBC1
AND UACSH2. IT USES 578 LOCATIONS.

0704 206NYOUT2 AVAILABLE PRIOR TO JANUARY 1962

DECIMAL OUTPUT PROGRAM UNDER SENSE LIGHT CONTROL
CONVERTS BINARY NUMBERS TO DECIMAL NUMBERS IN BINARY CODED
DECIMAL FORM AND WRITE THESE ON TAPE 2 AND/OR PRINT THEM ON
THE ON-LINE PRINTER.PROGRAM INCORPORATES UA BDC1 AND UA SPH1.
OCCUPIES 611 LOCATIONS OF WHICH THE LAST 94 ARE ERASABLE.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 221UATSQ1 AVAILABLE PRIOR TO JANUARY 1962

QUADOCTAL TAPE READING PROGRAM
QUADOCTAL INFORMATION CARDS PRODUCED BY UA CTQ 1 ARE
TRANSCRIBED ONTO A QUADOCTAL TAPE VIA THE OFF-LINE CARD
READER. THIS PROGRAM THEN READS AND CHECKS THIS TAPE,
CONVERTS THE QUADOCTAL INFORMATION BACK TO ITS ORIGINAL
BINARY FORM, AND STORES IT IN CORE MEMORY. THE PROCESS IS
CONTROLLED FROM THE ON-LINE CARD READER BY MEANS OF THE
BINARY CONTROL DECK ORIGINALLY PRODUCED BY UA CTQ 1.

0704 223CLDET3 AVAILABLE PRIOR TO JANUARY 1962

DETERMINANT AND EIGENVECTOR, REAL
CALCULATES THE DETERMINANT AND NORMALIZED
EIGENVECTOR OF A REAL MATRIX.
REQUIRES 157 STORAGES PLUS 13 COMMON CORR/ 410

0704 223CLDPA1 AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION FLOATING ADD
OBTAIN THE DOUBLE PRECISION SUM OF TWO DOUBLE PRECISION
FLOATING NUMBERS. REQUIRES 28 STORAGES, NO COMMON.

0704 223CLDPC1 AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION COMPLEX FAD AND FMP
OBTAINS THE DOUBLE PRECISION COMPLEX FLOATING SUM OR PRODUCT
OF TWO DOUBLE PRECISION COMPLEX NUMBERS. MAY ALSO BE USED
FOR DOUBLE PRECISION REAL FAD OR FMP. REQUIRES 144 STORAGES,
NO COMMON.

0704 223CLDPC2 AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION COMPLEX FAD, FMP, AND FDP
OBTAINS THE DOUBLE PRECISION COMPLEX FLOATING SUM, PRODUCT,
OR QUOTIENT OF TWO DOUBLE PRECISION COMPLEX NUMBERS. MAY
ALSO BE USED FOR DOUBLE PRECISION REAL FAD, FMP, OR FDP.
REQUIRES 296 STORAGES, NO COMMON.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 209NOVNPT AVAILABLE PRIOR TO JANUARY 1962

A VARIABLE FIELD PERIPHERAL INPUT
THIS ROUTINE WILL READ A TAPE PREPARED BY THE PERIPHERAL CARD
READER AND INPUT INTO MEMORY, FIELDS OF ANY SPECIFIED LENGTH
FROM ANY SPECIFIED LOCATION WITHIN THE RECORD. FIELDS ARE
PUNCHED IN FIXED DECIMAL WITH THE SIGN PUNCHED OVER ANY
COLUMN OF THE FIELD. SCALING IS DONE ACCORDING TO THE
LOCATION OF THE DECIMAL POINT IF PUNCHED. THE NUMBERS MAY BE
STORED IN FLOATING POINT OR IN FIXED POINT AT A SPECIFIED
BINARY SCALE. CORR./391

0704 212NYBPU5 AVAILABLE PRIOR TO JANUARY 1962

BINARY PUNCH PROGRAM
NY BPU5 WILL PUNCH A BLOCK OF N WORDS FROM MAGNETIC CORE
STORAGE ONTO ABSOLUTE BINARY CARDS. THIS ROUTINE IS SELF-
LOADING INTO UPPER CORE STORAGE. 0-2 AND 77706-77777 OCTAL
LOCATIONS. THE LOCATION OF THE BLOCK IS SPECIFIED BY CONTROL
CARDS OR MANUALLY ON THE CONSOLE. ANY NUMBER OF BLOCKS MAY BE
PUNCHED. THE CONTROL WORD IS, 9LD- FIRST WORD ADDRESS, 9LA-
LAST WORD ADDRESS.

0704 213NYBTD4 AVAILABLE PRIOR TO JANUARY 1962

BINARY TAPE OR DRUM DUMP
READS ONE RECORD FROM TAPE OR DRUM, OR WRITES ONE RECORD ONTO
TAPE OR DRUM. REPLACES NYBTD1 AND NYBTD2, SHARE DISTRIBUTION
75.

0704 215NYBOL1 AVAILABLE PRIOR TO JANUARY 1962

BINARY OCTAL LOADER
LOADS ABSOLUTE BINARY CARDS AND/OR OCTAL CARDS INTO MAGNETIC
CORE STORAGE,AND WILL EXIT ON A BINARY TRANSFER CARD.OCCUPIES
LOCATIONS 0-117 OCTAL

0704 216NYPLB3 AVAILABLE PRIOR TO JANUARY 1962

NY BOL1 TRANSITION
INTERRUPTS CARD LOADING BY NY BOL1 AND SIMULATES PRESSING THE
LOAD CARDS BUTTON

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 223CLDPD1 AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION FLOATING DIVIDE
OBTAINS THE DOUBLE PRECISION QUOTIENT OF TWO DOUBLE PRECISION
FLOATING NUMBERS. REQUIRES 54 STORAGES, NO COMMON.

0704 223CLMIV2 AVAILABLE PRIOR TO JANUARY 1962

INVERSE, REAL
TO INVERT A REAL N TH ORDER SQUARE MATRIX. DETERMINANT NOT
COMPUTED
REQUIRES 270 STORAGES PLUS COMMON THROUGH COMMON &/13&N/.

0704 223CLMIV3 AVAILABLE PRIOR TO JANUARY 1962

INVERSE, REAL OR COMPLEX.
TO INVERT A REAL OR COMPLEX N TH ORDER SQUARE MATRIX.
DETERMINANT NOT COMPUTED.
REQUIRES 470 STORAGES PLUS COMMON THROUGH COMMON &/19 &2N/.

0704 223CLMRT1 AVAILABLE PRIOR TO JANUARY 1962

REWIND TAPES
TO REWIND TAPES OR WRITE END OF FILE AND REWIND TAPES
WITHIN THE MATRIX ABSTRACTION.
REQUIRES 18 STORAGES. NO COMMON.

0704 223CLMST3 AVAILABLE PRIOR TO JANUARY 1962

STORE ROW MATRICES INTO A LARGE MATRIX
TO STORE ROW MATRICES, WHICH EXIST IN C. S. INTO A DIAGONAL
OR COLUMN FORM IN A LARGE MATRIX.
REQUIRES 145 STORAGES PLUS COMMON THROUGH COMMON &13

0704 223CLMTA1 AVAILABLE PRIOR TO JANUARY 1962

MATRIX TRANSFER
TO EXECUTE A TRANSFER WITHIN THE MATRIX ABSTRACTION.
REQUIRES 4 STORAGES

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 223ELMVP1 AVAILABLE PRIOR TO JANUARY 1962

VECTOR DOT PRODUCT
COMPUTES THE SCALAR PRODUCT OF TWO N TH ORDER REAL OR COMPLEX VECTORS.
REQUIRES 205 STORAGES PLUS COMMON THROUGH COMMON &10

0704 223CLSMD2 AVAILABLE PRIOR TO JANUARY 1962

SMOOTH AND DIFFERENTIATE DATA POINTS
TO SMOOTH N /NIS GREATER THAN OR EQUAL TO 7/ POINTS, WHICH MAY BE UNEQUALLY SPACED, BY THE METHOD OF LEAST SQUARES. OPTIONS TO MINIMIZE RANDOM ERRORS AND TO DIFFERENTIATE ARE PROVIDED. THE DATA POINTS MUST BE IN NORMALIZED FLOATING POINT NOTATION
REQUIRES 422 WORDS PLUS COMMON THROUGH COMMON &65. CORR./332

0704 223CLSME4 AVAILABLE PRIOR TO JANUARY 1962

SIMULTANEOUS EQUATIONS, REAL
CALCULATES K VECTOR SOLUTIONS OF N SIMULTANEOUS EQUATIONS. ARITHMETIC OPERATIONS ARE SKIPPED WHEN A ZERO ELEMENT IS ENCOUNTERED. REQUIRES 176 STORAGES PLUS 8 COMMON.

0704 223CLSME5 AVAILABLE PRIOR TO JANUARY 1962

SIMULTANEOUS EQUATIONS, REAL
CALCULATES K VECTOR SOLUTIONS OF N SIMULTANEOUS EQUATIONS. ARITHMETIC OPERATIONS ARE SKIPPED ON ZERO ELEMENTS. SOLUTION ARE IMPROVED BY ITERATIONS.
REQUIRES 580 STORAGES PLUS COMMON THROUGH COMMON &25

0704 224ASAS03 AVAILABLE PRIOR TO JANUARY 1962

EXPONENTIAL, FLOATING
COMPUTES FLOATING POINT EXPONENTIAL OF A FLOATING POINT ARGUMENT. ACCURATE TO 24 BITS MINUS THE NUMBER OF BITS IN THE INTEGER PART OF THE ARGUMENT. REQUIRES 39 STORAGES &3COMMON. TIMING IS 2.460 MS. CORR. / 437

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 225GMZER1 AVAILABLE PRIOR TO JANUARY 1962

ZEROS OF A COMPLEX POLYNOMIAL
A FLOATING POINT SUBROUTINE FOR COMPUTING THE COMPLEX ZEROES OF A POLYNOMIAL OF ARBITRARY DEGREE. THE COEFFICIENTS OF THE POLYNOMIAL ARE ASSUMED TO BE COMPLEX AND ALL ZEROS BOTH REAL AND COMPLEX MAY BE EVALUATED WITH EQUAL ACCURACY. THE COMPLEX NEWTON. RAPHSONIERATIVE PROCEDURE IS EMPLOYED. THE METHOD IS UNSUITED TO POLYNOMIALS WITH ZEROS OF MULTIPLICITY GREATER THAN TWO. THE OPTION OF DETERMINING ONLY A SINGLE ZERO IS AVAILABLE REQUIRES 272 CELLS PLUS 16 COMMON.

0704 230RS0128 AVAILABLE PRIOR TO JANUARY 1962

DE RELATIVIZE PROGRAM
TAKES A SHARE RELATIVE SYMBOLIC DECK /SUCH AS THAT PRODUCED BY CL REL/ AND PRODUCES A SHARE SYMBOLIC DECK IN WHICH SYMBOLS ARE ASSOCIATED WITH ALL REFERENCED LOCATIONS. INPUT AND OUTPUT MAY BE ON-LINE OR OFF-LINE. CORR./492

0704 232NYDMI1 AVAILABLE PRIOR TO JANUARY 1962

MATRIX INVERSION
DOUBLE-PRECISION, FLOATING-POINT MATRIX INVERSION OF REAL SQUARE MATRIX, WITH POSITIONING FOR SIZE AND ROW SUM CHECKING

0704 233ATMG01 AVAILABLE PRIOR TO JANUARY 1962

MESH GENERATOR
GENERATES A TWO DIMENSIONAL MESH OF POINTS DESCRIBING POLYGONAL REGIONS BY ASSIGNING TO EACH POINT A CORE WORD CONSISTING OF AN OCTAL CODE DESCRIBING T&E TYPE OF VERTEX, BOUNDARY, OR INTERIOR POINT AND IDENTIFYING ALL SURROUNDING REGIONS FROM INPUT GIVING JUST T&E COORDINATES OF THE VERTICES OF EACH REGIONS.

0704 235NYDBD1 AVAILABLE PRIOR TO JANUARY 1962

HOLLERITH TO BCD CONVERSION
CONVERTS 72 CARD COLUMNS OF HOLLERITH CODE TO 12 CORE LOCATIONS OF BINARY CODED DECIMAL. IT USES 148 LOCATIONS. CORR./ 456

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 224ASAS14 AVAILABLE PRIOR TO JANUARY 1962

POLYNOMIAL COEFFICIENT REDUCTION
REDUCES THE NUMBER OF COEFFICIENTS FOR A POWER SERIES APPROXIMATION OF A FUNCTION, MAINTAINING A SPECIFIED ACCURACY THE ORIGINAL SERIES, AS DP FP COEFFICIENTS IS REDUCED AND ROUNDED TO SINGLE PRECISION. PRINTING OF COEFFICIENTS AND A PROOF IS INCLUDED.

0704 224ASAS33 AVAILABLE PRIOR TO JANUARY 1962

HYPERBOLIC SINE-COSINE, FLOATING
COMPUTES FLOATING POINT SINH AND COSH OF A FLOATING POINT ARGUMENT. COSH IN MQ ON EXIT. SINH IS ACCURATE TO 2 BITS LESS THAN THE NUMBER OF FRACTIONAL BITS IN THE ARGUMENT, BUT NO MORE THAN 25 BITS. REQUIRES 71 STORAGES &5 COMMON. TIMING IS 5.112 MS. CORR. / 437

0704 225GMCFR1 AVAILABLE PRIOR TO JANUARY 1962

CONTINUED FRACTION SUBROUTINE
A FLOATING POINT SUBROUTINE FOR EVALUATING A CONTINUED FRACTION. SUCCESSIVE CONVERGENTS ARE ACCUMULATED BY MEANS OF THE STANDARD RECURRENCE RELATIONSHIPS. REQUIRES 57 CELLS PLUS 5 COMMON.

0704 225GMEIG2 AVAILABLE PRIOR TO JANUARY 1962

EIGENVALUE SUBROUTINE
FLOATING POINT ALL EIGENVALUES AND CORRESPONDING EIGENVECTORS OF A REAL NXN MATRIX USING A POWER METHOD. REQUIRES 280 STORAGE CELLS PLUS 3N CELLS DETERMINED BY THE PROGRAMMER.

0704 225GMIEF1 AVAILABLE PRIOR TO JANUARY 1962

INCOMPLETE ELLIPTIC INTEGRALS
IS A SUBROUTINE WHICH EVALUATES THE INCOMPLETE ELLIPTIC INTEGRALS OF THE FIRST AND SECOND KIND FROM A KNOWN PHI AND K. AUSSIAN INTERGRATION DEFINED BY THE LEGENDRE POLYNOMIAL IS EMPLOYED.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 235NYDHL1 AVAILABLE PRIOR TO JANUARY 1962

BCD TO HOLLERITH
CONVERTS 12 OR LESS CONSECUTIVE WORDS OF 6 BCD CHARACTERS EACH TO A 72 COLUMN DECIMAL CARD IMAGE. IT USES 102 LOCATIONS

0704 236CLMNR2 AVAILABLE PRIOR TO JANUARY 1962

NORMALIZE MATRIX BY ROWS
TO DIVIDE EACH ELEMENT OF A MATRIX BY THE ELEMENT OF LARGEST ABSOLUTE VALUE IN THE ROW CONTAINING THE ELEMENT.
REQUIRES 154 STORAGES PLUS COMMON THROUGH COMMON &13.

0704 236CLMNR3 AVAILABLE PRIOR TO JANUARY 1962

NORMALIZE MATRIX BY COLUMNS.
TO DIVIDE EACH ELEMENT OF A MATRIX BY THE ELEMENT OF LARGEST ABSOLUTE VALUE IN THE COLUMN CONTAINING THE ELEMENT.
REQUIRES 152 STORAGES PLUS COMMON THROUGH COMMON &12.

0704 237GLGAUS AVAILABLE PRIOR TO JANUARY 1962

INTEGRATION SUBROUTINE, 10 PT. GAUSS QUADRATURE METHOD
THE GAUSS QUADRATURE TECHNIQUE /10 POINT/ INTEGRATES A FUNCTION OVER THE INTERVAL /0,1/ BY CALCULATING A1FX1&A2FX2& ...&A10FX10 GIVEN A1,A2,...,A10 AND X1,X2,...,X10. SINCE A1-A10, A2-A9,..,A5-A6 AND X1-/1-X10/, X2-/1-X9/,...,X5-/1-X6/ THIS FORMULA IS SIMPLIFIED TO A1/FX1&FX10/&A2/FX2&FX9/&... &A5/FX5&FX6/. THE SUBROUTINE DIVIDES THE INTERVAL /A,B/ INTO N EQUAL INTERVALS AND BY THE PROPER TRANSFORMATION EACH INTERVAL IS INTEGRATED OVER THE INTERVAL /0,1/.

0704 238ATTPI AVAILABLE PRIOR TO JANUARY 1962

TWO POINT BOUNDRY CONDITION DIFFERENTIAL EQU. SOLVER
SOLVES A SET OF SIMULTANEOUS EQUATIONS FORMED BY DIFFERENCE EQUATIONS REPRESENTING A SECOND ORDER,ORDINARY, DIFFERENTIAL EQUATION WITH A TWO POINT BOUNDRY CONDITION.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 240NOSIG AVAILABLE PRIOR TO JANUARY 1962

SIMULTANEOUS MULTIPLE INTEGRATION, FLOATING POINT.
CARRIES OUT SIMULTANEOUSLY N /MULTIPLE IF DESIRED/ INTEGRATIONS BETWEEN SAME LIMITS. FLOATING POINT. MODIFIED SIMPSON RULE WITH INTERVALS AUTOMATICALLY ADJUSTING TO MEET ERROR SPECIFICATIONS. FOR MULTIPLE INTEGRATION, SUBROUTINE NEED BE ENTERED IN MEMORY ONLY ONCE. REQUIRES 243 WORDS STORAGE PLUS COMMON THROUGH COMMON & 4.

0704 246NA1353 AVAILABLE PRIOR TO JANUARY 1962

ARC SINE - ARC COSINE SUBROUTINE
TO COMPUTE THE ARC SINE OR ARC COSINE OF A FLOATING POINT NUMBER

0704 248CLDEQ AVAILABLE PRIOR TO JANUARY 1962

DIFFERENTIAL EQUATIONS ROUTINE
AN OPEN SUBROUTINE TO SOLVE A SET OF N SIMULTANEOUS FIRST ORDER DIFFERENTIAL EQUATIONS.
REQUIRES 285 & 20N STORAGES.

0704 248CLOUD1 AVAILABLE PRIOR TO JANUARY 1962

OVERFLOW, UNDERFLOW, AND DIVIDE CHECK TEST
TESTS CONDITION AND TURNS OFF OVERFLOW, UNDERFLOW AND DIVIDE CHECK INDICATORS.
REQUIRES 34 STORAGES.

0704 248CLPIN2 AVAILABLE PRIOR TO JANUARY 1962

BIVARIATE PARABOLIC INTERPOLATION
INTERPOLATES A FUNCTION, Z-F/X,Y/, GIVEN N VALUES OF X, M VALUES OF Y, AND THE CORRESPONDING Z-F/X,Y/. REQUIRES 136 STORAGES PLUS 29 COMMON.

0704 248CLPMC1 AVAILABLE PRIOR TO JANUARY 1962

EIGENVALUE SOLUTION, COMPLEX
TO FIND THE HIGHEST EIGENVALUE AND CORRESPONDING EIGENVECTORS OF A MATRIX.
REQUIRES 858 STORAGES PLUS COMMON THROUGH COMMON & 42 PLUS THE MATRIX MULTIPLY ROUTINE AND DRUMS 2, 3, AND 4.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 248CLTHA1 AVAILABLE PRIOR TO JANUARY 1962

THERMAL ANALYZER
THIS IS A COMPILER-TYPE PROGRAM TO SOLVE TRANSIENT AND STEADY-STATE THERMAL PROBLEMS WHICH CAN BE REPRESENTED BY A SIMPLE ELECTRICAL NETWORK.
USES TAPES 3, 4, 5 AND 6.

0704 250NYFSC1 AVAILABLE PRIOR TO JANUARY 1962

FIXED POINT FOURIER COEFFICIENTS
COMPUTES FOURIER COEFFICIENTS FOR A GIVEN FIXED POINT, SINGLE PRECISION FUNCTION, GIVING EITHER COMPLETE FOURIER SERIES, SINE SERIES, OR COSINE SERIES.

0704 251MUIND1 AVAILABLE PRIOR TO JANUARY 1962

MURA INTEGER DUMP
PRINTS THE CONTENTS OF A BLOCK OF CORE STORAGE AS FIXED POINT INTEGERS. LOCATIONS 0-102/DECIMAL/ ARE OVERWRITTEN.
PRINTER OPERATES AT FULL SPEED.

0704 251MULBL3 AVAILABLE PRIOR TO JANUARY 1962

MURA LOWER BINARY LOADER /ONE CARD/
LOADS ABSOLUTE BINARY CARDS PRODUCED BY EITHER UA SAP OR MURASS. EXECUTES TRANSFER CARDS. RECOGNIZES SUBSEQUENT SELF LOADING PROGRAMS. OCCUPIES FIRST 24 WORDS OF THE MEMORY.
SELF LOADING.

0704 251MUOCD1 AVAILABLE PRIOR TO JANUARY 1962

MURA OCTAL DUMP
PRINTS THE CONTENTS OF A BLOCK OF CORE STORAGE AS OCTAL NUMBERS. MEMORY LOCATIONS 0-99 /DECIMAL/ ARE OVERWRITTEN AND THE CONTENTS OF 11-99 /DECIMAL/ ARE RECORDED ON CARDS BEFORE OVERWRITING. PRINTER OPERATES AT FULL SPEED.

0704 253MUEAS2 AVAILABLE PRIOR TO JANUARY 1962

MURA EFFECTIVE ADDRESS SEARCH ROUTINE
SELF LOADING. SEARCHES MEMORY FOR ANY EFFECTIVE ADDRESS /I.E. ACCOUNT TAKEN OF INDEXING/ SET UP ON PANEL SWITCHES. ACCOUNT IS TAKEN OF MULTIPLE INDICES. LOCATIONS AND WORDS FOUND ARE PRINTED . OCCUPIES FIRST 110 WORDS OF MEMORY TIMING, ABOUT 4 SECONDS PER ADDRESS SEARCHED PLUS ONE LINE OF PRINT FOR EACH REFERENCE THERETO FOUND. CORR/800, MU EAS3

0704 253MUFRD1 AVAILABLE PRIOR TO JANUARY 1962

MURA FRACTION DUMP
PRINTS THE CONTENTS OF A BLOCK OF CORE STORAGE AS FIXED POINT FRACTIONS. LOCATIONS 0-105 /DECIMAL/ ARE OVER WRITTEN.
PRINTER OPERATES AT FULL SPEED.

0704 253MU704R AVAILABLE PRIOR TO JANUARY 1962

MURA REFLECTIVE 704 V
CAUSES THE 704 TO BEHAVE LIKE A 407 IN ITS ROLE AS A READER AND PRINTER OF CARDS. 53 WORDS PROGRAM PLUS 24 WORDS TEMPORARY. TIMING, 1/250 PLUS 1/150 MIN. PER CARD PROCESSED.
SUPERSEDED BY MU R704 DIST. 432.

0704 256MUBPU1 AVAILABLE PRIOR TO JANUARY 1962

MURA BINARY PUNCH ROUTINE
PUNCHES A BLOCK OF N WORDS FROM CORE STORAGE ONTO ABSOLUTE BINARY CARDS. LOADING ADDRESS ON CARD SAME AS LOCATION IN STORAGE. 37 WORDS OF PROGRAM & 4 WORDS COMMON. 905.4 MS. AVERAGE TIME FOR FIRST CARD IF PUNCH IS NOT IN MOTION ON ENTRY. FULL SPEED /100 CARDS/MIN./ IF TIME BETWEEN EXIT AND RE-ENTRY DOES NOT EXCEED 24.6 MS.

0704 256MUBPU2 AVAILABLE PRIOR TO JANUARY 1962

MURA BINARY PUNCH ROUTINE
PUNCHES A BLOCK OF N WORDS FROM CORE STORAGE AT LOCATION R ONTO ABSOLUTE BINARY CARDS WITH INITIAL LOADING ADDRESS S. S AND R MAY BE EQUAL. ALTERS ONLY THE LOADING ADDRESS AND NOT THE ADDRESS PORTION OF THE WORD. 40 WORDS OF PROGRAM & 5 WORDS COMMON. 905.4 MS. AVERAGE TIME FOR FIRST CARD IF PUNCH NOT IN MOTION ON ENTRY. FULL SPEED /100 CARDS/MIN./ IF TIME BETWEEN EXIT AND RE-ENTRY DOES NOT EXCEED 24.6 MS.

0704 256MUDPA2 AVAILABLE PRIOR TO JANUARY 1962

MURA DOUBLE PRECISION ADDITION /FIXED POINT/
ADDS A DOUBLE PRECISION NUMBER IN AC-MQ TO A SIMILAR NUMBER IN COMMON-COMMON&1. RESULT IN BOTH AC-MQ AND COMMON-COMMON&1. THE SIGNS OF THE MSP AND LSP IN THE AC AND MQ MUST AGREE. THE ROUTINE GUARANTEES THIS IS TRUE OF THE ANSWER.
22 WORDS OF PROGRAM, 2 WORDS OF COMMON. TIMING .55MS.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 256MUEXP1 AVAILABLE PRIOR TO JANUARY 1962

MURA EXPONENTIAL, BASE E
GIVEN X, A NEGATIVE FIXED POINT FRACTION, COMPUTES E TO THE X AS A FIXED POINT FRACTION. TIME, 4.4 MS. SPACE, 26 WORDS PROGRAM, 1 COMMON. ERROR LESS THAN 2 TO THE -31 AND FOR X LESS THAN 1/2 THE ERROR IS LESS THAN 2 TO THE -33.

0704 256MUEXP2 AVAILABLE PRIOR TO JANUARY 1962

MURA EXPONENTIAL, BASE 2
GIVEN X, A NEGATIVE FIXED POINT FRACTION OR ZERO, COMPUTES 2 TO THE X AS A FIXED POINT FRACTION. TIME, 4.2 MS. SPACE, 26 WORDS PROGRAM, 1 COMMON. ERROR LESS THAN 2 TO THE -31 AND FOR X LESS THAN 1/2 THE ERROR IS LESS THAN 2 TO THE -33

0704 256MURDI1 AVAILABLE PRIOR TO JANUARY 1962

MURA READ DECIMAL INTEGER ROUTINE
READS AT FULL READER SPEED A SEQUENCE OF DECIMAL INTEGERS FROM CARDS, CONVERTS THEM TO BINARY INTEGERS AND STORES THEM IN THE MEMORY. EACH CARD CONTAINS A LOADING ADDRESS AND THE INTEGER. CONTROL IS RETURNED BY ANY CARD HAVING A 12R PUNCH WITH 12R IN THE AC.

0704 259GMITR3 AVAILABLE PRIOR TO JANUARY 1962

GMITR3 ITERATION SUBROUTINE
GMITR3 IS A MODIFICATION OF ITR1 FOR SOLUTION OF SIMULTANEOUS NON-LINEAR EQUATIONS. IT CONTAINS AN IMPROVED TECHNIQUE FOR ROOTS NEAR ZERO. 160 CELLS & 7 COMMON.

0704 260NA1891 AVAILABLE PRIOR TO JANUARY 1962

EIGENVALUE FOR SYMMETRIC MATRICES IN FLOATING POINT
THOMAS KASPARIAN THE PURPOSE OF THIS SUBROUTINE IS TO FIND THE EIGENVALUES OF A SYMMETRIC MATRIX USING NORMALIZED FLOATI NG POINT NUMBERS, THE ROUTINE OCCUPIES 364 LOCATIONS WITH TEM PORARY STORAGE INCLUDED IN THE PROGRAM

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 261GMIOS1 AVAILABLE PRIOR TO JANUARY 1962

INPUT-OUTPUT SYSTEM
AN EXECUTIVE ROUTINE WHICH CONTROLS MULTIJOB NON-STOP OFF LINE OPERATION OF THE 704. OPERATES IN THREE PHASES /1/ CONVERTS ALL JOBS FROM BCD TO BINARY. /2/ SUPERVISES SEQUENCING OF JOBS DURING PROGRAM EXECUTION AND /3/ CONVERTS BINARY OUTPUT TO BCD FOR ALL JOBS. ALSO PROVIDES SAP ASSEMBLIES WITH OPTIONAL IMMEDIATE EXECUTION, TWO TYPES OF DEBUGGING ROUTINES AND JOB ACCTG. REQUIRES 6 TAPES, 1 CORE, DRUM 1 AND A PROGRAMMABLE CLOCK /OPTIONAL/.

0704 262NYPCV1 AVAILABLE PRIOR TO JANUARY 1962

PERIPHERAL CARD VERIFIER
VERIFIES AN N CHARACTER BCD TAPE RECORD OF M FIELDS ON SELECTED INPUT /NY PCR2/ OR OUTPUT /NY PCP2/ TAPE.SUB-PROGRAM OF THE N. Y. INPUT-OUTPUT SYSTEM. USES 125 LOCATIONS.

0704 262NYPLV1 AVAILABLE PRIOR TO JANUARY 1962

PERIFPHERAL LINE PRINTER VERIFIER
TO VERIFY AN N CHARACTER BCD RECORD OF M FIELDS ON A SELECTED OUTPUT TAPE FOR PERIPHERAL PRINTING

0704 263MUATN1 AVAILABLE PRIOR TO JANUARY 1962

MURA FIXED POINT ARCTANGENT ROUTINE
COMPUTES ARCTANGENT OF A FIXED POINT FRACTION. REQUIRES 27 WORDS PLUS 2 COMMON. TIMING 4.5 MS.

0704 263MUBPU3 AVAILABLE PRIOR TO JANUARY 1962

MURA BINARY PUNCH ROUTINE
PUNCHES A BLOCK OF N WORDS FROM CORE STORAGE ONTO ABSOLUTE BINARY CARDS. LOADING ADDRESS ON CARD SAME AS LOCATION IN STORAGE. PARAMETERS R,N MUST BE ENTERED INTO THE MQ. 41 WORDS OF PROGRAM. THE PUNCH OPERATES AT FULL SPEED /100 CARDS/MIN./. SELF-LOADING.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 267PKEDIT AVAILABLE PRIOR TO JANUARY 1962

EDITOR AND TRANSLATOR
TRANSLATES BCD,AND BINARY TO DECIMAL,FIXED TO FIXED,FLOATING TO FIXED OR FLOATING TO FLOATING. WRITES ON PRINTER,PUNCHED CARDS OR TAPE. TSX SEQUENCE WITH CONTROL WORDS SPECIFYING TYPE OF TRANSLATION AND PRINTED LINE,PUNCHED CARD OR TAPE RECORD FORMAT. PRINTS OR PUNCHES 72 COLUMNS PER CARD OR LINE & WRITES 120 CHARACTERS PER TAPE RECORD. REQUIRES 442 STORAGE CELLS.

0704 270GIDBUG AVAILABLE PRIOR TO JANUARY 1962

DEBUGGING ROUTINE
DEBUG IS A COLLECTION OF THREE SUBROUTINES USED IN DEBUGG-ING. 1/ TRACE IS A COMPLETE FULL TRACE PROGRAM. 2/ TRAP IS A PARTIAL TRACE USING THE TRAPPING MODE. 3/ DUMP IS A CORE DUMP ROUTINE. USES THE LAST 780 STORAGE CELLS IN MEMORY.

0704 273CLMMD1 AVAILABLE PRIOR TO JANUARY 1962

MATRIX ELEMENT BY ELEMENT MULTIPLY OR DIVIDE, REAL
OPERATES ON TWO MATRICES BOTH OF WHICH ARE REAL AND ENTIRELY IN CORE, TO FORM A RESULTING MATRIX REAL AND ENTIRELY IN CORE BY AN ELEMENT BY ELEMENT MULTIPLICATION OR DIVISION. REQUIRES 81 WORDS PLUS COMMON THROUGH COMMON & 8 CORR. 343

0704 273CLMMP2 AVAILABLE PRIOR TO JANUARY 1962

POSTMULTIPLY REAL BY SYMETRIC REAL MATRIX
TO POSTMULTIPLY A REAL MATRIX, WHICH IS IN CORE, BY A SYMMETRIC REAL MATRIX WHICH IS IN CORE, IN AN ELEMENTAL MANNER. THE PRODUCT WILL BE IN CORE. USES MATRIX INTER-PRETATION ROUTINE, CL MTX1. REQUIRES 306 WORDS PLUS COMMON THROUGH COMMON & 16. CORR. 343

0704 273CLSME6 AVAILABLE PRIOR TO JANUARY 1962

NON-LINEAR SIMULTANEOUS EQUATIONS, REAL
TO CALCULATE A VECTOR SOLUTION OF N SIMULTANEOUS QUADRATIC EQUATIONS IN THE NEIGHBORHOOD OF A VECTOR GUESS. THE ROUTINE ASSUMES THE SOLUTIONS HAVE CONVERGED WHEN THE SUMS OF THE ITERATES OF TWO SUCCESSIVE ITERATIONS AGREE TO FOUR OCTAL FIGURES. REQUIRES 364 WORDS PLUS COMMON THROUGH COMMON & 14.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 263MULBL4 AVAILABLE PRIOR TO JANUARY 1962

24 WORD PER CARD BINARY LOADER
A ONE CARD SELF-LOADING PROGRAM. THIS ROUTINE CONSECUTIVELY LOADS ABSOLUTE BINARY CARDS WITH 24 WORDS PER CARD. A PROGRAM STOP ALLOWS THE USER TO ENTER MANUALLY AN INITIAL LOADING ADDRESS INTO THE MQ. THIS ADDRESS MUST BE LARGER THAN 7.

0704 263MURDI2 AVAILABLE PRIOR TO JANUARY 1962

MURA READ DECIMAL INTEGERS ROUTINE
READS ONE OR TWO DECIMAL INTEGERS FROM A CARD AND PLACES THEM IN CORE STORAGE. STORAGE REQUIRED-62 WORDS PROGRAM & 6 COMMON. EXIT IS AFTER EACH CARD WITH 12R IN AC. FOR FULL READER SPEED, 24.9 MS. ARE AVAILABLE FOR COMPUTATION BETWEEN EXIT AND RE-ENTRY.

0704 263MURON1 AVAILABLE PRIOR TO JANUARY 1962

MURA READ OCTAL NUMBER ROUTINE
READS OCTAL ADDRESSES AND WORDS FROM CARDS, CONVERTS TO BINARY, AND PLACES THE WORDS INTO THEIR SPECIFIED LOCATIONS. EITHER A SELF-LOADING PROGRAM OR A CLOSED SUBROUTINE WITH EXIT TO ZERO. UP TO FOUR OCTAL WORDS PER CARD ARE ALLOWED. CARD READER RATE OF 250 CARDS PER MINUTE IS MAINTAINED

0704 263MUSQR2 AVAILABLE PRIOR TO JANUARY 1962

MURA FIXED POINT SQUARE ROOT ROUTINE
COMPUTES THE SQUARE ROOT OF A SINGLE OR DOUBLE PRECISION FIXED POINT FRACTION. REQUIRES 18 WORDS PLUS 3 COMMON. TIMING .5MS MINIMUM.

0704 264ASAS49 AVAILABLE PRIOR TO JANUARY 1962

STORAGE HISTORY TRACE
PRINTS ONLY THE REFERENCES TO A GIVEN BLOCK OF STORAGE WITHIN A GIVEN PART OF A PROGRAM--TRACING INFORMATION COMING FROM CONTROL CARDS. USES OCTAL LOCATIONS 0 TO 403.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 273CLSME6 AVAILABLE PRIOR TO JANUARY 1962

NON-LINEAR SIMULTANEOUS EQUATIONS, REAL
TO CALCULATE A VECTOR SOLUTION OF N SIMULTANEOUS QUADRATIC EQUATIONS IN THE NEIGHBORHOOD OF A VECTOR GUESS. THE ROUTINE ASSUMES THE SOLUTIONS HAVE CONVERGED WHEN THE SUMS OF THE ITERATES OF TWO SUCCESSIVE ITERATIONS AGREE TO FOUR OCTAL FIGURES.
REQUIRES 364 WORDS PLUS COMMON THROUGH COMMON & 14 CORR. 343

0704 274RSO140 AVAILABLE PRIOR TO JANUARY 1962

MNEMONIC OCTAL LOADER
LOADS INSTRUCTIONS WITH OCTAL ADDRESSES, TAGS, AND DECRE-MENTS AND MNEMONIC OPERATIONS FROM THE SHARE EXTENDED ORDER LIST INTO DESIGNATED OCTAL LOCATIONS IN MEMORY GREATER THAN 403.

0704 275NYSNAP AVAILABLE PRIOR TO JANUARY 1962

SNAPSHOT TRACER
PROVIDES, AT ANY POINT IN A PROGRAM UNDER TEST, SNAPSHOTS OF ANY SELECTED PORTIONS OF MEMORY. OUTPUT IS WRITTEN ON A BINARY TAPE, THE MACHINE CONDITION COMPLETELY RESTORED, AND THE PROGRAM CONTINUED AFTER EACH SNAPSHOT. AT COMPLE-TION OF PROGRAM OR UNEXPECTED STOP, A POST MORTEM MAY BE IN-ITIATED WHICH WILL GIVE ANY FURTHER SNAPSHOTS DESIRED. AN OUTPUT PROGRAM READS IN THE BINARY TAPE AND CONVERTS THE SNAPSHOTS TO FIXED DECIMAL, FLOATING DECIMAL, OCTAL, OR BCD FORMAT. ON-LINE OR OFF-LINE PRINTING AVAILABLE.

0704 278UASP04 AVAILABLE PRIOR TO JANUARY 1962

TRAP OCTAL MEMORY PRINT - /TRAP SCOOP/
PRINTS, IN OCTAL, OFF-LINE AND/OR ON-LINE, THE CONTROL PANEL INFORMATION AND THE CONTENTS OF ANY NUMBER OF BLOCKS OF CORE STORAGE. PRINTING MAY BE PERFORMED DURING THE EXECUTION OF THE PROGRAM, WITHOUT OTHERWISE AFFECTING THE ACTION OF THE PROGRAM IN ANY WAY. PRINTING IS SPECIFIED BY CONTROL CARDS, EACH TRAP BEING SPRUNG WHEN A SELECTED INSTRUCTION HAS BEEN EXECUTED A DESIGNATED NUMBER OF TIMES. PRINTING MAY ALSO BE PERFORMED AFTER THE PROGRAM HAS STOPPED. THE ROUTINE IS STORED ON A DRUM AND READ INTO CORE STORAGE WHEN NEEDED.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 279PK9AP4 AVAILABLE PRIOR TO JANUARY 1962

704 ASSEMBLER OF 709 PROGRAMS
MODIFICATION OF UA SAP2 TO ASSEMBLE 709 SYMBOLIC PROGRAMS ON THE 704.

0704 280MUCRT1 AVAILABLE PRIOR TO JANUARY 1962

MURA FLOATING POINT CUBE ROOT.
COMPUTES CUBE ROOT OF A NORMALIZED FLOATING POINT NUMBER RESIDING IN THE ACCUMULATOR. UPON EXIT THE NORMALIZED RESULT IS AGAIN PLACED IN THE ACCUMULATOR. REQUIRES 30 WORDS PLUS 3 COMMON. TIMING IS 5.1 MS.

0704 280MUDPA1 AVAILABLE PRIOR TO JANUARY 1962

MURA FLOATING POINT DOUBLE PRECISION ADDITION
ADDS TWO DOUBLE PRECISION FLOATING POINT NUMBERS, ONE LOCATED IN AC AND MQ, THE OTHER IN COMMON AND COMMON&1. THE MSP OF EACH NUMBER MUST BE NORMALIZED. 32 WORDS OF PROGRAM & 4 COMMON. TIMING .6-1.4 MS.

0704 280MULCG2 AVAILABLE PRIOR TO JANUARY 1962

MURA FIXED POINT LOGARITHM, BASE 2
GIVEN A FIXED POINT FRACTION X MORE THAN ZERO AND LESS THAN 1, LOGARITHM X BASE 2 IS COMPUTED. MAXIMUM ERROR 2EXP-34. MINIMUM TIME 15.9 MS., MAXIMUM TIME 19.2 MS. 46 WORDS PROGRAM & 5 WORDS COMMON.

0704 280MURKY1 AVAILABLE PRIOR TO JANUARY 1962

MURA FIXED POINT RUNGE-KUTTA V
SOLVES A SET OF N SIMULTANEOUS FIRST ORDER DIFFERENTIAL EQUATIONS. 52 WORDS OF PROGRAM PLUS 3 COMMON PLUS 3N WORDS OF STORAGE. TIMING 4.22N & 0.59 MS. PLUS AUXILLIARY TIME PER RUNGE-KUTTA STEP. SEE S.D. D2 MU RKY4 891

0704 280MUSIN2 AVAILABLE PRIOR TO JANUARY 1962

MURA FIXED POINT SINE
COMPUTES THE SINE OF AN ANGLE EXPRESSED IN RADIANS. ENTER WITH ANGLE//2PI/ IN AC. EXIT WITH 1/2 SINE IN AC. MAXIMUM ERROR 1.2 X 2 EXP-34. RMS ERROR 1.4 X 2 EXP-36. 38 WORDS PROGRAM & 3 WORDS COMMON. TIMING 3.1 MS.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 283MURDF4 AVAILABLE PRIOR TO JANUARY 1962

MURA READ DECIMAL FRACTION ROUTINE
READS A DECIMAL ADDRESS AND FRACTION FROM A CARD AND PLACES THEM IN COMMON AND COMMON &1 RESPECTIVELY. ACCURACY IS I 2EXP-36. STORAGE REQUIRED--89 PROGRAM &9 COMMON. EXIT IS AFTER EACH CARD WITH 12R LOGICALLY IN AC. FOR FULL READER SPEED 15 MS. ARE AVAILABLE BETWEEN EXIT AND RE-ENTRY.

0704 283MURFD2 AVAILABLE PRIOR TO JANUARY 1962

MURA READ FLOATING DECIMAL ROUTINE
READS A NUMBER AND AN ADDRESS FROM A CARD AND PLACES THE NUMBER IN CORE AT THE SPECIFIED ADDRESS. EXIT IS UPON END OF FILE OR ON 12 RIGHT WITH 12 RIGHT IN THE ACCUMULATOR AS A LOGICAL WORD. STORAGE REQUIRED, 164 WORDS & 10 COMMON. UNDER EXCEPTIONAL CIRCUMSTANCES THE READER MAY NOT BE OPERATED AT FULL SPEED.

0704 283MUSQR3 AVAILABLE PRIOR TO JANUARY 1962

MURA FIXED POINT SQUARE ROOT ROUTINE
COMPUTES THE SQUARE ROOT OF A SINGLE OR DOUBLE PRECISION FIXED POINT FRACTION. REQUIRES 21 WORDS PLUS 3 COMMON. TIMING..5MS. MINIMUM.

0704 284WHWH20 AVAILABLE PRIOR TO JANUARY 1962

ARBITRARY CURVE PLOTTER SUBROUTINE
PLOTS SIMULTANEOUSLY FROM 1 TO 6 FUNCTIONS USING ON-LINE PRINTER. COORDINATE LINES PRINTED AT SPECIFIED INTERVALS. PLOCTING CHARECTER FOR EACH VARIABLE MAY BE CHANGED AT WILL. PRINT WHEEL POSITIONS 8 THRU 108 ARE USED. TIMING DEPENDENT UPON VALUES PLOTTED. VARIES FROM 75 TO 150 LINES/MIN. RESOLUTION & OR - O. PER CENT FULL SCALEE. CORR./397.

0704 286NYDSO1 AVAILABLE PRIOR TO JANUARY 1962

OCTAL MEMORY PRINT OUT PROGRAM
PRINTS IN OCTAL,AND WITH ALPHABETIC INTERPRETATION OF OPERATION CODES,T&E CONTENTS OF CORE STORAGETDRUMS,TAPESTAND THE MACHINE CONDITION,AT THE USERS OPTION,RESTORES THE ORIGINAL MACHINE CONDITION AND CONTENTS OF STOR175,EXCEPT CORE LOCATIONS 0-7 AND ANO ONE LOGICAL DRUM

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 280MUSIN3 AVAILABLE PRIOR TO JANUARY 1962

MURA FIXED POINT SINE
COMPUTES THE SINE OF AN ANGLE EXPRESSED IN RADIANS. ENTER WITH ANGLE//2PI/ IN AC. EXIT WITH 1/2 SINE IN AC. MAXIMUM ERROR .7 X 2 EXP-33. RMS ERROR 2 EXP-35. 34 WORDS PROGRAM & 3 WORDS COMMON. TIMING 3.1 MS.

0704 282PKCKRS AVAILABLE PRIOR TO JANUARY 1962

CHECKER DEMONSTRATION PROGRAM
WILL PLAY A STANDARD CHECKER GAME, USING A STANDARD CHECKER BOARD WHICH IS NUMBERED. USES STANDARD SHARE BOARDS. REQUIRES A MASK FOR THE MQ REGISTER NEONS ON OP. PANEL. OP. PANEL KEYS SHOULD BE RENUMBERED. PRINTS OUT THE MOVES FOR BOTH SIDES AND AN ANALYSIS. MACHINE WILL STOP IF ITS OPPONENT ENTERS AN ILLEGAL MOVE. WILL PUNCH OUT A CARD CONTAINING THE PCSITIONS OF THE PIECES ON THE BOARD IF THE GAME IS TO BE CONTINUED AT A LATTER TIME.

0704 283MUBPU4 AVAILABLE PRIOR TO JANUARY 1962

MURA BINARY PUNCH ROUTINE 4
PUNCHES BINARY INFORMATION FROM CORE MEMORY ONTO 704 BINARY CARDS WITH 24 WORDS PER CARD. THE FIRST WORD ADDRESS AND TOTAL NUMBER OF WORDS DESIRED TO BE PUNCHED ARE SPECIFIED BY MANUAL ENTRY INTO MQ. A SELF-LOADING PROGRAM OF 20 WORDS. PUNCH OPERATES AT FULL SPEED.

0704 283MULCG3 AVAILABLE PRIOR TO JANUARY 1962

MURA FIXED POINT LOGARITHM, BASE E
COMPUTES THE NATURAL LOGARITHM OF 1&Y IN FIXED POINT ARITHMETIC, FOR Y GREATER OR EQUAL TO -1/2 AND LESS THAN 1. RMS ERROR ABOUT 1.5 TIMES 2 EXP-35, MAX ERROR LESS THAN 2 EXP-32. TIME 2.7 MS. 41 WORDS PROGRAM & 3 WORDS COMMON.

0704 283MURDF3 AVAILABLE PRIOR TO JANUARY 1962

RDF3 MURA READ DECIMAL FRACTION
READS AND CONVERTS TO BINARY DECIMAL FRACTIONS AND ADDRESSES. CARDS ARE PUNCHED WITH ONE FRACTION AND ADDRESS ON EACH. ANY PUNCHING IN 12R WILL CAUSE ROUTINE TO GIVE UP CONTROL. CONVERSION OF FRACTION IS ACCURATE TO 35 BITS. WHEN READING, THE CARD READER IS KEPT AT FULL SPEED. REQUIRES 93 STORAGE CELLS PLUS 8 CELLS OF TEMPORARY STORAGE.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 290GEMTOI AVAILABLE PRIOR TO JANUARY 1962

MATRIX TRANSPOSED ON ITSELF
MATRIX CONSISTS OF IJ&1 WORDS
THE FIRST OF WHICH IS A CODE WORD
IA EQU ZER I,O,J
THE REMAINING IJ WORDS IN ROW FORM
83 LOCATIONS & 7 COMMON STORAGE. CORR.976

0704 290GESTOI AVAILABLE PRIOR TO JANUARY 1962

SQUARE MATRIX TRANSPOSED ON ITSELF
MATRIX CONSISTS OF M/M/&1 WORDS
THE FIRST OF WHICH IS A CODE WORD
IA EQU ZER M,O,M
THE REMAINING M/M/ WORDS IN ROW FORM
58 LOCATIONS & 6 COMMON STORAGE

0704 296NY CP2 AVAILABLE PRIOR TO JANUARY 1962

AUTO-CORRELATION AND POWER SPECTRUM ANALYSIS
TO COMPUTE EITHER OR BOTH THE AUTO-CORRELATION COEFFICIENTS AND THE POWER SPECTRUM OF A SET OF TIME-SERIES DATA. IF IT IS DESIRED, THE DATA MAY BE NORMALIZED BEFORE BEING USED IN THE ABOVE COMPUTATION. IN THIS CASE THE FREQUENCY DISTRIBUTION OF THE NORMALIZED DATA IS ALSO COMPUTED. THIS DIFFERS FROM NY CP1 IN THAT CORE STORAGE OF 8192 IS REQUIRED. UP TO 5300 OBSERVATIONS MAY BE HANDLED. CORR./ 680

0704 300CSRDM1 AVAILABLE PRIOR TO JANUARY 1962

RANDOM NUMBER GENERATOR
GENERATES A FLOATING POINT RANDOM NUMBER IN THE ACCUMULATOR DRAWN FROM A SQUARE DISTRIBUTION. IT USES TEN CELLS AND .5 MILLISECONDS

0704 301RLO133 AVAILABLE PRIOR TO JANUARY 1962

OCTAL TAPE PRINT
PRINTS A TAPE, ON LINE OR OFF LINE, BINARY OR DECIMAL. CONTROL CARD PROVIDES---OPTIONAL REWIND, OPTIONAL BACKSPACING OR SKIPPING OF RECORDS, SELECTION OF THE NUMBER OF FILES OR RECORDS TO BE PRINTED, SELECTION OF ANY N CONSECUTIVE WORDS WITHIN RECORDS, OPTIONAL USE OF IDENTIFICATION.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 302NYMON1 AVAILABLE PRIOR TO JANUARY 1962

MONITOR SUBROUTINE
PRINTS ONLINE IN OCTAL THE CONTENTS OF ANY SPECIFIED CORE LOCATIONS ALONG WITH ANY DESIRED BCD INFORMATION. THIS SUBROUTINE MAY BE USED TO MONITOR PROGRAMS,E.G. TO PRINT OUT THE CONTENTS OF A VARIABLE CONTROL WORD UPON ENCOUN TERING AN ERROR.

0704 302NYMON2 AVAILABLE PRIOR TO JANUARY 1962

MONITOR SUBROUTINE AND OUTPUT PROGRAM
PRINTS ONLINE IN OCTAL THE CONTENTS OF ANY SPECIFIED CORE LOCATIONS,ALONG WITH ANY DESIRED BCD INFORMATION. THIS SUBROUTINE MAY BE USED TO MONITOR PROGRAMS,E.G.,TO PRINT OUT THE CONTENTS OF A VARIABLE CONTROL WORD UPON ENCOUNT ERING AN ERROR. MON2 CONTAINS NY OUT3 WHICH MAY BE USED INDEPENDENTLY.

0704 304NORNGN AVAILABLE PRIOR TO JANUARY 1962

RANDOM NUMBER GENERATOR
GENERATES FIXED OR FLOATING POINT UNIFORM RANDOM NUMBERS

0704 310MUSCP2 AVAILABLE PRIOR TO JANUARY 1962

MURA SIX COLUMN FRACTION CATHODE RAY TUBE DISPLAY
SCOPE SIX FIXED-POINT FRACTIONS LOCATED IN SUCCESSIVE CORE MEMORY LOCATIONS AS ONE LINE. 93 PROGRAM PLUS 7 COMMON WORDS. TIMING 550 MS. 1 LINE.

0704 311GMMUF1 AVAILABLE PRIOR TO JANUARY 1962

THE TRANSCENDENTAL FUNCTIONS MU AND NU
COMPUTATION OF THE TRANSCENDENTAL FUNCTIONS MU AND NU USED IN THE HERTZ STRESS FORMULAS. GIVEN COS TAU, MU AND NU ARE COMPUTED BY A FIFTH OR NINTH DEGREE POLYNOMIAL APPROXIMATION. REQUIRES GMSQT1 BASED ON UASQR3 WITH AN ERROR RETURN. 107 CELLS & 11 COMMON

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 318GMTED1 AVAILABLE PRIOR TO JANUARY 1962

TAPE EDITOR AND DUPLICATOR WITH COMPARE
TO TRANSFER AND/OR COMPARE IN ANY ORDER, ANY RECORDS OR ANY FILES FROM ANY TAPE OR TAPES TO ANY OTHER TAPE OR TAPES 305 CELLS FOR PROGRAM REMAINDER OF CORE ERASABLE

0704 319GLDAS1 AVAILABLE PRIOR TO JANUARY 1962

SIMULATES A DIGITAL DIFFERENTIAL ANALYZER TO SOLVE SIMULTANEOUS ORDINARY DIFFERENTIAL EQUATIONS OF ANY ORDER, LINEAR OR NON-LINEAR. INTEGRATORS ARE DEFINED TO OPERATE IN THE MANNER OF THOSE OF CONVENTIONAL DIGITAL DIFFERENTIAL ANALYZERS. A MULTIPOINT FORWARD INTEGRATION FORMULA IS USED. FLOATING POINT ARITHMETIC IS PERFORMED THROUGHOUT SO NO SCALING OF THE INTEGRATORS IS REQUIRED. EMPIRICAL FUNCTIONS MAY BE INTRODUCED INTO THE EQUATION/S/. THE NUMBER OF INTEGRATORS AVAILABLE IS APPROXIMATELY 300 PER 4096-CORE STORAGE.

0704 321MUFDD2 AVAILABLE PRIOR TO JANUARY 1962

MURA FLOATING DECIMAL DUMP
PRINTS A SPECIFIED BLOCK OF NUMBERS FROM STORAGE IN FLOATING POINT FORM. MURA PRINTER BOARD 1 IS REQUIRED. THE LOCATIONS FROM 0 THROUGH 264 ARE USED BY THIS ROUTINE, AND WORDS IN THEM ARE DESTROYED.

0704 321MUSCP8 AVAILABLE PRIOR TO JANUARY 1962

MURA CATHODE RAY TUBE POINT PLOTTER
DISPLAYS A SEQUENCE OF POINTS ON THE CRT. POINTS ARE PLOTTED AT REGULAR INTERVALS ALONG THE X AXIS. 73 WORDS PROGRAM. AVERAGE TIME PER POINT PLOTTED IS 1.15MS.ON SUBSEQUENT ENTRY.

0704 324NYDMI3 AVAILABLE PRIOR TO JANUARY 1962

MATRIX INVERSION BY PARTITIONING
INVERSION OF POSITIVE DEFINITE SYMMETRIC MATRICES OF ORDER UP TO 150.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 314MUCRT3 AVAILABLE PRIOR TO JANUARY 1962

MURA FIXED POINT CUBE ROOT
COMPUTES THE CUBE ROOT OF A SINGLE OR DOUBLE PRECISION FIXED POINT FRACTION. REQUIRES 28 WORDS PROGRAM PLUS 3 TEMPORARY. TIMING IS 1.2 MS PER ITERATION

0704 314MUPRF4 AVAILABLE PRIOR TO JANUARY 1962

MURA SIX COLUMN FRACTION PRINT
TO PRINT SIX FIXED POINT FRACTIONS ON ONE LINE OF THE 716 PRINTER. THE LOCATION OF THE FIRST FRACTION IS GIVEN IN THE CALLING SEQUENCE. A MAXIMUM ERROR OF 3 IN THE ELEVENTH DECIMAL PLACE IS INTRODUCED DURING CONVERSION. THE SHARE PRINTER BOARD NO. 1 IS USED. 114.8 MS OF CALCULATING TIME IS AVAILABLE BETWEEN SUCCESSIVE ENTRIES WITHOUT REDUCING THE PRINTER SPEED OF 150 LINES PER MINUTE.

0704 314MURKY3 AVAILABLE PRIOR TO JANUARY 1962

MURA FLOATING POINT RUNGE-KUTTA
SOLVES A SET OF N SIMULTANEOUS FIRST ORDER DIFFERENTIAL EQUATIONS. 114 WORDS OF PROGRAM & 8 WORDS TEMPORARY & 7N WORDS OF STORAGE. TIMING .72MS. &/4.98&X/N MS. & 4/AUXILIARY SUBROUTINE TIME/MS. PER INTEGRATION STEP.

0704 314MUSCP3 AVAILABLE PRIOR TO JANUARY 1962

GENERAL ALPHANUMERIC CATHODE RAY DISPLAY
DISPLAYS ALPHANUMERIC MESSAGES ON THE 740 OUTPUT RECORDER. 144 WORDS PROGRAM & 7 WORDS COMMON. TIME ABOUT 8.5 MILLISECONDS PER CHARACTER.

0704 316NA0259 AVAILABLE PRIOR TO JANUARY 1962

PACT 1A SAMPLE PROGRAM.
PROVIDES AN EXAMPLE OF PACT 1A INPUT AND OUTPUT AND PROVIDES A SIMPLE TEST OF COMPILER OPERATION ON ANY MA3HINE CONFIG- URATION. PROGRAM IS WRITTEN IN PACT LANGUAGE.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 325RS0141 AVAILABLE PRIOR TO JANUARY 1962

FIXED AND FLOATING DECIMAL CARD INPUT REPLACES RS0046
READS UP TO FOUR DECIMAL NUMBERS PER CARD AND STORES THEM IN CORE STORAGE AS EITHER NORMALIZED FLOATING POINT OR FIXED POINT BINARY NUMBERS. ALLOWS FOR COMPUTING BETWEEN CARDS IF DESIRED AND FOR ALTERING THE EFFECTIVE STORAGE LOCATION. NORMAL TSX SEQUENCE WITH ONE CONTROL WORD,ERROR RETURN,AND TWO NORMAL RETURNS DEPENDING UPON WHETHER THERE IS COMPUTING BETWEEN CARDS. USES 352 STORAGE CELLS & 41 COMMON. THIS PROGRAM MADE VOID BY RS0046 DIST. 386

0704 327GMITR2 AVAILABLE PRIOR TO JANUARY 1962

ITERATION SUBROUTINE, INTERVAL-HALVING METHOD
GIVEN F/X/, TO FIND A VALUE FOR X WITHIN A GIVEN EPSILON OF RELATIVE ERROR IN A SPECIFIED INTERVAL /A,B/. THE INTERVAL-HALVING METHOD IS PREFERRED OVER THE METHOD USED IN GMITR1 WHEN X MUST BE BOUNDED BY W, OR FOUND IN A GIVEN INTERVAL /A,B/. THE INTERVAL IS THEN HALVED SUCCESSIVELY TOWARD F/X/-0 UNTIL THE PRESCRIBED ACCURACY IS SATISFIED REQUIRES 134 STORAGES CELLS & 2 COMMON.

0704 329NYDFM1 AVAILABLE PRIOR TO JANUARY 1962

DOUBLE-PRECISION FLOATING BINARY MATRIX CONVERSION PROG
TO CONVERT A MATRIX OR VECTOR IN FLOATING DECIMAL ON A BCD TAPE TO DOUBLE-PRECISION FLOATING BINARY ON A BINARY TAPE, ZEROS INSERTED WHERE NECESSARY.

0704 331CLSMD3 AVAILABLE PRIOR TO JANUARY 1962

SMOOTH AND DIFFERENTIATE UNEQUALLY SPACED DATA POINTS
TO SMOOTH N POINTS, WHERE N EQUALS OR IS GREATER THAN 7, WHICH MAY BE UNEQUALLY SPACED, BY THE METHOD OF LEAST SQUARES. OPTIONS TO MINIMIZE RANDOM ERRORS/I.E. DISCARD WILD POINTS/ AND TO DIFFERENTIATE ARE PROVIDED. THIS ROUTINE DIFFERS FROM CL SMD2 IN THAT THE FIRST DATA POINT IS ANCHORED, I.E., UNCHANGED, SO THAT THE CURVE WILL ALWAYS PASS THROUGH THIS POINT.
REQUIRES 448 WORDS PLUS 66 COMMON.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 333CWBD0 AVAILABLE PRIOR TO JANUARY 1962

BINARY DECK MINIMIZER
REDUCES,THE SIZE OF A RELOCATABLE BINARY DECK OR AN ABSOLUTE BINARY DECK CONTAINING PATCH CARDS BY PUNCHING ANEW ABSOLUTE DECK. USES CELLS 0-35

0704 334NA0228 AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION INPUT SCALING
FRANK MAJDALI CONVERTS A GIVEN DOUBLE PRECISION BINARY INTEGER TO A SCALED,FLOATING AND NORMALIZED DOUBLE PRECISION BINARY NUMBER X WITH COMPATIBLE SIGNS AND CHARACTERISTIC OF L SH EQUAL CHARACTERISTIC OF MSH LESS 27.
SPACE REQUIRED 103 CELLS

0704 334NA0229 AVAILABLF PRIOR TO JANUARY 1962

DOUBLE PRECISION OUTPUT SCALING
FRANK MAJDALI SCALES A DOUBLE PR539S9ON 6LOITING BINARY NUMBER TO A DOUBLE PRECISION BINARY INTEGER FOR OUTPUT.
SPACE REQUIRED 160 CELLS

0704 335NYMA01 AVAILABLE PRIOR TO JANUARY 1962

MOVING AVERAGES OF TIME-SERIES DATA
TO ANALYZE A SET OF NON-STATIONARY TIME-SERIES DATA FOR PERIODIC AND TREND COMPONENTS. MOVING 1V5R175S OF THE DATA ARE USED TO MEASURE THE TREND OR NON-STATIONARY COMPONENTS, WHEREAS THE DEVIATIONS OF THE ORIGINAL 41T1 FROM THE MOVING AVERAGES INDICATE SHORTER FLUCTUATIONS. PERIODIC AVERAGES OF THE DEVIATIONS GIVE AN ESTIMAT5 OF THE PERIODIC COMPONENTS IN THE ORIGINAL DATA. THE OUTPUT OF MOVING AVERAGES AND DEVIATIONS MAY BE USED DIRECTLY AS INPUT WITH NY CP2. IT WILL HANDLE UP TO 3200 OBSERVATIONS.

0704 338CLPMC2 AVAILABLE PRIOR TO JANUARY 1962

EIGENVALUE SOLUTION, REAL
TO FIND THE HIGHEST EIGENVALUE AND CORRESPONDING EIGEN-VECTORS OF THE MATRIX EQUATION
/A/ /X SUB I/ - LAMDA SUB I /X SUB I/
WHERE /LAMDA SUB I/ IS AN EIGENVALUE AND /X SUB I/ IS THE ASSOCIATED EIGENVECTOR OF THE MATRIX /A/. THE MATRIX MULTIPLY ROUTINE, CLMMP1 MUST BE ASSEMBLED CONCURRENTLY REQUIRES 651 WORDS PLUS COMMON THROUGH COMMON & 40 PLUS THE MATRIX MULTIPLY SUBROUTINE, DRUMS 2,3,4 AND TAPE 5.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 341AAATM1 AVAILABLE PRIOR TO JANUARY 1962

ATMOSPHERIC DATA SUBROUTINE
THIS SUBROUTINE EFFECTIVELY REPRODUCES PORTIONS OF THE ATMOSPHERIC DATA BASED ON THE ARDC MODEL ATMOSPHERE FOR 1956 UP TO 53 KILOMETERS.
GIVEN ALTITUDE, FIND CORRESPONDING TEMPERATURE IN DEGREES RANKINE, PRESSURE RATIO, DENSITY RATIO AND VELOCITY OF SOUND IN FT PER SEC.
REQUIRES A SQUARE ROOT, LOGARITHM AND EXPONENTIAL SUBROUTINE. USES 168 STORAGE CELLS PLUS 5 COMMON NEEDED FOR SQR. RT, EXP, AND LN. SUBROUTINES. TIME APPROX 12.0MS.

0704 344RL0146 AVAILABLE PRIOR TO JANUARY 1962

TABLE SEARCH ROUTINE
ROUTINE USES BINARY SEARCH TECHNIQUE TO FIND AN ENTRY IN AN ORDERED TABLE. CENTRAL SEARCH LOOP CONSUMES NINE CYCLES FOR EACH ENTRY EXAMINED. TABLE LENGTH MAY VARY FROM ONE WORD TO ALL OF STORAGE. MEAN SEARCH TIME FOR A 1000 WORD TABLE IS1.260 MS. RL 0146 REQUIRES 65 STORAGE CELLS PLUS TWO COMMON. ROUTINE IS NON-STANDARD IN THE SENSE THAT THE RESULT APPEARS IN INDEX 1.

0704 345ELSAV1 AVAILABLE PRIOR TO JANUARY 1962

THIS SUBROUTINE SAVES THE CONSOLE /AC,MQ,IRA,IRB,IRC, AC AND MQ OVERFLOW, DIVIDE CHECK, TAPE CHECK, 4 SENSE LIGHTS, AND SENSE SWITHES 1-5/ AND ALL OF CORE STORAGE AND WRITES A SELF LOADING TAPE. THIS TAPE WILL LOAD ITSELF, RESTORE CORES AND THE CONSOLE AND RETURN CONTROL TO THE MAIN PROGRAM.

0704 345ELSAV2 AVAILABLE PRIOR TO JANUARY 1962

THIS SUBROUTINE SAVES THE CONSOLE /AC,MQ,IRA,IRB,IRC, AC AND MQ OVERFLOW, DIVIDE CHECK, TAPE CHECK, 4 SENSE LIGHTS, AND SENSE SWITHES 1-5/, DRUMS 1-4, AND ALL OF CORE STORAGE AND WRITES A SELF LOADING TAPE. THIS TAPE WILL LOAD ITSELF, RESTORE CORES, DRUMS 1-4 AND THE CONSOLE AND RETURN CONTROL TO THE MAIN PROGRAM.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 347UASAP3 AVAILABLE PRIOR TO JANUARY 1962

SHARE ASSEMBLER
ASSEMBLES PROGRAMS WRITTEN IN SYMBOLIC FORM. INPUT AND OUT-PUT MAY BE EITHER OFF-LINE OR ON. PRINTED OUTPUT INCLUDES THE GIVEN PROGRAM IN SYMBOLIC AND THE ASSEMBLED PROGRAM IN OCTAL. OUTPUT IS ALSO PUNCHED ON BINARY CARDS, OR IT MAY BE WRITTEN ON TAPE IN BINARY CARD IMAGE FORM. DECIMAL, OCTAL, AND HOLLERITH DATA MAY BE USED. A LIBRARY OF STANDARD SUB-ROUTINES IS AVAILABLE ON TAPE. ADDRESS ARITHMETIC MAY BE PERFORMED. UA SAP 3-7 SUPERCEDES UA SAP 1-2. CORR/ 431,457, WRITE-UP DIST. 564. CORR./716

0704 352GMFS01 AVAILABLE PRIOR TO JANUARY 1962

THE F SYSTEM
THIS IS AN EXECUTIVE PROGRAM THAT CONTROLS FORTRAN TO ALLOW MULTI-JOB--MULTI-FUNCTION OPERATION. ANY COMBINATION OF COMPILE, EXECUTE, OR COMPILE AND EXECUTE JOBS MAY BE PLACED ON THE INPUT TAPE. NORMAL OPERATION UTILIZES INSTRUCTION DECKS T&AT ARE ACCEPTABLE TO THE PERIPHERAL EQUIPMENT. BINARY4DECKS MAY BE OBTAINED. THE SAP7LISTING MAY BE PRINTED OR PUNCHED. OPERATION IS SINGLE PHASE WITH FORTRAN UNCHANGED. IT REQUIRES 3 TAPES BEYOND THE MACHINE COMPONENTS NEEDED BY FORTRAN.

0704 354NA63.3 AVAILABLE PRIOR TO JANUARY 1962

COMPLEX NTH ROOT
YARBROUGH COMPUTES THE NTH ROOT OF A COMPLEX NUMBER PERFORMS PSEUDO-OPERATION IN COMPLEX ARITHMETIC ABSTRACTION SPACE REQUIRED, 48 LOCATIONS CORRECTS NO. 87

0704 354NA66.3 AVAILABLE PRIOR TO JANUARY 1962

COMPLEX NATURAL LOGARITHM
YARBROUGH COMPUTES NATURAL LOGARITHM OF A COMPLEX NUMBER. PERFORMS A PSEUDO-OPERATION IN THE COMPLEX ARITHMETIC ABSTRACTION. SPACE REQUIRED 21 LOCATIONS

0704 354NA87.3 AVAILABLE PRIOR TO JANUARY 1962

RECTANGULAR TO POLAR CONVERSION
YARBROUGH CONVERTS COORDINATES FROM RECTANGULAR TO POLAR. PERFORMS A PSEUDO-OPERATION IN THE COMPLEX ARITHMETIC ABSTRACTION. SPACE REQUIRED, 19 LOCATIONS

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 355GMATN1 AVAILABLE PRIOR TO JANUARY 1962

SINGLE-VALUED ARCTANGENT ROUTINE
COMPUTES ARCTAN QUOTIENT OF TWO ARGUMENTS WITH PROPER QUADRANT ALLOCATION. DIVISION IS CHECKED. USES 122 CELLS PLUS 9 COMMON. TIMING. MAXIMUN 6.1 MILLISECOND.

0704 355GMDETR AVAILABLE PRIOR TO JANUARY 1962

DETERMINANT EVALUATING SUBROUTINE
GIVEN AN ARBITRARY SQUARE MATRIX A AND SOME FLOATING POINT VARIABLE D, THIS SUBROUTINE WILL EVALUATE THE EXPRESSION. D X DET /A/. REQUIRES 426 MEMORY LOCATIONS PLUS 6 COMMON. THIS ROUTINE IS PART OF THE SUBROUTINE GMSIMQ.

0704 355GMDTAB AVAILABLE PRIOR TO JANUARY 1962

DOUBLE INTERPOLATION
COMPUTES Y EQUALS F OF X AND Z FROM A TABLE OF X,Y,Z. ALL VALUES AND CALCULATIONS ARE IN FLOATING POINT. GM TAB1 MUST ALSO BE IN CORE STORAGE. REQUIRES 122 STORAGE CELLS & COMMON DEPENDING UPON TABLE SIZE. EXTRAPOLATES FOR X OUTSIDE TABLE. CORR./394

0704 355GMITRF AVAILABLE PRIOR TO JANUARY 1962

ITERATION SUBROUTINE
GIVEN X-R/X/, TO FIND A VALUE FOR X WITHIN A GIVEN EPSILON OF RELATIVE ERROR. THIS TECHNIQUE ACCELERATES THE RATE OF CONVERGENCE IF THE ITERATION CONVERGES AND INDUCES CONVERGENCE IF THE ITERATION DIVERGES.

0704 355GMSIMQ AVAILABLE PRIOR TO JANUARY 1962

SIMULTANEOUS EQUATIONS SUBROUTINE
SOLVES AX EQUALS B WHERE A,B, AND X ARE MATRICES N BY N,N BY S, AND N BY S. S LESS THAN OR EQUAL TO N. ALL ELEMENTS MUST BE STORED IN FLOATING POINT FORM. SUBROUTINE DESTROYS A AND B. REQUIRES 415 STORAGE CELLS. 2 MINUTES TO INVERT A 40 BY 40 MATRIX.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 355GMTAB1 AVAILABLE PRIOR TO JANUARY 1962

TABLE INTERPOLATION
ALL FLOATING POINT. GIVEN X COMPUTES Y EQUALS F OF X FROM A TABLE OF X,Y VALUES. USUAL TS X SEQUENCE WITH RETURN TO L&3. REQUIRES 99 STORAGE CELLS & COMMON DEPENDING UPON TABLE SIZE. EXTRAPOLATES FOR X OUTSIDE TABLE. CORR /408

0704 356 CA0015 AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION SIMULTANEOUS REAL EQUAT9ONS, 3
DETERMINANT
K VECTOR SOLUTIONS AND DETERMINANT OF SIMULTANEOUS EQUATIONS. REQU9R5S 542 STORAGES PLUS 8 COMMON.

0704 356 CA0022 AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION DETERMINANT EVALUATION 3
EVALUATION BY CROUTS METHOD. REQUIRES 236 STORAGES PLUS 8 COMMON

0704 357MULOG4 AVAILABLE PRIOR TO JANUARY 1962

MURA FIXED POINT LOGARITHM, BASE 2.
GIVEN A FIXED POINT FRACTION X MORE THAN 0 AND LESS THAN 1, LOGARITHM X, BASE 2, IS COMPUTED. MAXIMUM ERROR 2EXP-34. MINIMUM TIME 16.6 MS.,MAXIMUM TIME 19.9 MS. 38 WORDS PROGRAM & 4 WORDS COMMON.

0704 357MUNCI2 AVAILABLE PRIOR TO JANUARY 1962

NCI2 FIXED POINT NEWTON-COTES QUADRATURE
APPROXIMATES THE VALUE OF AN INTEGRAL OF THE FORM ZY SQUARED DX BETWEEN XSUB ZERO AND XSUB4. THE VARIOUS VALUES FOR Y ARE ASSUMED TO BE LOCATED IN THE MEMORY. Z IS TO BE SUPPLIED BY AN AUXILIARY SUBROUTINE. COMPUTATION IS DONE IN DOUBLE PRECISION. REQUIRES TWO AUXILIARY SUBROUTINES MU DPA2 AND FACT. OCCUPIES 77 STORAGE CELLS PLUS 10 TEMPORARY. TIMING IS ABOUT 4 MS PER INTEGRATION STEP.

.BM 0704 PROGRAM LIBRARY ABSTRACT
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0704 357MUPRF5 AVAILABLE PRIOR TO JANUARY 1962

MURA VARIABLE COLUMN FRACTION PRINT
THIS ROUTINE PRINTS, ON LINE, ONE TO FIVE FIXED POINT FRACTIONS PLUS A FIVE DIGIT INTEGER LINE LABEL. THE MURA PRINTER BOARD 1 IS REQUIRED. ACCURATE TO -3 IN THE ELEVENTH DECIMAL PLACE. THE PROGRAM USES 82 WORDS STORAGE PLUS 20 WORDS TEMPORARY.

0704 357MUPRF6 AVAILABLE PRIOR TO JANUARY 1962

MURA VARIABLE COLUMN FRACTION PRINT
THIS ROUTINE PRINTS, ON LINE, ONE TO FIVE FIXED POINT FRACTIONS PLUS AN INTEGER LINE LABEL. THE MODIFIED SHARE 1 BOARD IS REQUIRED. ACCURATE TO -3 IN THE ELEVENTH DECIMAL PLACE. THE PROGRAM USES 81 WORDS STORAGE PLUS 26 WORDS TEMPORARY.

0704 357MUSCP9 AVAILABLE PRIOR TO JANUARY 1962

SCOPE GRID PLOTTER
TO DISPLAY ON THE 740 OUTPUT RECORDER A GRID OF HORIZONTAL AND VERTICAL LINES. PROVISION IS MADE FOR PLOTTING CERTAIN SPECIFIED LINES HEAVIER THAN OTHERS. PROGRAM REQUIRES 51 WORDS STORAGE PLUS 2 TEMPORARY.

0704 359ELSM01 AVAILABLE PRIOR TO JANUARY 1962

BCD ADD-SUBTRACT
ADDS OR SUBTRACTS TWO SIGNED 12 DIGIT BCD NUMBERS. ADDS 6 DIGITS SIMULTANEOUSLY. USES ELSM02 TO RESTORE CORRECT BCD FORM. 42 STORAGE LOCN PLUS 4 COMMON MINIMUM TIMING 1.6 MSEC, MAXIMUM OVERALL 2.3 MSEC.

0704 359ELSM02 AVAILABLE PRIOR TO JANUARY 1962

BCD ARITHMETIC CORRECTION
RETURNS THE RESULT OF ADDITION OR SUBTRACTION OF TWO SIGNED 6 DIGIT BCD NUMBERS TO CORRECT BCD FORM. ALL SIX CHARACTERS ARE CORRECTED AT ONCE. 22 STORAGE LOCN PLUS 1 COMMON. MINIMUM TIMING 348 MICROSEC MAXIMUM 396 MICROSEC.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 359ELSM09 AVAILABLE PRIOR TO JANUARY 1962

BINARY TO PACKED BCD CONVERTER
CONVERTS SIGNED BINARY INTEGERS IN CONSECUTIVE LOCATIONS TO EQUIVALENT BCD NUMBERS ALSO IN CONSECUTIVE LOCATIONS. SIGNS MAY BE IGNORED IF DESIRED.

0704 359ELS083 AVAILABLE PRIOR TO JANUARY 1962

GENERAL SORT ROUTINE
TO SORT A TABLE IN WHICH THE UNIT RECORD IS LONGER THAN ONE 704 WORD. MASKS MAY BE USED TO SELECT THE BITS OF A RECORD TO BE USED IN SORTING.

0704 362NA1171 AVAILABLE PRIOR TO JANUARY 1962

WRITE 6-DIGIT DECIMAL INTEGER AND SIGN ON CRT
K. SHIMIZU WRITE 6-DIGIT DECIMAL INTEGER WITH BINARY SCALE 35 AT SPECIFIED LOCATION ON CRT. WILL PRINT MINUS SIGNS AND SUPPRESSES PLUS SIGNS. SPACE REQUIRED - 58 LOCATIONS PLUS 66 WORDS OF A MODIFIED VERSION OF NA-109 WHICH INCLUDES A TABLE OF TEN CHARACTERISTIC WORDS

0704 363NYAR01 AVAILABLE PRIOR TO JANUARY 1962

AUTOREGRESSION ANALOSIS
NYAR1 PERMITS A REGRESSION ANALYSIS TO BE PERFORMED UPON THE THE RESULTS OF AN AUTOCORRELATION ANALYSIS. THE AUTOCORRELATION ANALYSIS IS PERFORMED BY NYCP1. THE REGRESION ANALYSIS IS PERFORMED BY CERTAIN PARTS OF NYMR1. T85 NY3P1 PROGRAM HAS BEEN SO MODIFIED THAT ITS OUTPUT MAY BE DIRECTLY UTILIZED BY THE REGRESSION PARTS OF NYMR1.

0704 363NYAR02 AVAILABLE PRIOR TO JANUARY 1962

AUTOREGRESSION ANALYSIS
NYAR2 PERMITS A REGRESSION ANALYSIS TO BE PERFORMED UPON THE THE RESULTS OF AN AUTOCORRELATION ANALYSIS. THE AUTOCORRELATION ANALYSIS IS PERFORMED BY NYCP1. THE REGRESION ANALYSIS IS PERFORMED BY CERTAIN PARTS OF NYMR2# T85 NY3P1 PROGRAM HAS BEEN SO MODIFIED THAT ITS OUTPUT MAY BE DIRECTLY UTILIZED BY THE REGRESSION PARTS OF NYMR2.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 367MBMTX2 AVAILABLE PRIOR TO JANUARY 1962

GENERAL MATRIX ABSTRACTION FROM TAPES
USED IN CONJUNCTION WITH MB MTX1 FOR MATRIX MANIPULATIONS WHERE EITHER OR BOTH OF THE MATRICES A AND B ARE TOO LARGE FOR AVAILABLE C.S. PERFORMS THE FOLLOWING MATRIX OPERATIONS ON REAL OR COMPLEX MATRICES
1. ADD
2. SUBTRACT
3. MULTIPLY
4. MULTIPLY A MATRIX BY A DIAGONAL MATRIX
5. TRANSPOSE

0704 368NA2740 AVAILABLE PRIOR TO JANUARY 1962

SINGLE INTEGRATION SUBROUTINE
ROGER MILLS INTEGRATES A SINGLE VALUED FUNCTION OVER A FINITE RANGE. USES COTES NUMBERSAS WEIGHTING COEFFICIENTS. SPACE REQUIRED - 59 LOCATIONS PLUS 5 COMMON.

0704 368NA2750 AVAILABLE PRIOR TO JANUARY 1962

DOUBLE INTEGRATION SUBROUTINE
ROGER MILLS COMPUTES A TWICE ITERATED INTEGRAL OF A SINGLE VALUED FUNCTION OF A SINGLEVARIABLE OVER A FINITE RANGE. USES COTES NUMBERS AS WEIGHTING COEFFICIENTS. SPACE REQUIRED - 56 LOCATIONS PLUS 6 COMMON.

0704 368NA2760 AVAILABLE PRIOR TO JANUARY 1962

TRIPLE INTEGRATION SUBROUTINE
ROGER MILLS COMPUTES A THRICE ITERATED INTEGRAL OF A SINGLE VALUED FUNCTION OF A SINGLEVARIABLE OVER A FINITE RANGE. USES COTES NUMBERS AS WEIGHTING COEFFICIENTS. SPACE REQUIRER-69 LOCATIONS PLUS 8 COMMON

0704 370RS0130 AVAILABLE PRIOR TO JANUARY 1962

NORMALIZED ADD--EXTENDED RANGE FLOATING BINARY ARITH.
TO ADD OR SUBTRACT TWO NUMBERS EXPRESSED IN EXTENDED RANGE FLOATING BINARY. EACH NUMBER OCCUPIES 2 MEMORY CELLS, 35 BIT FRACTION AND 35 BIT EXPONENT. 83 CELLS & 2 CELLS OF COMMON.

0704 370RS0131 AVAILABLE PRIOR TO JANUARY 1962

NORMALIZED MULT.--EXTENDED RANGE FLOATING BINARY ARITH.
TO MULTIPLY TWO NUMBERS EXPRESSED IN EXTENDED RANGE FLOATING BINARY. EACH NUMBER OCCUPIES 2 MEMORY CELLS, 35 BIT FRACTION AND 35 BIT EXPONENT. 27 CELLS & 2 CELLS OF COMMON.

0704 370RS0132 AVAILABLE PRIOR TO JANUARY 1962

NORMALIZED DIVIDE-EXTENDED RANGE FLOATING BINARY ARITH.
TO DIVIDE TWO NUMBERS EXPRESSED IN EXTENDED RANGE FLOATING BINARY. EACH NUMBER OCCUPIES TWO MEMORY CELLS, 35 BIT FRACTION AND 35 BIT EXPONENT. PROVIDES FOR ERROR RETURN IN CASE OF A DIVIDE CHECK. 39 CELLS & 2 CELLS OF COMMON.

0704 370RS0133 AVAILABLE PRIOR TO JANUARY 1962

NORMALIZED LOG-EXTENDED RANGE FLOATING BINARY ARITH.
TO EVALUATE THE NATURAL LOGARITHM OF A NUMBER EXPRESSED IN EXTENDED RANGE FLOATING BINARY. NUMBER OCCUPIES 2 MEMORY CELLS, 35 BIT FRACTION AND 35 BIT EXPONENT. ERROR RETURN PROVIDED. RS0130 MUST BE IN MEMORY. 131 CELLS & 6 CELLS OF COMMON. CORR/ 554

0704 370RS0134 AVAILABLE PRIOR TO JANUARY 1962

NORMALIZED E TO X-EXTENDED RANGE FLOATING BINARY ARITH.
TO EVALUATE THE EXPONENTIAL OF A NUMBER EXPRESSED IN EXTENDED RANGE FLOATING BINARY. NUMBER OCCUPIES 2 MEMORY CELLS, 35 BIT FRACTION AND 35 BIT EXPONENT. PROVIDES FOR ERROR RETURN WHEN OUT OF RANGE. 158 CELLS & 8 CELLS OF COMMON.

0704 370RS0135 AVAILABLE PRIOR TO JANUARY 1962

NORMALIZED ARCTAN-EXTENDED RANGE FLOATING BINARY ARITH.
TO EVALUATE THE ARCTANGENT OF A NUMBER EXPRESSED IN EXTENDED RANGE FLOATING BINARY. NUMBER OCCUPIES 2 MEMORY CELLS, 35 BIT FRACTION AND 35 BIT EXPONENT. RS0130 MUST BE IN MEMORY. 295 CELLS & 2 CELLS OF COMMON.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 370RS0136 AVAILABLE PRIOR TO JANUARY 1962

NORMALIZED SQ.ROOT-EXTENDED RANGE FLOATING BINARY ARITH
TO EVALUATE THE SQUARE ROOT OF A NUMBER EXPRESSED IN EXTENDED RANGE FLOATING BINARY. NUMBER OCCUPIES 2 MEMORY CELLS, 35 BIT FRACTION AND 35 BIT EXPONENT. PROVIDES ERROR RETURN FOR NEGATIVE ARGUMENTS. 42 CELLS & 5 CELLS OF COMMON.

0704 370RS0139 AVAILABLE PRIOR TO JANUARY 1962

DECIMAL PRINT-EXTENDED RANGE FLOATING BINARY ARITH.
TO PRINT ON-LINE UP TO 6 NUMBERS PER LINE, NUMBERS IN MEMORY AS EXTENDED RANGE FLOATING BINARY. A 10 DIGIT FRACTION PLUS SIGN AND A 3 DIGIT EXPONENT PLUS SIGN IS PRINTED. PROVIDES FOR INDEXABLE MEMORY LOCATIONS, COMPUTING BETWEEN LINES, AND ECHO CHECKING WITH OVER-PRINT ON FAILING COLUMNS. 356 CELLS & 46 CELLS OF COMMON.

0704 370RS0148 AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT & FIXED POINT DECIMAL INPUT.
READS UP TO FOUR DECIMAL NUMBERS PER CARD AND STORES THEM IN CORE STORAGE AS EITHER NORMALIZED FLOATING POINT OR FIXED POINT BINARY NUMBERS. ALLOWS FOR COMPUTING BETWEEN CARDS IF DESIRED AND FOR ALTERING THE EFFECTIVE STORAGE LOCATION. NORMAL TSX SEQUENCE WITH ONE CONTROL WORD, ERROR RETURN, AND TWO NORMAL RETURNS DEPENDING UPON WHETHER THERE IS COMPUTING BETWEEN CARDS. USES 350 STORAGE CELLS & 41 COMMON.
PROGRAM MADE VOID BY RS 0046 DIST. 386

0704 372 BSCRB AVAILABLE PRIOR TO JANUARY 1962

CORBIE, AUTOMATIC OPERATOR SYSTEM
READS SYMBOLIC CODE CARDS. STORES CODES ON TAPE. AUTOMATICALLY FINDS CODES ON TAPE AND CORRECTS THEM OR RUNS THEM. PRINTS MONITORED RE3OR4 2UT NO LISTING. LIBRARY OF SUBROUTINES IS AVAILABLE ON TAPE. INCLUDES SAP ASSEMBLER. NO PERIPHERAL TAPE EQUIPMENT IS USED. SUITABLE FOR REMOTE USE OF COMPUTER BY PROGRAMMERS. CODE CHECKING FEATURES ARE INCLUDED.

0704 373 BSRN AVAILABLE PRIOR TO JANUARY 1962

FIXED POINT PSEUDO RANDOM NUMBER GENERATOR

0704 374NA2770 AVAILABLE PRIOR TO JANUARY 1962

STANDARD-TO-COLUMN BINARY CARD CONVERSION, ON-LINE
CONVERTS SHARE STANDARD BINARY CARDS TO COLUMN BINARY CARDS. NOT A SUBROUTINE. 134 LOCATIONS.

0704 375UAUPE2 AVAILABLE PRIOR TO JANUARY 1962

UNIVARIATE POLYNOMIAL EVALUATION
IF A FUNCTION HAS BEEN APPROXIMATED BY A SEQUENCE OF ONE OR MORE POLYNOMIAL ARCS, AND THE COEFFICIENTS OF THESE SECTIONS HAVE BEEN STORED IN CORE, THIS ROUTINE WILL SEARCH OUT THE APPROPRIATE SECTION AND EVALUATE IT FOR THE GIVEN VALUE OF X. THE NUMBER OF SECTIONS IS NOT RESTRICTED, NOR MUST ALL OF THE SECTIONS BE OF THE SAME DEGREE. CHANGES IN THE NUMBER OF SECTIONS, OR IN THE DEGREE OF ANY SECTION/S/, CHANGE ONLY THE COEFFICIENT STORAGE - CALLING SEQUENCE/S/ BEING UNAFFECTED. USES 42 CELLS PLUS 3 COMMON PLUS COEFFICIENT STORAGE.

0704 375UAUPE3 AVAILABLE PRIOR TO JANUARY 1962

UNIVARIATE POLYNOMIAL EVALUATION FOR FORTRAN I PROGRAMS
BASICALLY, THIS ROUTINE IS UA UPE 2 MODIFIED SO THAT IT CAN BE USED WITH SUCH FORTRAN I PROGRAMS AS REQUIRE UNIVARIATE POLYNOMIAL INTERPOLATION. THE FINAL RUNNING DECK IS MADE UP OF THE FORTRAN I OBJECT PROGRAM, UA UPE 3 ITSELF, AND A SAP ASSEMBLY OF THE POLYNOMIAL COEFFICIENTS AND CERTAIN OTHER AUXILIARY DATA, - ALL IN RELOCATABLE BINARY. FORTRAN SOURCE LANGUAGE REFERENCES ARE OF THE FORM SOMEF/N,X/ WHERE N TELLS WHICH FUNCTION IS TO BE INTERPOLATED /AS MANY MAY BE USED AS ARE NEEDED/, AND X IS THE INDEPENDENT VARIABLE.

0704 376UAZDR2 AVAILABLE PRIOR TO JANUARY 1962

SELF-LOADING DRUM RESET PROGRAM
RESETS ONE OR MORE DRUMS TO PLUS ZEROES. CONTROL PUNCHING IN 7R DECREMENT INDICATES WHICH DRUMS ARE TO BE RESET. ONE SELF-LOADING CARD.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 378CA0012 AVAILABLE PRIOR TO JANUARY 1962

TRIPLE PRECISION ARITHMETIC PACKAGE
PERFORMS BASIC ARITHMETIC OPERATIONS ON TRIPLE PRECISION FLOATING POINT NUMBERS. EACH NUMBER REPRESENTED AS A SIGNED 70 BIT FRACTION AND A SIGNED 35 BIT EXPONENT. 69 BITS OF ACCURACY WITH ROUNDING ARE RETAINED. USES 372 CELLS.

0704 378CA0025 AVAILABLE PRIOR TO JANUARY 1962

TRIPLE PRECISION OUTPUT
CONVERTS N TRIPLE PRECISION FLOATING BINARY NUMBERS TO BCD LINE IMAGE FORM WITH 3 FLOATING DECIMAL NUMBERS PER LINE. PROGRAMMER MUST PROVIDE OWN BCD TAPE WRITING ROUTINE.USED WITH CA012 TRIPLE PRECISION PACKAGE EXTENT 308 WORDS PLUS 2 COMMON.

0704 381ASAS50 AVAILABLE PRIOR TO JANUARY 1962

TWO CARD BINARY AND OCTAL LOADER
LOADS ABSOLUTE BINARY AND OCTAL CARDS IN ANY ORDER. EXECUTES TRANSFER CARDS. THE PUNCH TO IGNORE BINARY CHECK SUMS IS RECOGNIZED. UP TO FOUR OCTAL WORDS, WITH THEIR LOCATIONS, PER CARD.

0704 381ASAS55 AVAILABLE PRIOR TO JANUARY 1962

VARIABLE FIXED FORMAT CARD READ
READS CARDS, WITH FORMAT AND LOCATIONS FIXED BY THE CALLING SEQUENCE, AT FULL CARD READER SPEED. FIXED DECIMAL, FLOATING DECIMAL, AND HOLLERITH WILL BE CONVERTED. CORR. / 437

0704 382GSTOP AVAILABLE PRIOR TO JANUARY 1962

TAPE OPERATOR PROGRAM /TOP/
TOP IS A SELF-CONTAINED PROGRAM THAT AUTOMATICALLY SEQUENCES A SET OF COMPLETELY INDEPENDENT CALCULATIONS.THE PROGRAMS NECESSARY FOR THESE CALCULATIONS ARE SELF-CONTAINED AND SELF-LOADED FROM PROGRAM FILE TAPES,EACH OF WHICH CONTAINS MANY PROGRAMS,OR FROM BINARY CARDS,OR CHINESE BINARY TAPE.THE INPUT DATA FOR THE CALCULATIONS AND THE CHINESE BINARY PROGRAMS,IF ANY,ARE ENTERED ON THE INPUT TAPE.TOP INSPECTS THE INPUT FILE TO DETERMINE THE PROGRAM REQUIRED,LOCATES THIS PROGRAM AND INITIATES A SELF-LOADING SEQUENCE FOR THE PROGRAM

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 385BSCONV AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION FLOATING POINT LOAD SUBROUTINE
READS BCD DOUBLE PRECISION NUMBERS FROM CARDS AND CONVERTS THEM TO BINARY, STORING EACH NUMBER IN 3 CONSECUTIVE CORE LOCATIONS. USES UA CSH2. REQUIRES 211 STORAGE PLUS 26 COMMON CELLS.

0704 385BSEXP AVAILABLE PRIOR TO JANUARY 1962

INTERPRETABLE DOUBLE PRECISION EXPONENTIAL INSTRUCTION
USED BY GIVING PSEUDO-INSTRUCTION WHILE IN THE INTERPRETIVE MODE OF BS INTP. EXPONENTIAL IS ACCURATE TO 18 DECIMAL PLACES. USES BS INTP. REQUIRES 81 STORAGE PLUS 24 COMMON CELLS.

0704 385BSINTP AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION FLOATING POINT INTERPRETIVE SUBROUTINE
INTERPRETS 21 INSTRUCTIONS IN A DOUBLE PRECISION FLOATING MODE, INCLUDING ARITHMETIC OPERATIONS ON DOUBLE PRECISION FLOATING POINT NUMBERS. EACH NUMBER OCCUPIES 3 STORAGE CELLS, 2 FOR THE FRACTIONAL PART AND 1 FOR THE EXPONENT. REQUIRES 354 STORAGE PLUS 10 COMMON CELLS. 16000

0704 385BSLNX AVAILABLE PRIOR TO JANUARY 1962

INTERPRETABLE DOUBLE PRECISION LOGARITHM INSTRUCTION
USED BY GIVING PSEUDO-INSTRUCTION WHILE IN THE INTERPRETIVE MODE OF BS INTP. COMPUTES NATURAL LOGARITHM. USES BS INTP. REQUIRES 90 STORAGE PLUS 29 COMMON.

0704 385BSOUT AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION FLOATING POINT PRINT SUBROUTINE
CONVERTS A SPECIFIED BLOCK OF 3 CELL DOUBLE PRECISION NUMBERS FROM BINARY TO BCD AND PRINTS THEM ON THE ON LINE PRINTER. PRINTS UP TO 3 NUMBERS PER LINE. EACH PRINTED NUMBER IS A 20 DIGIT FRACTION FOLLOWED BY A 5 DIGIT EXPONENT. USES BS INTP AND UA SPH1. REQUIRES 102 STORAGE PLUS 51 COMMON.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 390MIPMR1 AVAILABLE PRIOR TO JANUARY 1962

POST-MORTEM ROUTINE
MIPMR1 RECORDS SPECIFIED RANGES OF CORE MEMORY IN SPECIFIED FORMATS WHICH CORRESPOND TO THOSE FORMATS ALLOWED BY THE SAP INPUT LANGUAGE. ONE OF THESE FORMATS IS INSTRUCTIONS WITH SYMBOLIC ADDRESSES

0704 391NOERTB AVAILABLE PRIOR TO JANUARY 1962

CONSTRUCT A TABLE OF ERRORS FOR PRINTING—ERTBL
IN MANY PROBLEMS IT IS DESIRABLE TO NOTE ERRORS AS THEY OCCUR AND PRINT THEM OUT AS A BLOCK AFTER THE COMPUTATION HAS BEEN COMPLETED. THE INFORMATION TO BE PRINTED GENERALLY CONSISTS OF A REMARK AND PERTINENT NUMERIC INFORMATION. THE PURPOSE OF THIS SUBROUTINE IS TO RECORD THE SPECIFIED INFORMATION IN A TABLE IN THE PROPER FORMAT FOR PRINTING BY SUBROUTINE PRETB

0704 391NOPRTB AVAILABLE PRIOR TO JANUARY 1962

PRINT TABLE OF ERRORS--PRETB
THE PURPOSE OF THIS SUBROUTINE IS TO CONSTRUCT AND EXECUTE THE NECESSARY GLOUT CALLING SEQUENCES REQUIRED TO PRINT A TABLE OF ERRORS AND ASSOCIATED DATA WHICH WAS CONSTRUCTED BY SUBROUTINE ERTBL

0704 392OLPLOT AVAILABLE PRIOR TO JANUARY 1962

ON LINE PLOT ROUTINE
PLOTS FROM 1 TO 10 VARIABLES ON THE ON LINE PRINTER
THE VARIABLES MAY BE EITHER FIXED OR FLOATING PT NUMBERS.A A FIXED PT NUMBER IS ASSUMED TO HAVE ITS BINARY PT ON ITS EXTREME LT & ARE PLOTTED FROM -1 TO &1. FLOATING PT NUMBERS ARE PLOTTED FROM A MINIMUM TO A MAXIMUM AS DETERMINED BY THE CALLING SEQUENCE.AN ERROR RETURN IS PROVIDED SHOULD THIS RANGE BE EXCEEDED.THE PROGRAM OCCUPIES 234 STORAGE LOCATIONS PLUS 40 ERASABLE LOCATIONS DESIGNATED BY COMMON

0704 395LL0003 AVAILABLE PRIOR TO JANUARY 1962

BINARY TO CHINESE BINARY
READS A FILE OF BINARY CARDS USING THE 711 MODEL 1 OR MODEL 2 CARD READER. FORMS THE CHINESE BINARY EQUIVALENT OF EACH CARD AND PUNCHES A CHINESE BINARY CARD.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 385BSS&C AVAILABLE PRIOR TO JANUARY 1962

INTERPRETABLE DOUBLE PRECISION SINE AND COSINE
USED BY GIVING PSEUDO-INSTRUCTION WHILE IN THE INTERPRETIVE MODE OF BS INTP. ANGLE MUST BE GIVEN IN RADIAN MEASURE. USES BS INTP. REQUIRES 130 STORAGE PLUS 26 COMMON.

0704 385BSSQRT AVAILABLE PRIOR TO JANUARY 1962

INTERPRETABLE DOUBLE PRECISION SQUARE ROOT INSTRUCTION
USED BY GIVING PSEUDO-INSTRUCTION WHILE IN THE INTERPRETIVE MODE OF BS INTP. SQUARE ROOT IS ACCURATE TO 20 DECIMAL PLACES.& USES BS INTP. REQUIRES 45 STORAGE PLUS

0704 387CEI4E AVAILABLE PRIOR TO JANUARY 1962

CARD TO TAPE CONVERSION-EDITING ROUTINE
A CARD TO TAPE CONVERSION ROUTINE /DECIMAL TO BINARY/ OF UNUSUAL FLEXIBILITY. DOES AWAY WITH REPRODUCTION OF CARDS TO FIT SPECIFIED INPUT FORMATS. CHANGES FIXED TO FLOATING, SINGLE OR DOUBLE PRECISION, CONVERTS FIXED TO FIXED, CONVERTS FLOATING TO FLOATING WITH ANY DECIMAL EXPONENT OFFSET. TAKES ANY KIND OF FIELDS IN ANY ORDER FROM CARDS, INCLUDING HOLLERITH.

0704 387CEI4H AVAILABLE PRIOR TO JANUARY 1962

READ TAPE TO CORE
READS A TAPE OF ANY LENGTH FROM A BCD-TAPE, WITH REDUNDANCY CHECKING AND STORES IN CORE.

0704 387CEI032 AVAILABLE PRIOR TO JANUARY 1962

BCD TO BINARY FIELD CONVERSION
16 COMMON CELLS.
BCD TO BINARY CONVERSION OF ANY FIELD UP TO 10 CONSECUTIVE CARD COLUMNS. /FIXED POINT ONLY/.

0704 387CEI041 AVAILABLE PRIOR TO JANUARY 1962

HOLLERITH TO BCD INPUT FROM CARDS
CONVERT ON-LINE HOLLERITH IMAGE TO BCD /BETWEEN COPIES/.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 395LL0029 AVAILABLE PRIOR TO JANUARY 1962

DYNAMIC ACCESS TO MEMORY PROGRAM
DYNAMICALLY DUMPS UP TO 24 SECTIONS OF CORE AND DRUM MEMORY AS SPECIFIED BREAKPOINTS ARE PASSED IN PROGRAM UNDER TEST. A CHOICE OF 5 OUTPUT MODES IS AVAILABLE FOR ON LINE AND/OR OFF LINE PRINTING. THE ROUTINE OPERATES AS NTH FILE ON TAPE 1. USES LOCATIONS 0 TO 64 DECIMAL AND ALL OF LOGICAL DRUM 1

0704 395LL0030 AVAILABLE PRIOR TO JANUARY 1962

TRACE AND RECORD ALTERATIONS IN MEMORY PROGRAM
TRACES THROUGH PROGRAM UNDER TEST /CHECKEE/ UNTIL ONE OF CERTAIN TABOO IN-OUT INSTRUCTIONS IS ENCOUNTERED AT WHICH TIME CONTROL IS RETURNED TO CHECKEE. RECORDS SO TRACING ALL CHANGES EFFECTED IN CORE MEMORY AS WELL AS ALL EXECUTED TRANSFERS. OUTPUT IS PRINTED ON LINE AND/OR OFF LINE. AN INTERPRETIVE ROUTINE ON RELOCATABLE CARDS OCCUPYING 874 LOCATIONS.

0704 395LL0103 AVAILABLE PRIOR TO JANUARY 1962

LOAD BINARY CARD IMAGES FROM TAPE TO CORE AND DRUMS
READS BINARY CARD IMAGES FROM TAPE INTO CORE AND ONTO DRUMS AND INITIATES THE EXECUTION OF THE PROGRAM UPON ENCOUNTERING THE IMAGE OF A TRANSFER CARD. A CALLING SEQUENCE ALLOWS RECALL OF PROGRAM.

0704 399MISRT1 AVAILABLE PRIOR TO JANUARY 1962

SQUARE ROOT, FLOATING-POINT
FULL SINGLE-PRECISION ACCURACY /26 BITS/.
TIMING - 1.224 M.S. ERROR RETURN FOR X NEGATIVE AND NON-ZERO. TURNS AC INDICATOR OFF. SPACE REQUIREMENTS, 37 LOCATIONS & 2 COMMON. /FASTER THAN NA 034.1, GE SQR, CL SQRT3, CL SQRT2, UA SQRT4, UA SQRT3, UA SQRT2, UA SQRT1./

0704 399MISRT2 AVAILABLE PRIOR TO JANUARY 1962

SQUARE ROOT, FLOATING-POINT, FORTRAN LIB. VERSION
FULL SINGLE-PRECISION ACCURACY /26 BITS/.
TIMING 1.308 M.S. ERROR STOP WHENEVER X NEGATIVE AND NON-ZERO. PRESERVES STATUS OF AC, MQ, AND DIVIDE CHECK INDICATORS. SPACE REQUIREMENTS 45 LOCATIONS &2 COMMON. /THIS ROUTINE IS AN ADAPTATION OF MI SRT1./

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 403MITCRL AVAILABLE PRIOR TO JANUARY 1962

READ-WRITE TAPE CONTROL PROGRAM
FOUR ROUTINES FORM A PACKAGE WHICH, WHEN USED WITH UA RWT1 /BINARY READ-WRITE TAPE PROGRAM, DIST. NO. 120/, ENABLES THE USER TO READ AND WRITE ON ANY OF THE TEN TAPE UNITS ATTACHED TO THE 704 WITH CONTROL AND WITH A MINIMUM OF TAPE MOVEMENT.

0704 404GISG AVAILABLE PRIOR TO JANUARY 1962

SORT GENERATOR
PRODUCES A SORT PROGRAM WHICH WILL SEQUENCE DATA AND ARRANGE INPUT IN ASCENDING ORDER

0704 405PFCCBA AVAILABLE PRIOR TO JANUARY 1962

ABSOLUTE BINARY LOADER
SELFLOADING PROGRAM.LOADS ABSOLUTE BINARY CARDS.
OCCUPIES 24 FIRST STORAGE CELLS.

0704 405PFCR02 AVAILABLE PRIOR TO JANUARY 1962

CORRELATIONAL RESIDUE COMPUTATIONC
RESIDUAL DEVIATION BETWEEN OBSERVED VALUES AND POINTS OF THE REGRESSION LINE.INPUT BY CARDS,OUTPUT ON DCB TAPE.

0704 405PFDCB2 AVAILABLE PRIOR TO JANUARY 1962

ALPHANUMERICAL READING AND BCD CONVERSION.
SAME TASK AS PFDCB1 BUT ALSO SUBSTITUES A VALID CODE TO DOUBLE PUNCHES.
OCCUPIES 133 STORAGE CELLS.

0704 405PFEL01 AVAILABLE PRIOR TO JANUARY 1962

MATRIX INVERSION.
FLOATING POINT MATRIX INVERSION AND SOLUTION OF MATRICIAL EQUATIONSC INPUT BO CARDS OR BO BCD TAPE,ON OR OFF.LINE PRINTING.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 414GLMARK AVAILABLE PRIOR TO JANUARY 1962

A MORE ACCURATE RUNGE-KUTTA
A DIFFERENTIAL EQUATIONS ROUTINE UTILIZING THE METHOD OF RUNGE-KUTTA-GILL TO SOLVE A SET OF N SIMULTANEOUS FIRST ORDER DIFFERENTIAL EQUATIONS. USES DOUBLE-PRECISION FLOATING POINT ARITHMETIC THROUGHOUT,LARGELY ELIMINATING THE EFFECT OF ROUND-OFF ERROR.REQUIRES THE USE OF SHARE ROUTINE GL DPPA. HAS AN OPTION FOR THE USER TO COMPUTE THE DERIVATIVES IN DOUBLE-PRECISION. PROGRAM REQUIRES TOTAL OF 499 & 6N STORAGES/INCLUDING 331 FOR GL DPPA/. CORR./ 419

0704 415ATBESI AVAILABLE PRIOR TO JANUARY 1962

BESSEL FUNCTIONS
BESSEL FUNCTIONS COMPUTES ALL ORDERS OF THE MODIFIED

0704 416CSNMBI AVAILABLE PRIOR TO JANUARY 1962

NEUMANN FUNCTIONS OF LARGE ARGUMENTS
THIS ROUTINE WILL COMPUTE THE NEUMANN FUNCTION Y/N,Z/ FOR ALL INTEGER ORDERS FROM 0 TO N, /N LARGER THAN 1/, FOR LARGE REAL VALUES OF Z, OR WILL COMPUTE ONLY Y/0,Z/.

0704 417PFCBN1 AVAILABLE PRIOR TO JANUARY 1962

BINOMIAL COEFFICIENT-FLOATING POINT
COMPUTES THE CLASSICAL BINOMIAL COEFFICIENT AND ITS GENERALISATION BY INTERPRETING FACTORIALS AS EULERIAN INTEGRALS.
OCCUPIES 316 STORAGE CELLS.

0704 417PFCR01 AVAILABLE PRIOR TO JANUARY 1962

MULTIPLE CORRELATIONS AND REGRESSIONS ANALYSIS
ANALYSE OF LINEAR REGRESSIONS AND CORRELATIONS OF K OBSERVATIONS AND P INDEP. VARABLES.
SINGLE OR DOUBLE PRECISION.ESTIMATION OF STANDARD DEVIATION AND MEAN VALUECINPUT BY CARDS OR BY BCD TAPE. OUTPUT BY ON-LINE OR OFF-LINE PRINTING. 4 TAPES MIN.REQUIRED.
SELF-LOADING PROGRAM. CORR./643

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 405PFIDP1 AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION MATRIX INVERSION
FLOATING POINT INVERSION AND SOLUTION OF LINEAR SYSTEMS. INPUT.OUTPUT BY TAPE. THE ORDRE OF THE MATRIX IS ILLIMITED.THE ROUTINE WORKS ALSO IN SINGLE PRECISION.
OCCUPIES 311 STORAGE CELLS.

0704 405PFMVP1 AVAILABLE PRIOR TO JANUARY 1962

EIGENVALUE COMPUTATION.
DETERMINATION OF THE M LARGEST EIGENVALUES OF AN M.ORDRE MATRIX AND OF THE CORRESPONDING EIGENVECTORS.ITERATIVE METHOD.
OCCUPIES 956 CELLS&VARIABLE BLOC.

0704 405PFPF01 AVAILABLE PRIOR TO JANUARY 1962

BINARY PUNCH PROGRAM
PUNCHING INTO ABSOLUTE BINARY CARDS THE CONTENTS OF SEVERAL STORAGE BLOCKS.SELF-LOADING.
OCCUPIES CELLS 24 THRU 59.

0704 405PFSMLG AVAILABLE PRIOR TO JANUARY 1962

CHECKSUM CORRECTOR
SELFLOADING ONE-CARD PUNCHING PROGRAM.

0704 405PFZPC1 AVAILABLE PRIOR TO JANUARY 1962

ZEROS OF A COMPLEX POLYNOMIAL
SINGLE PRECISION FLOATING POINT COMPUTATION OF A POLYNOMIAL WITH COMPLEX COEFFICIENTS.
OCCUPIES 765 STORAGE CELLS.

0704 405PFZPR1 AVAILABLE PRIOR TO JANUARY 1962

ZEROS OF A REAL POLYNOMIAL.
SINGLE PRECISION FLOATING POINT COMPUTATION OF A POLYNOMIAL WITH REAL COEFFICIENTS
OCCUPIES 765 STORAGE CELLS.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 417PFCSF1 AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION SIGN COMPATIBILITY
GRANTS IDENTICAL SIGNS TO 2 PORTIONS OF A FLOATING POINT DOUBLE PRECISION NUMBER
OCCUPIES 47 STORAGE CELLS.

0704 417PFCSH1 AVAILABLE PRIOR TO JANUARY 1962

HYPERBOLIC SINE AND COSINE,FLOATING POINT.
OCCUPIES 77 STORAGE CELLS

0704 417PFDCB1 AVAILABLE PRIOR TO JANUARY 1962

ALPHANUMERICAL READING AND BCD CONVERSION
READING OF 72.COLUMN CARDS ALPHANUMERICALLY PUNCHED AND CONVERSION INTO 12 WORDS BCD.
OCCUPIES 112 STORAGE CELLS.

0704 417PFSAC1 AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT COMPLEX ARITHMETICS.
EXECUTION OF MACHINE OPERATIONS ON COMPLEX NUMBERS BY A PROGRAM WRITTEN IN ORDARY MACHINE LANGUAGE.
OCCUPIES 328 STORAGE CELLS.

0704 417PFSDP1 AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT DOUBLE PRECISION ARITHMETICS.
EXECUTION OF MACHINE OPERATIONS ON DOUBLE PRECISION NUMBERS BY A PROGRAM WRITTEN IN ORDINARY LANGUAGE
OCCUPIES 326 STORAGE CELLS.

0704 417PFZPQ1 AVAILABLE PRIOR TO JANUARY 1962

GENERAL POLYNOMIAL PROGRAM
COMPUTATION OF ZEROS OF A POLYNOMIAL WITH REAL OR COMPLEX COEFFICIENTS.SELF-LOADING.
METHOD OF NEWTON.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 420CSDS01 AVAILABLE PRIOR TO JANUARY 1962

DUMP STORAGE, CORE, DRUM, AND TAPES
THIS IS A MODIFICATION OF NO DS1 WEICG WILL DUMP CORES, DRUMS AND TAPES, NOT REQUIRING THE USE OF A LOGICAL DRUM FOR SAVING THE FIRST 2048 WORDS OF CORE MEMOROC A MAGNETIC TAPE /LOGICAL 1 TC 8/ IS USED FOR SAVING INSTEAD. THE SAME SENSE OPTION AS NYDS1 IS USED TO SELECT THE TAPE. WITH CS DS1 IT IS POSSIBLE TO DUMP ALL OF CORE AND ALL OF DRUM MEMORY WITH ONE PASS ON THE MACHINE. SELF LOADING EINARY DECK. REQUIRES MINIMUM 704 & 711 CARD READER, 727 TAPE AND 716 PRINTER OR AN ADDITIONAL 727 TAPE. SUPERSEDED BY CS-DS2 DIST. 496.

0704 421AAANVA AVAILABLE PRIOR TO JANUARY 1962

ANALYSIS OF VARIANCE
COMPUTES MEANS,SUMS OF SQUARES,DEGREES OF FREEDOM AND F FACTOR FOR UP TO 13 WAY ANALYSIS. ANY NUMBER OF VARIABLES PER WHY AND ANY AMOUNT OF DATA MAY BE USED.

0704 422NOPCUT AVAILABLE PRIOR TO JANUARY 1962

POPOUT--A GENERAL PURPOSE PRINT AND PUNCH SUBROUTINE
THIS SUBROUTINE IS A MODIFICATION OF GLOUT-2 CAPABLE OF PERIPHERAL AND/OR ON-LINE PRINTING AND/OR PUNCHING OF UP TO 120 CHARACTERS. OTHER DIFFERENCES WITH GLOUT-2 ARE---
1. ON-LINE PRINTING IS NOT ECHO CHECKED.
2. TAPE WRITING IS NOT CHECKED BY RE-READING.
3. LOCATIONS OF CALL SEQUENCE ERRORS ARE NOT PRINTED.
4. THE END-OF-TAPE TEST IS MADE.
THE SUBROUTINE USES 347 INSTRUCTION CELLS & 51 ERASABLE CELLS

0704 423BSATN AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION ARC TANGENT INSTRUCTION
COMPUTES DOUBLE PRECISION ARC TANGENT OF A DOUBLE PRECISION ARGUMENT, AS DESCRIBED IN BS INTP.
REQUIRES BS INTP AND 25 COMMON STORAGES.
BS ATN REQUIRES 73 STORAGE LOCATIONS.

0704 423BSDCH1 AVAILABLE PRIOR TO JANUARY 1962

BCD TO BINARY CONVERSION OF UNRESTRICTED INTEGERS.
CONVERTS A BCD INTEGER OF 6 OR 12 CHARACTERS TO A BINARY INTEGER. ASSUMES THAT SIGN IS IN FIRST BIT POSITION OR OVERPUNCH OVER LEFTMOST POSITION.
RANGE IS -34,359,738,367 TO &34,359,738,367. USES 63 STORAGE CELLS PLUS 4 COMMON.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 423BSFRE1 AVAILABLE PRIOR TO JANUARY 1962

BINARY TO BCD CONVERSION OF UNRESTRICTED INTEGERS.
CONVERTS A BINARY INTEGER TO A PACKED BCD INTEGER OF 12 CHARACTERS. SIGN WILL APPEAR AS LEFT MOST CHARACTER. ROUTINE ACCEPTS ANY PLUS OR MINUS BINARY INTEGER THAT DOES NOT EXCEED THE CAPACITY OF A 704 WORD. USES 33 STORAGE CELLS PLUS 3 COMMON.

0704 423BSGQI AVAILABLE PRIOR TO JANUARY 1962

INTEGRATION BY GAUSSIAN QUADRATURE
INTEGRATES OVER INTERVAL /A,B/ BY 3,4,...,1C,16, OR 32 POINT QUADRATURE. WILL BREAK /A,B/ INTO K EQUAL INTERVALS, IF DESIRED. REQUIRES 197 STORAGE.

0704 423BSHQI AVAILABLE PRIOR TO JANUARY 1962

INTEGRATION BY HERMITE QUADRATURE
INTEGRATES FROM MINUS INFINITY TO PLUS INFINITY BY 3,4,...,10,15, OR 20 POINT QUADRATURE. REQUIRES 192 STORAGE.

0704 424ANE201 AVAILABLE PRIOR TO JANUARY 1962

ARGONNE LEAST SQUARE LEGENDRE POLYNOMIAL FIT
GIVEN N /NOT MORE THAN 80/ POINTS, CALCULATES IN FLOATING POINT THE COEFFICIENTS FOR THE EXPANSION IN LEGENDRE POLY-NOMIALS /NOT MORE THAN 20/ IN THE LEAST-SQUARES SENSE, AND THE VARIANCE OF THE DATA FROM THE CALCULATED CURVE. REQUIRES 8K CORE MEMORY. COMPLETE INCLUDING NYINP1, UASEC1, SCPNFX, UAINV1, UASQR4, MUPFD2, AND MUOUT2. INPUT FROM CARDS OR TAPE. MURA PRINT BOARD. OPTION FOR WEIGHTS OF POINTS EQUAL TO 1, 1/Y, OR ARBITRARY. ACCURACY TO 5 SIG. FIGURES FOR CASES TESTED.

0704 425WBCTB2 AVAILABLE PRIOR TO JANUARY 1962

CARD TO TAPE, BINARY
IS A SELF-LOADER TO WRITE ONE BINARY FILE ON TAPE 1 FROM NON-RELOCATABLE BINARY CARDS. WITH WB TSB2 /CF./ IT CONVERTS A PROGRAM FROM CARDS TO TAPE /ALSO READ BY WB RWT4/. LOCATIONS A THRU B INTO WHICH WB TSB2 WILL LOAD THE RECORD ARE SPECIFIED ON A CONTROL CARD AND MUST INCLUDE ALL EFFECT-IVE LOADING ADDRESSES IN THE DECK BETWEEN THE CONTROL CARD AND NEXT TRANSFER CARD. CONTROL CARDS CAN WRITE TAPE LOADER WB TSB2 BETWEEN PROGRAM RECORDS. ABSOLUTE BINARY CARDS AND TAPE RECORDS ARE CHECKSUM TESTED. ALSO RTT TEST IS USED.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 425WBPTD1 AVAILABLE PRIOR TO JANUARY 1962

DECIMAL TAPE DUMP
PRINTS CONTENTS OF A SPECIFIED RECORD AND FILE, WRITTEN BY WBRWT4, FROM A SPECIFIED TAPE, ON-AND/OR OFF-LINE IN FLOATING DECIMAL FORM, 8 WORDS PER LINE, WITH OCTAL NUMBERING. ORIGINAL MACHINE CONDITION CANNOT BE RESTORED. PROGRAM IS SELF LOADING AND USES 990 LOCATIONS. PRINTING IS SPECIFIED BY CONTRCL CARDS AND/OR BY MANUAL CONTROL.

0704 425WBSRV1 AVAILABLE PRIOR TO JANUARY 1962

SERVICE TAPE GENERATOR
WRITES A SERVICE TAPE CONSISTING OF SERVICE ROUTINES, DEBUGGING ROUTINES, AND PRODUCTION PROGRAMS. THE ROUTINE PUNCHES OUT ONE CARD LOADERS WHICH ARE USED TO CALL THE PRODUCTION PROGRAMS FROM THE SERVICE TAPE

0704 425WBTSB2 AVAILABLE PRIOR TO JANUARY 1962

BINARY TAPE LOADER
IS A SELF-LOADER THAT LOADS THE NEXT RECORD ON TAPE 1, IN THE WB CTB2 FORMAT, INTO LOCATIONS A THRU B AS SPECIFIED BY WORDS 3 AND 4 OF THE RECORD AND TRANSFERS CONTROL TO THE LOCATION IN THE ADDRESS OF WORD B-A&6. IT WILL NOT LOAD OVER ITSELF, AND SO MAY BE REENTERED TO LOAD SUBSEQUENT RECORDS. WITHOUT BOOTSTRAP FEATURE, IT CAN BE ASSEMBLED ANYWHERE IN CORE. READING IS VERIFIED BY BOTH CHECKSUM AND RTT TESTS.

0704 425WBTTC2 AVAILABLE PRIOR TO JANUARY 1962

TAPE TO TAPE COPY WITH CHANGES
COPIES PROGRAM AND DATA TAPES WITH WB FORMAT AND PROVIDES A MEANS OF CORRECTING A SPECIFIED RECORD/S/.

0704 427NSMRG2 AVAILABLE PRIOR TO JANUARY 1962

3 WAY MERGE PROGRAM
STARTING WITH ONE PRE-BLOCKED FILE EACH ON THREE INPUT TAPES, PROGRAM MERGES ONTO THREE OTHER TAPES. PROCESS IS REPEATED BACK AND FORTH AS LONG AS NECESSARY, WITH LENGTH OF BLOCKS IN SORT INCREASING IN MULTIPLES OF 3, UNTIL COMPLETE FILE IS IN SORT. PROGRAM THEN UNPACKS BLOCKS INTO ORIGINAL SPECIFIED RECORD SIZE. COMMENTS AS TO NUMBER OF PASSES MADE AND NUMBER OF SEQUENCES REMAINING ARE PRINTED OUT ON LINE. PROGRAM REQUIRES 7 TAPE UNITS AND ETT ORDER. PROGRAM NORMALLY FOLLOWS NS SRT2, SORT PROGRAM. CORR/ 465

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 427NSSRT2 AVAILABLE PRIOR TO JANUARY 1962

SORT PROGRAM
READS RECORDS FROM TAPE, PACKS INTO OPTIMUM BLOCK SIZE AND WRITES BLOCKS OUT ON THREE OTHER TAPES IN BINARY. SORT IS LOGICAL WITH SIGN BIT TREATED AS MAJOR SORTING BIT IN WORD. SORTING METHOD USED IS ADDRESS SORT. MAXIMUM BLOCK SIZE IS 832 WORDS FOR 4K CORE, 8000 WORDS FOR 32K. PROGRAM NORMALLY PRECEDES NS MRG2, 3-WAY MERGE PROGRAM. CORR/ 465

0704 428 GSSTPR AVAILABLE PRIOR TO JANUARY 1962

THERMODYNAMIC PROPERTIES OF STEAM AND WATER
A SET OF SUBROUTINES TO BE USED IN VARIOUS COMBINATIONS WITH ONE ANOTHER TO PRODUCE VALUES FOR T&E T&ERMODYNAMIC PROPER-TIES OF STEAM AS TABULATED BY KEENAN AND KEY5S# RESULTS CAN BE COMPUTED FOR PRESSURE, TEMPERATURE, ENTHALPY, ENTROPY, VISCOSITY, SPECIFIC VOLUMET AND QUALITY IN TERMS OF ONE OR TWO OF THE OTHER PARAMETERS IN THE WET, DRY, SATURATED, OR LIQUID REGIONS WGEREVER APPLICABLEC CORR/ 852

0704 429BAN203 AVAILABLE PRIOR TO JANUARY 1962

RANDOM NUMBER GENERATOR
UNIFORM AND NORMAL RANDOM NUMBER GENERATOR- PRODUCES UNIFORM MEMBER IF ENTERED WITH ACC POSITIVE AND 3NORMAL IF ENTERED WITH ACC NEGATIVE-FL PT-42 WORDS-NO COMMON-METHOD OF CONGRUENCES

0704 432MUMAM1 AVAILABLE PRIOR TO JANUARY 1962

MURA MATRIX MULTIPLY /FLOATING POINT/
MULTIPLIES AN MXN MATRIX BY AN NXQ MATRIX TO GIVE AN MXQ MATRIX. THE ELEMENTS OF EACH MARTIX ARE SEQUENTIALLY LOCATED BY ROWS. REQUIRES 88 WORDS PROGRAM PLUS 7 TEMPORARY.

0704 432MUMAS1 AVAILABLE PRIOR TO JANUARY 1962

MURA MATRIX ADD OR SUBTRACT, FIXED POINT
GIVEN MATRIX A, ADD TO OR SUBTRACT FROM IT MATRIX B, IN FIXED POINT ARITHMETIC, RESULTING IN MATRIX C. OCCUPIES 30 WORDS OF STORAGE.

0704 432MUMTR1 AVAILABLE PRIOR TO JANUARY 1962

SQUARE MATRIX TRANSPOSE ON ITSELF
TO SUPPLY THE TRANSPOSE OF A MATRIX STORED ROW-WISE IN CORE STORAGE AND PLACE IN THE SAME LOCATIONS AS THE ORIGINAL MATRIX. PROGRAM REQUIRES 33 WORDS PLUS 4 TEMPORARY. AN 80 BY 80 MATRIX IS TRANSPOSEC IN LESS THAN 800 MICROSECONDS. CORR/ 472

0704 432MURBL1 AVAILABLE PRIOR TO JANUARY 1962

MURA UPPER RELOCATABLE BINARY LOADER /ONE CARD/
LOADS STANDARD RELOCATABLE BINARY CARDS WITHOUT ALTERATION OF LOADING ADDRESSES. EXECUTES TRANSFER CARDS. OCCUPIES LAST 22 WORDS OF MEMORY. SELF LOADING.

0704 432MUR704 AVAILABLE PRIOR TO JANUARY 1962

MURA REFLECTED 704
CAUSES THE 704 TO BEHAVE LIKE A 407 IN ITS ROLE AS A READER AND PRINTER OF CARDS. 50 WORDS PROGRAM PLUS 24 WORDS FOR LOWER BINARY LOADER. REACER AND PRINTER OPERATE AT FULL SPEED. SUPERSEDES MU 704R DIST. 253.

0704 432MUSCO1 AVAILABLE PRIOR TO JANUARY 1962

SCOPE GRID PLOTTER
TO DISPLAY ON THE 740 OUTPUT RECORDER A GRID OF HORIZONTAL AND VERTICAL LINES. PROVISION IS MADE FOR PLOTTING CERTAIN SPECIFIED LINES HEAVIER THAN OTHERS. PROGRAM REQUIRES 53 WORDS STORAGE PLUS 2 TEMPORARY.

0704 433MCITR1 AVAILABLE PRIOR TO JANUARY 1962

ITERATION, ONE OR TWO VARIABLES
GIVEN X-F/X,Y/, Y-G/X,Y/, TO FIND A VALUE FOR X AND Y WITHIN A GIVEN EPSILON OF RELATIVE ERROR.
REQUIRES 265 WORDS PLUS 36 ERASABLE STORAGES. CORR. /442

0704 435MACEQ AVAILABLE PRIOR TO JANUARY 1962

DETERMINANT EXPANSION
THIS ROUTINE CALCULATES THE CHARACTERISTIC EQUATION OF M OF THE DETERMINANT M&I LAMBDA. REQUIRES 390 WORDS OF STORAGE & COMMON THRU COMMON & 2N & 9 WHERE N-ORDER OF THE MATRIX CORR/ 1024

0704 435MAMATM AVAILABLE PRIOR TO JANUARY 1962

MATRIX MULTIPLICATION
MULTIPLIES TWO MATRICIES OF THE FORM A X B - C IN FLOATING POINT ARITHMETIC REQUIRES 77 WORDS OF STORAGE

0704 435MAPOLM AVAILABLE PRIOR TO JANUARY 1962

POLYNOMIAL EXPANSION
COMPUTES THE POLYNOMIAL RESULTING FROM THE MULTIPLICATION OF LINEAR AND QUADRATIC FACTORS9 REQUIRES 139 WORDS OF STORAGE PLUS 62 WORDS OF COMMON STORAGE

0704 436AAATM2 AVAILABLE PRIOR TO JANUARY 1962

ATMOSPHERIC DATA SUBROUTINE
GIVEN A GEOMETRIC ALTITUDE H IN THE RANGE 0 TO 295,000 FEET, COMPUTE THE FOLLOWING -UANTITIES - 1 TEMPERATURE /IN DEGREES RANKINE/. 2 DENSITY RATIO. 3 PRESSURE RATIO. 4 VELOCITY OF SOUND /FT./SEC./. ROUTINE REQUIRES 158 CELLS PLUS COMMON STORAGE AS NEEDED FOR S-RT SUBROUTINE.

0704 439NA0290 AVAILABLE PRIOR TO JANUARY 1962

GENERAL CATHODE RAY TUBE COUPLE SUBROUTINE.
THIS SUBROUTINE WILL DRAW A SUB-DIVIDED GRID,WRITE A TITLE A TOP OF GRID,WRITE A LABEL AND APPROPRIATE SCALE LABELS,AND PL OT POINTS,OR SYMBOLS FOR POINTS ON THE 740 CRT OUTPUT RECORD ER.

0704 441 CSTYD AVAILABLE PRIOR TO JANUARY 1962

TYDAC /PSEUDO COMPUTER/ SIMULATOR
THIS COMPUTER IS DESCRIBED IN THE BOOK DIGITAL COMPUTER PROGRAMMING BY D. D. MC CRACKEN

0704 443LL0248 AVAILABLE PRIOR TO JANUARY 1962

RESET AND CLEAR CORE AND N LOGICAL DRUMS
ONE CARD SELF LOADING PROGRAM TO CLEAR CONSECUTIVE LOGICAL DRUMS, CORES, AC, MQ, AND ALL INDEX REGISTERS. TO RESET TRAP, CHECK, DIVIDE CHECK, AC OVERFLOW, MQ OVERFLOW AND ALL SENSE LIGHTS BEFORE LOADING IN NEXT CARD. CORR/ 461

0704 445PEPARD AVAILABLE PRIOR TO JANUARY 1962

DIFFERENTIATION AND PARTIAL DIFFER. OF RATIONAL FUNCT.
TO OPERATE ON AN EXISTING PROGRAM FOR A FUNCTION IN CORE STORAGE AND GENERATE THE DERIVATIVE OF THE FUNCTION.

0704 446PECSMO AVAILABLE PRIOR TO JANUARY 1962

GENERAL CARD LOADER SUBROUTINE GROUP
TO READ AND TRANSLATE HOLLERITH DATA PUNCHED ON CARDS, EITHER ON LINE OR FROM BCD TAPE PREVIOUSLY PREPARED BY THE CARD-TO-TAPE UNIT, IN A VARIABLE FORMAT CONVERTING HOLLERITH TO BCD, OCTAL INTEGERS TO BINARY INTEGERS, FIXED DECIMAL TO FLOATING BINARY, AND FIXED DECIMAL TO FIXED BINARY.

0704 449MI9SIM AVAILABLE PRIOR TO JANUARY 1962

LOADS BINARY ABSOLUTE, CORRECTION AND TRANSFER CARDS-SIMULATES 709 EXECUTION OF PROGRAM. BY MEANS OF CONTROL CARDS, LOGICAL TRACE IS AVAILABLE. BY MEANS OF CALL CARD, MEMORY DUMP IS AVAILABLE. CORR/ 471

0704 450RWDE2F AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT ADAMS-MOULTON, RUNGE-KUTTA INTEGRATION
INTEGRATES A SYSTEM OF N SIMULTANEOUS, FIRST ORDER, ORDINARY DIFFERENTIAL EQUATIONS. OPTION OF USING EITHER 4TH ORDER RUNGE-KUTTA METHOD OR 4TH ORDER PREDICTOR-CORRECTOR METHOD /ADAMS-MOULTON/ IS PROVIDED. ALSO OPTION OF AUTOMATIC ERROR CONTROL WITH VARIABLE STEP-SIZE IS PROVIDED. INPUT AND OUTPUT ARE SINGLE PRECISION BUT DOUBLE PRECISION IS USED INTERNALLY TO CONTROL ROUND-OFF ERRORS. REQUIRES 12N & 3 CELLS FOR DATA AND 610 WORDS FOR PROGRAM.

0704 450RWDE3F AVAILABLE PRIOR TO JANUARY 1962

FLOAT. PT. MILNE, RUNGE-KUTTA INTEGRAT. OF 2ND ORD. EQ.
INTEGRATES A SYSTEM OF N SIMULTANEOUS, SECOND ORDER, ORDINARY DIFFERENTIAL EQUATIONS WITH MISSING FIRST DERIVATIVES. OPTION OF USING EITHER 4TH ORDER RUNGE KUTTA METHOD OR 5TH ORDER MILNE METHOD IS PROVIDED. ALSO OPTION OF AUTOMATIC ERROR CONTROL WITH VARIABLE STEP-SIZE IS PROVIDED. INPUT AND OUTPUT ARE SINGLE PRECISION BUT DOUBLE PRECISION IS USED INTERNALLY TO CONTROL ROUND-OFF ERRORS. REQUIRES 19N & 3 CELLS FOR DATA AND 684 WORDS FOR THE PROGRAM.

0704 451CLDEQF AVAILABLE PRIOR TO JANUARY 1962

FORTRAN DIFFERENTIAL EQUATIONS
SOLVES SET OF N SIMULTANEOUS FIRST ORDER DIFFERENTIAL EQUATIONS. THIS IS CLDEQ MODIFIED FOR FORTRAN. DECKS CONSIST OF A PARTIAL SOURCE PROGRAM CONTAINING MAINLY EQUIVALENCES AND A RELOCATABLE BINARY DECK WITH FORTRAN CONTROL CARD. PARTIAL SOURCE PROGRAM RESTRICTS N TO 50 OR LESS BUT THIS CAN EASILY BE CHANGED AS PER WRITE-UP. USES 406 LOCATIONS AND 3 COMMON. REQUIRES GM XLOCF OR ITS EQUIVALENT.

0704 451CLDFRT AVAILABLE PRIOR TO JANUARY 1962

DEFCRT
A PARTIAL SOURCE PROGRAM TO BE USED WITH THE PROGRAMMERS OWN SOURCE PROGRAM IN WHICH HE USES THE FORTRAN DIFFERENTIAL EQUATIONS FUNCTION, CL DEQF. SEE THE WRITE-UP OF THE LATTER, DEFCRT HAS NO WRITE-UP OF ITS OWN.

0704 452SCTRIV AVAILABLE PRIOR TO JANUARY 1962

TRIVARIATE TABLE LOOK-UP
EVALUATES THE FUNCTION W - F/X,Y,Z/ AND ITS THREE PARTIAL DERIVATIVES BY LINEAR INTERPOLATION WHERE W HAS BEEN TABULATED AS A FUNCTION OF X,Y,AND Z. THE TABULATED FUNCTION TABLE MAY BE STORED ON DRUM OR IN CORE. AN OUT OF RANGE ERROR RETURN IS PROVIDED FOR EACH VARIABLE. ROUTINE REQUIRES 208 STORAGE CELLS PLUS 25 COMMON.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 455BESCB1 AVAILABLE PRIOR TO JANUARY 1962

ABSOLUTE ROW OR COLUMN BINARY CARD PUNCH
OPERATES AS A SUBROUTINE TO PUNCH OUT ON-LINE A BLOCK OF CORE STORAGE AS ABSOLUTE ROW OR COLUMN DATA CARDS. MAY BE USED TO PUNCH EITHER ROW BINARY OR SHARE STANDARD COLUMN BINARY CARDS. A LOADING ORIGIN DISTINCT FROM THE ORIGIN OF THE BLOCK PUNCHED MAY BE SPECIFIED. 78 PROGRAM & 26 COMMON.

0704 455BETCB1 AVAILABLE PRIOR TO JANUARY 1962

BINARY TAPE-TO-CARD SIMULATOR
PUNCHES OUT ONE OR MORE FILES OF BINARY CARD IMAGES FROM TAPE 4 USING THE ON-LINE PUNCH. PRODUCES SHARE STANDARD COLUMN BINARY CARDS. OPERATES AS A NON-SELF-LOADING EXECUTIVE ROUTINE. PUNCH OPERATES AT FULL SPEED FOR EACH GROUP OF 24 CARDS. PROGRAM STORAGE /30-131/ OCTAL, ERASABLE STORAGE /132-1573/ OCTAL.

0704 458GDNUMB AVAILABLE PRIOR TO JANUARY 1962

CRT NUMBER PLOT
PLOTS ANY DECIMAL DIGIT DISPLAYED IN A 15 X 10 ARRAY WITH ANY GIVEN COORDINATES. THE PLOT IS MADE 5 TIMES. SENSE SWITCH 1 CONTROLS THE INTENSITY OF THE PLOTS.

0704 460MICNT1 AVAILABLE PRIOR TO JANUARY 1962

CONTRACT SQUARE SYMMETRIC MATRIX TO TRIANGULAR FORM.
THIS SUBROUTINE CONTRACTS A REAL, SYMMETRIC MATRIX STORED IN SQUARE FORM TO THE MORE EFFICIENTLY STORED TRIANGULAR FORM.

0704 460MIEXA1 AVAILABLE PRIOR TO JANUARY 1962

EXPAND TRIANGULAR MATRIX TO SQUARE SYMMETRIC FORM.
THIS SUBROUTINE EXPANDS A REAL MATRIX STORED IN TRIANGULAR FORM TO THE SQUARE SYMMETRIC FORM.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 460MIHDI1 AVAILABLE PRIOR TO JANUARY 1962

EIGENVALUES AND VECTORS OF A REAL, SYMMETRIC MATRIX. V
THIS SUBROUTINE DIAGONALIZES A REAL, SYMMETRIC MATRIX BY MEANS OF JACOBIS METHOD WHEN THE MATRIX ELEMENTS ARE SINGLE-PRECISION, FLOATING-POINT NUMBERS STORED IN TRIANGULAR FORM. MATRICES OF LARGE ORDER, N, ARE DIAGONALIZED IN A TIME PROPORTIONAL TO N CUBED AND WITH A MINIMUM NUMBER OF ROTATIONS. SUPERSEDED BY MI HDI4, DIST. 697.

0704 460MIMAUG AVAILABLE PRIOR TO JANUARY 1962

PRELIM. EIGENVALUE PROB. OF A COMPLEX HERMITIAN MATRIX.
THIS SUBROUTINE CONVERTS A COMPLEX HERMITIAN MATRIX H OF ORDER N STORED IN STANDARD FORM /SEE DIST. 85/ INTO A REAL SYMMETRIC MATRIX S OF ORDER 2N. S HAS THE PROPERTY THAT ITS EIGENVALUES AND EIGENVECTORS ARE SIMPLY RELATED TO THOSE OF H, AND THEY CAN BE DETERMINED USING SUBROUTINE MI HDI1 /THIS DIST./.

0704 460MIOPM1 AVAILABLE PRIOR TO JANUARY 1962

OPERATE ON A REAL, SYMMETRIC MATRIX.
ANY FUNCTIONAL OPERATION /SPECIFIED BY THE USER/ IS PERFORMED ON A REAL, SYMMETRIC MATRIX STORED IN TRIANGULAR FORM. THIS IS ACCOMPLISHED BY TRANSFORMING THE MATRIX TO A DIAGONAL BASIS, PERFORMING THE OPERATION ON THE EIGENVALUES, AND BACK-TRANSFORMING TO THE ORIGINAL BASIS.

0704 462SCFPT1 AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT TRAP ROUTINE THIS ROUTINE SETS UNDERFLOW REGISTERS TO ZERO AND PROCEEDS, ON OVERFLOW STOPS WITH CAUSE INDICATION IN ACC

0704 464IBTFL AVAILABLE PRIOR TO JANUARY 1962

THE TRANSPORTATION PROBLEM, FLOW- OR HUNGARIAN METHOD INPUT FROM CARD OR TAPE . COMPUTATION ENTIRELY IN CORE-STORAGE. RESTRICTIONS...N SMALLER, EQUAL 600, M. N&1 & 2. N&M & 700 SMALLER THAN HIGH SPEED STORAGE AVAILABLE. CORR./588, 644, 701, 796

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 466RL0178 AVAILABLE PRIOR TO JANUARY 1962

FIXED POINT LOGARITHM
COMPUTES LOGARITHM OF X IN FIXED POINT USING A RAND APPROX.. MAX ERROR IS 3 IN THE EIGHT DECIMAL PLACE. REQUIRES 41 CELLS PLUS 2 COMMON. REPLACES RL0038. TIME 3.5 MS

0704 467BECSB1 AVAILABLE PRIOR TO JANUARY 1962

RELOCATABLE BINARY LOADER
LOADS ABSOLUTE AND RELOCATABLE DATA CARDS AND TRANSFER CARDS, ABSOLUTE CORRECTION/TRANSFER CARDS, AND ORIGIN CARDS FOR RELOCATABLE LOADING. EITHER ROW OR SHARE STANDARD COLUMN BINARY CARDS MAY BE LOADED, THE MODE BEING UNDER CONTROL OF BINARY CORRECTION CARDS. THE ALGORITHM FOR RELOCATABLE LOADING IS THE SAME USED BY THE FORTRAN I FOUR-CARD LOADER. OCCUPIES 0-265 OCTAL LOCATIONS. CORR/ 490,

0704 468 CF0058 AVAILABLE PRIOR TO JANUARY 1962

LOGICAL MEMORY SORT, MINIMUM TIME 46
SORTS ON M SELECTED BITS OF N CONSECUTIVE ONE-WORD ITEMS IN CORE STORAGE. REQUIRES 115 STORAGES & N COMMON. TIMING /.192*N*M & .192MN & C76 MM & 1.1/ MS.

0704 468 CF0064 AVAILABLE PRIOR TO JANUARY 1962

GENERALIZED TAPE SORTING ROUTINE 46
INPUTS ONE FILE OF ITEMS FROM LOGICAL TAPE 2, PLACES THE ITEMS IN ASCENDING LOGICAL SEQUENCE US9N7 30R5 STORAGE AND TAPES 3,4,5, AND 6, AND WRITES A SORTED OUTPUT TAPE. INPUT AND OUTPUT MAY BE IN EITHER THE BINARY MODE OR THE BCD MODE. REQUIRES 810 STORAGES & 3OMMON 45S97N1T54 BY USER.

0704 469 NUBES1 AVAILABLE PRIOR TO JANUARY 1962

BESSEL FUNCTIONS FOR REAL ARGUMENT AND ORDER 4
FOR A GIVEN REAL ARGUMENT AND ORDER, COMPUTES THE BESSEL FUNCTIONS J,Y,EXP/-X/*I,OR EXP/X/*K. NOT RESTRICTED TO INTEGRAL ORDER. CORR. 986

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 470ELBELO AVAILABLE PRIOR TO JANUARY 1962

704 COMPILER FOR BELL LABORATORY INTERPRETIVE SYSTEM
COMPILES 650 PROGRAMS WRITTEN FOR THE BELL LABORATORY INTERPRETIVE SYSTEM. THE COMPILER PRODUCES A SAP PROGRAM WHICH INCLUDES ANY REQUIRED LIBRARY ROUTINES. ANY VIOLATIONS ENCOUNTERED BY THE COMPILER ON THE BELL SYSTEM WILL BE INDICATED BY A REM CARD AND COMPILING WILL USUALLY CONTINUE. THE COMPILER REQUIRES 8K CORE MEMORY, HALF WORD ARITHMETIC AND 4 TAPES ON LINE. RESULTANT 704 OBJECT PROGRAM SHOULD BE ABLE TO BE RUN ON ANY 704.

0704 473 CSBUL1 AVAILABLE PRIOR TO JANUARY 1962

ONE CARD ABSOLUTE BINARY UPPER LOADER. 4
LOADS ABSOLUTE BINARY CARDS, CHECKING SUMS AND TRANSFERRING PROPERLO REGARDLESO OF THE INITIAL MACHINE CONDITION. CHECK SUMS CANNOT BE IGNORED.

0704 474NUMXEW AVAILABLE PRIOR TO JANUARY 1962

EIGENVALUES AND EIGENVECTORS SYMMETRIC MATRIX - FI
COMPUTES EIGENVALUES AND EIGENVECTORS /IF DESIRED/ OF A REAL SYMMETRIC MATRIX OF UP TO 81 BY 81 FOR 8K MACHINE, UP TO 175 BY 175 FOR 32K MACHINE. GIVENS METHOD IS USED FOR EIGENVALUES. A METHOD DUE TO WILKINSON IS USED TO FIND VECTORS. THE MATRIX IS ASSUMED GIVEN IN FIXED POINT IN CORE STORAGE. OUTPUT OF EIGENVALUES AND VECTORS AS FIXED POINT BINARY NUMBERS IS ON A BINARY TAPE, VALUES ALSO AVAILABLE IN CORE STORAGE. EIGENVECTORS MORE ACCURATE THAN MXEV. APPROXIMATE TIME .1 TIMES N SQUARED SECONDS FOR N BY N MATRIX. CORR./545

0704 477ERMPR2 AVAILABLE PRIOR TO JANUARY 1962

STEPWISE MULTIPLE REGRESSION PROCEDURE
PERFORMS A STEPWISE MULTIPLE LINEAR REGRESSION ON M SETS OF DATA CONTAINING N INDEPENDANT VARIABLES AND ONE DEPENDANT VARIABLE. EACH SET OF DATA CAN BE WEIGHTED. A SUBSET OF K COEFFICIENTS, K EQUAL OR LESS THAN N, IS OBTAINED THAT ARE SIGNIFICANT AT A SPECIFIED SIGNIFICANCE LEVEL. PREDICTED VALUES OF DEPENDANT VARIABLE ARE CALCULATED.
RESTRICTIONS -INDEPENDANT VARIABLE LIMITED TO 59 - SETS OF OBSERVATIONS UNLIMITED - 8K CORE AND 3 TAPES REQUIRED

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 480CEFLP AVAILABLE PRIOR TO JANUARY 1962

FORTRAN LINEAR PROGRAMMING CODE. MAX SIZE, 51 ROWS BY 91 COLUMNS INCLUDING ALL FUNCTIONALS BUT EXCLUDING ARTIFICIAL COLUMNS AND RIGHT HAND SIDE. DESIGN IS MODULAR WITHIN LIMITS OF FORTRAN. ALGORITHM INCLUDES PHASE I, ARBITRARY TRANSFORMATIONS AND COMPOSITE ALGORITHM. SPEED QUITE GOOD BUT PRECISION ONLY FAIR. COMPUTED TOLERANCES USED TO PARTIALLY OFFSET INADEQUACY OF SINGLE PRECISION FLOATING POINT. THE TOLERANCE IN STATEMENT 109 MAY BE CRITICAL. MAKING IT LARGE HAS EFFECT OF BYPASSING COMPOSITE ALGORITHM. COMPILE TIME ABOUT 15 MINS

0704 480CE650S AVAILABLE PRIOR TO JANUARY 1962

SIMULATE BASIC 650 COMPUTER WITH 704. CODED FOR 8K BUT SHOULD WORK ON 4K IF ONLY 1904 LOCATIONS USED FOR 650 PROG. USES CE 650W TO SIMULATE 650 INPUT PLUGBOARD. TAPE INPUT IS MANDATORY. ISSUED ONLY AS BINARY DECK. CORR/ 562

0704 480CE650W AVAILABLE PRIOR TO JANUARY 1962

SIMULATES INPUT PLUGBOARD OF BASIC 650. READS BCD TAPE 9 AND WRITES BINARY TAPE 10. FOR USE WITH CE 650S. CODED FOR 8K BUT SHOULD WORK ON 4K. ISSUED ONLY IN BINARY.

0704 481CA0031 AVAILABLE PRIOR TO JANUARY 1962

TRIPLE PRECISION SQUARE ROOT
OBTAINS THE SQUARE ROOT OF A TRIPLE PRECISION NUMBER. CA045 MUST BE IN CORE. REQUIRES 55 CELLS & 23 COMMON.

0704 481CA0045 AVAILABLE PRIOR TO JANUARY 1962

TRIPLE PRECISION ARITHMETIC
ADD, SUBTRACTS, MULTIPLIES OR DIVIDES TWO TRIPLE PRECISION NUMBERS. A TRIPLE PRECISION NUMBER HAS 1 CELL FOR EXPONENT AND 2 CELLS FOR THE FRACTION. PROVIDES 20 DECIMAL PLACES OF ACCURACY. REQUIRES 379 CELLS & 12 COMMON

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 483NA0296 AVAILABLE PRIOR TO JANUARY 1962

SPLINE CURVE FIT
FITS A SET OF POINTS WITH A CONTINUOUS FUNCTION THAT ACTS LIKE AN IDEAL SPLINE IN T&AT THE FIRST AND SECOND DERIVATIVES OF THE FUNCTION ARE ALSO CONTINUOUS. SUBROU TINE OCCUPIES 295 LOCS. PLUS TEMPORARY STORAGE FOR DATA

0704 483NA0297 AVAILABLE PRIOR TO JANUARY 1962

SPLINE CURVE READ
OBTAINS FUNCTIONAL VALUET SLOPE AND SECOND DERIVATIVE FOR A GIVEN ARGUMENT USING THE RESULTS OF NA-296 .SPACE REQUIREDT 114 LOCOC

0704 483NA0298 AVAILABLE PRIOR TO JANUARY 1962

MINIMUM ARC LGT&C INTERPOLATION FOR SURFACES AND CURVES
INTERPOLATES FOR VALUES ON A CURVE OR ON A SURFACE WHERE THE SURFACE IS REPRESENTED BY A FAMILY OF SINGLE-VALUED CURVES OR A GRID OF -O&NTOC SPACE RE-UIREDT 372 LOCS.

0704 484MIFDP1 AVAILABLE PRIOR TO JANUARY 1962

FUNCTION DISPLAY PROGRAM.
THIS PROGRAM PROVIDES A MEANS FOR DISPLAYING PLOTS OF CROSS-SECTIONS OF A FUNCTION OF THREE VARIABLES ON THE CATHODE RAY TUBE. THE OPERATOR CAN VARY THE RANGE AND MAGNIFICATION OF THESE PLOTS BY APPROPRIATE USE OF THE SENSE SWITCHES. THE PROGRAM REQUIRES 1098 CELLS PLUS A SUBROUTINE FOR CALCULATING THE FUNCTION. THE SUBROUTINE FOR THE GIVEN FUNCTION USES 193 CELLS.

0704 486CMCISS AVAILABLE PRIOR TO JANUARY 1962

CHRYSLER INTERPRETER AND 650 SIMULATOR
THIS PROGRAM ENABLES PROGRAMS DEVELOPED FOR THE 650 /USING A THREE ADDRESS INTERPRETATIVE SYSTEM AND 650 MACHINE LANGUAGE/ TO BE RUN ON A 704.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 487DAZ002 AVAILABLE PRIOR TO JANUARY 1962

SUPERVISORY CONTROL PROGRAM
Z002 IS AN EXECUTIVE PROGRAM WHICH MAKES A STACKED PROGRAM-STACKED OUTPUT SYSTEM OF OPERATION POSSIBLE. PROGRAMS AND OUTPUT MAY BE ON OR OFF-LINE AT THE DISCRETION OF THE 704 OPERATOR. Z002 PRINTS MONITORING INFORMATION AT THE BEGINNING OF EACH JOB AND PROVIDES A HALT BETWEEN JOBS IF DESIRED. IT INCLUDES MASTER INPUT AND GENERAL OUTPUT SUBROUTINES AND ALSO CONTAINS AN AUTOMATIC CORE DUMP ROUTINE AND A CONSOLE PRINT SUBROUTINE. IT REQUIRES ONLY THE MINIMUM 704, OCCUPIES 963 WORDS OF CORE, AND USES 51 WORDS OF COMMON.

0704 491RWAV2F AVAILABLE PRIOR TO JANUARY 1962

GENERAL ANALYSIS OF VARIANCE
COMPUTES,ALL SUMS OF SQUARES FOR A FACTORIAL EXPERIMENT. POLYNOMIAL PARTITIONING OPTIONAL. FRACTIONAL AND MULTIPLE REPLICATION PERMISSIBLE. PSEUDO-DATA NOT REQUIRED FOR BLANK CELLS IN CASE OF FRACTIONAL REPLICATION.

0704 491RWAV3F AVAILABLE PRIOR TO JANUARY 1962

LATIN SQUARES ANALYSIS OF VARIANCE
COMPUTES ALL SUMS OF SQUARES FOR A LATIN SQUARE EXPERIMENT. POLYNOMIAL PARTITIONING OPTIONAL. MULTIPLE REPLICATION PERMISSIBLE.

0704 491RWDE4F AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT GILL METHOD FOR RUNGE-KUTTA INTEGRATION
SOLVES N SIMULTANEOUS FIRST ORDER DIFFERENTIA EQUATIONS BY THE RUNGE-KUTTA-GILL METHOD. USES DOUBLE PRECISION INTERNALLY IN CALCULATING THE DEPENDENT VARIABLES. THE USER MUST PROVIDE AN AUXILIARY SUBROUTINE WHICH EVALUATES THE FIRST ORDER DERIVATIVES. INITIALLY, THE USER MUST PROVIDE THE VALUES OF THE FIRST ORDER DERIVATIVES. REQUIRES 135 PLUS 2N CELLS.

0704 493LAS858 AVAILABLE PRIOR TO JANUARY 1962

PSI FUNCTION FOR COMPLEX ARGUMENTS
THIS SUBROUTINE COMPUTES THE REAL AND IMAGINARY PARTS OF THE PSI FUNCTION FOR A COMPLEX ARGUMENT WHERE THE PSI FUNCTION IS DEFINED AS THE DERIVATIVE OF THE LOGARITHM OF THE GAMMA FUNCTION.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 493LAS860 AVAILABLE PRIOR TO JANUARY 1962

LOGARITHM OF THE GAMMA FUNCTION FOR COMPLEX ARGUMENTS
THIS SUBROUTINE COMPUTES THE REAL AND IMAGINARY PARTS OF THE NATURAL LOGARITHM OF THE GAMMA FUNCTION FOR A COMPLEX ARGUMENT.

0704 495CVI020 AVAILABLE PRIOR TO JANUARY 1962

CONVERTS BCD TAPE RECORDS ACCORDING TO A FORTRAN TYPE FORMAT SPECIFICATION.

0704 496CSDS2 AVAILABLE PRIOR TO JANUARY 1962

DUMP STORAGE, CORE, DRUM, AND TAPES
THIS IS A MODIFICATION OF NY DS1 WHICH WILL DUMP CORES, DRUMS AND TAPES, NOT REQUIRING THE USE OF A LOGICAL DRUM FOR SAVING THE FIRST 2048 WORDS OF CORE MEMORY. A MAGNETIC TAPE/LOGICAL 1 TO 8/ IS USED FOR SAVING INSTEAD. THE SAME SENSE SWITCH OPTION AS NYDS1 IS USED TO SELECT THE TAPE. WITH CS DS2 IT IS POSSIBLE TO DUMP ALL OF CORE AND DRUM MEMORY WITH ONE PASS ON THE MACHINE. SELF LOADING BINARY DECK. REQUIRES MINIMUM 704 & 711 CARD READER 727 TAPE AND 716 PRINTER OR AN ADDITIONAL 727 TAPE. CORR./531

0704 497ASAS63 AVAILABLE PRIOR TO JANUARY 1962

GENERAL PURPOSE OUTPUT PROGRAM
WRITES ONE VARIABLE-FORMAT LINE ON TAPE PRINTER, OR PUNCH. RESULTS ARE FLOATING, FIXED, HOLLERITH, OR OCTAL. REPEATING, INDIRECT ADDRESSING, AND CHECKINK OF OUTPUT ARE OPTIONS IN CALLING SEQUENCE. ANY NUMBER OF OUTPUT MODES POSSIBLE FROM ONE CALLING SEQUENCE. TAPE OR PRINTER USE SAME CARRIAGE CONTROL CODES. USES 460 CELLS PLUS 46 COMMON.

0704 498CA0048 AVAILABLE PRIOR TO JANUARY 1962

GIVEN X, THIS PROGRAM CALCULATES LN X TO 20D OR 20S. REQUIRES THAT CA 045 BE IN CORE. TIMING APPROX. 153 MS. 3 PER LN. SPACE REQUIRED — 159 LOCATIONS.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 499CMOCDP AVAILABLE PRIOR TO JANUARY 1962

ON LINE OCTAL DUMP
TO BE READ IN ON LINE AFTER A PROGRAM STOP, AND TO DUMP A BLOCK OF CORE IN LOGICAL OCTAL WORDS. REQUIRES 95 CELLS.

0704 500BSBFP2 AVAILABLE PRIOR TO JANUARY 1962

LEAST MAXIMAL ABSOLUTE ERROR POLYNOMIAL FIT
FINDS THE POLYNOMIAL P OF GIVEN NON ZERO DEGREE N THAT MINIMIZES THE MAXIMAL ABSOLUTE ERROR AT A GIVEN SET OF K DATA POINTS. P IS PRESENTED AS A SUM OF POWERS AND AS A SUM OF CHEBYSHEV POLYNOMIALS. AN ERROR TABLE IS PRINTED. FLOATING POINT ARITHMETICS. REQUIRES UA IN AND OUTPUT SUBROUTINES AND THEIR COMMON CELLS, 339 CELLS FOR THE CODE AND 16&3/N&K/ CELLS FOR DATA.

0704 500BSEWOT AVAILABLE PRIOR TO JANUARY 1962

BCD OUTPUT SUBROUTINE
PRINTS A BCD RECORD OF ARBITRARY LENGTH ON THE ON-LINE PRINTER WITH ECHO CHECKING. MAIN PROGRAM MAY SWITCH TO DOUBLE SPACE, PUNCHING, PRINTING WITHOUT ECHO OR SHORT FORMAT. USES 106 CELLS PLUS 31 COMMON .

0704 503ANI111 AVAILABLE PRIOR TO JANUARY 1962

ARGONNE TAPE LOWER BINARY LOADER
SELF-LOADING.BY LOAD TAPE KEY READS SHARE ABSOLUTE BINARY PROGRAM RECORDS INTO CORE AND EXECUTES TRANSFER RECORDS. CAD ORDER REQUIRED.USE E.G. ANI112,CARD TO BINARY TAPE LOADER,TO PREPARE TAPE. OCCUPIES CELLS 0-23.

0704 503ANI112 AVAILABLE PRIOR TO JANUARY 1962

ARGONNE CARD TO BINARY TAPE LOADER
PRECEDE BY ONE-CARD LOWER BINARY LOADER FOR COMPLETE SELF-LOADING PROGRAM.READS BINARY PROGRAM CARDS AND TRANSFER CARDS INTO CORE WITH CHKSUM CHK AND WRITES CORRESPONDING BINARY TAPE RECORDS WITH BIT CHK. RESULT MAY BE LOADED BY LOAD TAPE KEY IF TAPE BINARY LOADER PRECEDES TAPE RECORDS. CAD ORDER REQUIRED. OCCUPIES CELLS 24-139.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 512DMCVT1 AVAILABLE PRIOR TO JANUARY 1962

BCD TO MODIFIED BCD CONVERSION ROUTINE
TO CONVERT A SERIES OF BCD WORDS TO MODIFIED BCD.

0704 512DMDPO1 AVAILABLE PRIOR TO JANUARY 1962

DATA PROCESSING OUTPUT ROUTINE
TO SET UP AND PRINT ONE LINE OF OUTPUT ON AN ON-LINE PRINTER IF SW. 2 IS ON OR OFF-LINE ON TAPE 2 IF SW. 2 IS OFF. THIS ROUTINE CONVERTS BOTH FLOATING AND FIXED POINT BINARY NUMBERS TO FIXED POINT OUTPUT AND PRINTS HOLLERITH AND MODIFIED HOLLERITH INFORMATION.

0704 512DMPUN2 AVAILABLE PRIOR TO JANUARY 1962

GENERAL PUNCHED OUTPUT ROUTINE
TO SET UP THE IMAGE OF ONE CARD ON TAPE 3 TO BE PUNCHED ON OFF-LINE PUNCH OR TO SET UP CARD IMAGE IN CORE. THIS ROUTINE CONVERTS BOTH FLOATING AND FIXED POINT BINARY NUMBERS TO FIXED POINT OUTPUT AND PRINTS HOLLERITH AND MODIFIED HOLLERITH INFORMATION.

0704 513BEL1A AVAILABLE PRIOR TO JANUARY 1962

INTERPRETER FOR 650 PROGRAMS
INTERPRETS 650 PROGRAMS WRITTEN ACCORDING TO IBM TECHNICAL NEWSLETTER NO. 11. ACCEPTS EXISTING PROGRAM DECKS WITH MINOR MODIFICATION. PRODUCES THE SAME OUTPUT CARD /AFTER TAPE-CARD/. PROVIDES UP TO A 60 TO 1 SPEED INCREASE OVER 650. CORR./566,655

0704 513BESAK2 AVAILABLE PRIOR TO JANUARY 1962

MAKE SAP OCTAL
WHEN LOADED USING THE SAP 3-7 PLB 1 PSEUDO-OPERATION, THE DECIMAL-TO-BINARY INTEGER CONVERSION ROUTINE OF SAP IS CHANGED TO CONVERT OCTAL-TO-BINARY. ALL INTEGERS IN THE SYMBOLIC DECK ARE THEREFORE REGARDED AS OCTAL, EXCEPT THOSE IN THE VARIABLE FIELD OF DEC CARDS. THIS PATCH TO SAP IS PRIMARILY USEFUL FOR ASSEMBLING PROGRAM CORRECTIONS.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 506MICR1 AVAILABLE PRIOR TO JANUARY 1962

CONTOUR PLOT PROGRAM
PLOTS CONTOUR LINES OF FUNCTION OF TWO VARIABLES ON CATHODE RAY TUBE.

0704 506MICR2 AVAILABLE PRIOR TO JANUARY 1962

CONTOUR PLOT PROGRAM
PLOTS REFINED CONTOUR LINES OF FUNCTION OF TWO VARIABLES ON CATHODE RAY TUBE. USED WITH MICR1.

0704 508DIGPL1 AVAILABLE PRIOR TO JANUARY 1962

GENERAL PROGRAM LOADER
COMBINATION OF NY BOL 2 AND NY RBL 1. LOADS ABSOLUTE BINARY, RELOCATABLE BINARY, TRANSFER, RBL1 CONTROL, AND FOUR-WORD OCTAL CARDS. SELF-LOADS INTO 0-206 OCTAL.

0704 508DITPC1 AVAILABLE PRIOR TO JANUARY 1962

TAPE CORRECTOR
DUPLICATES A BCD TAPE AND MAKES INSERTIONS, DELETIONS, OR CHANGES. CORRECTIONS MAY BE READ ON-LINE OR OFF-LINE.

0704 510IBEXP AVAILABLE PRIOR TO JANUARY 1962

FIXED POINT EXPONENTIAL SUBROUTINE
TIMING ABOUT 2.46MS, 71 LOCATIONS, 10 DIGIT ACCURACY.
CORR./629

0704 511MICNF1 AVAILABLE PRIOR TO JANUARY 1962

CAPACITATED NETWORK FLOW PROGRAM
THE PROGRAM DETERMINES A FLOW PATTERN OVER A GENERAL NETWORK SO THAT A LINEAR COST FUNCTION OF THE BRANCH FLOWS ASSUMES ITS MINIMUM VALUE. BRANCH FLOWS ARE RESTRICTED TO BEING NON-NEGATIVE AND LESS THAN OR EQUAL TO THE CAPACITIES OF THE BRANCHES, AND FLOW INTO AND OUT OF THE NODES IS CONSERVED.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 514NA0299 AVAILABLE PRIOR TO JANUARY 1962

DETERMINANT EVALUATION AND ROOT EXTRACTION
M. OJALVO THIS ROUTINE EVALUATES A DETERMINANT WITH POLYNOMIAL ELEMENTS AND EXTRACTS T&E ROOTS OF T85 RESULTING POLYNOMIAL. THE ORDER OF THE DETERMINANT,N,MAY VARY FROM 2 TO 20,AND THE DEGREE OF THE ELEMENTS,M,MAY BE POSITIVE INTEGRAL VALUES FROM 0 UPWARDTSUC& TGAT M&1 TIMES N SQUARED IS EQUAL TO OR LESS THAN 1200. THE ROOT EXTRACTION PART HANDLES UP TO A 60TH DEGREE POLONOMIALC IN ADDITIONTHE ROUTINE MAY BE USED TO EVALUATE A DETERMINANT ONLY,OR EXTRACT THE ROOTS OF A POLYNOMIAL ONLO.

0704 516LAS862 AVAILABLE PRIOR TO JANUARY 1962

INCOMPLETE GAMMA FUNCTION.
GIVEN A AND X, THIS SUBROUTINE WILL COMPUTE THE INCOMPLETE GAMMA FUNCTION DEFINED AS THE INTEGRAL FROM X TO INFINITY OF EXP/-U/TIMES U TO THE /A-1/ POWER DU.

0704 521PFAF1 AVAILABLE PRIOR TO JANUARY 1962

FACTOR ANALYSIS
CENTROID METHOD OF THURSTONE.
ANALYSIS OF A CORRELATION MATRIX,
EXTRACTION OF SUCCESSIVE FACTORS AND
COMPUTATION OF COMMUNALITIES.
MAX.ORDER OF MATRIX IS 68.
INPUT BY CARDS OR BY TAPE.OUTPUT ON TAPE.

0704 522PFEL3 AVAILABLE PRIOR TO JANUARY 1962

COMPLEX LINEAR SYSTEM SOLUTION PROGRAM
SIMPLE PRECISION SOLUTION OF COMPLEX LINEAR SYSTEMS AND INVERSION OF COMPLEX MATRIX. HIGHEST ORDER OF MATRIX IS 40. HIGHEST NUMBER OF MEMBER VECTORS IS 10. OFF-LINE OUTPUT. JORDAN S METHOD.

0704 523SCMAP AVAILABLE PRIOR TO JANUARY 1962

MUSH DATA ASSEMBLER AND PRINT ROUTINES
PROVIDES INPUT AND OUTPUT FOR SC-MUSH. USES A SLIGHTLY MODIFIED RAND LP INPUT TAPE /OR DECK/. OUTPUT FORMAT SIMILAR TO THAT OF RAND.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 523SCMUSH AVAILABLE PRIOR TO JANUARY 1962

LINEAR PROGRAMMING SUBROUTINE
SOLVES PROBLEM WITH UP TO 55 EQUATIONS BY MODIFIED SIMPLEX METHOD. MAXIMUM NUMBER OF VARIABLES DEPENDS ON SIZE OF CORE FOR WHICH ASSEMBLED. SINGLE PRECISION ARITHMETIC USED THROUGH OUT. ROUND-OFF ERROR IN INVERSE CAN BE REDUCED BY PERIODIC USE OF A PURIFICATION DEVICE. FEASIBILITY OBTAINED BY BIG M METHOD. VARIOUS RESTARTS PROVIDED.

0704 525PKBCD1 AVAILABLE PRIOR TO JANUARY 1962

BINARY TO BCD CONVERSION SUBROUTINE
CONVERTS A POSITIVE BINARY INTEGER TO 12 BCD CHARACTERS AND REPLACES LEADING ZEROS WITH BLANKS. 37 CELLS AND 3 COMMON.

0704 525PKCBRD AVAILABLE PRIOR TO JANUARY 1962

FLOATING-POINT DOUBLE-PRECISION CUBE ROOT
COMPUTES THE CUBE ROOT OF A DOUBLE-PRECISION FLOATING-POINT NUMBER. NORMAL TSX SEQUENCE. 52 BIT ACCURACY. REQUIRES 86 STORAGE CELLS PLUS 7 COMMON. TIMING 6.444 MS.

0704 525PKCLAD AVAILABLE PRIOR TO JANUARY 1962

PK CLAD & PK STOD - DOUBLE PRECISION CLEAR AND ADD-- AND DOUBLE PRECISION STORE.
DOUBLE-PRECISION ANALOGS FOR CLA AND STO. USES LOCATIONS DEFINED BY PK DOUF. NORMAL TSX SEQUENCE. REQUIRES 26 STORAGE CELLS. TIMING 0.336 MS. FOR CLAD AND 0.384 MS. FOR STOD.

0704 525PKCSBA AVAILABLE PRIOR TO JANUARY 1962

RELOCATING BINARY LOADER,LOWER
LOADS INTO CORE MEMORY INFORMATION FROM ABSOLUTE AND RELOCATABLE BINARY DATA CARDS, CORRECTION-TRANSFER CARDS, AND ORIGIN TABLE CARDS. ONLY THE DATA CARDS WILL BE CHECK-SUMMED. SEARCHES BOTH NOMINAL LOCATION AND NOMINAL ADDRESS OF INSTRUCTION IN CHOOSING AMOUNT OF RELOCATION THUS ALLOWING FOR SHARE CONVENTION OF COMMON AT 2000,OCTAL, FOR RELOCATABLE ROUTINES. CORRECTIONS MAY BE UP-DATED AND UP-DATING WILL CONTINUE EVEN THOUGH A PREVIOUS INSTRUCTION HAS BEEN IGNORED. OCCUPIES 202 STORAGE CELLS.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 525PKCSBB AVAILABLE PRIOR TO JANUARY 1962

RELOCATING BINARY LOADER, UPPER
LOADS INTO CORE MEMORY INFORMATION FROM ABSOLUTE AND RELOCATABLE BINARY DATA CARDS,CORRECTION-TRANSFER CARDS,AND ORIGIN TABLE CARDS. ONLY THE DATA CARDS WILL BE CHECK SUMMED. LOCATED IN UPPER PORTION OF ANY SIZE MEMORY. REQUIRES BINARY LOADER. OCCUPIES 201 STORAGE CELLS.

0704 525PKCSBL AVAILABLE PRIOR TO JANUARY 1962

ABSOLUTE BINARY CARD AND CORRECTION CARD LOADER
LOADS AND CHECKS ABSOLUTE BINARY DATA CARDS AND ABSOLUTE BINARY CORRECTION-TRANSFER CARDS USING SHARE FORMAT.UPDATING OF LOCATIONS IS POSSIBLE ON CORRECTION-TRANSFER CARDS. OCCUPIES 0-107 OCTAL. STRAIGHT ACROSS READER BOARD.

0704 525PKCSBU AVAILABLE PRIOR TO JANUARY 1962

ABSOLUTE BINARY CARD AND CORRECTION CARD LOADER.
LOADS AND CHECKS BINARY DATA CARDS AND ABSOLUTE BINARY CORRECTION-TRANSFER CARDS USING SHARE FORMAT. UPDATING OF LOCATIONS DONE ON C/T CARDS. PUSHES LOAD-CARDS FOR CARD WITH A 9 ROW COLUMN 1 PUNCH. OCCUPIES 0,1, AND 77672-77777 OCTAL. PUSHING START AFTER CHECKSUM STOP /77740/ CAUSES CORRECTED CARD TO BE PUNCHED /BINARY DATA CARD ONLY/. CORRECTION CARDS NOT CHECKED. USES STRAIGHT ACROSS READER BOARD. WILL LOAD INTO 0 AND 1. TO REUSE LOADER, TRANSFER TO /77705/8.

0704 525PKCTH2 AVAILABLE PRIOR TO JANUARY 1962

HOLLERITH CARD TO TAPE
A SELF-LOADING PROGRAM TO WRITE INFORMATION FROM A HOLLERITH CARD ON A TAPE UNIT SPECIFIED ON THE CARD. TERMINATES BY INITIATING LOAD CARDS SEQUENCE OR READING A TRA CARD. MAY BE ENTERED FROM A PROGRAM TO READ SUCCEEDING CARDS. 130 CELLS.

0704 525PKDOUF AVAILABLE PRIOR TO JANUARY 1962

DOUBLE-PRECISION FLOATING-POINT ARITHMETIC PACKAGE
PERFORMS DOUBLE-PRECISION FLOATING-POINT ARITHMETIC OPERATIONS WITH SELF-CONTAINED ERROR CHECKING. PART OF INTERPRETIVE PACKAGE PK INDP. MAY BE USED ALONE AS WELL AS WITH PK INTD. REQUIRES 157 STORAGE CELLS.

0704 525PKFAKT AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT N FACTORIAL SUBROUTINE
N IS AN INTEGER LESS THAN 473. METHOD IS ITERATED SINGLE PRECISION FLOATING MULTIPLICATION APPROXIMATELY .44 N MS. 31 CELLS. CORR./628

0704 525PKINDP AVAILABLE PRIOR TO JANUARY 1962

DOUBLE-PRECISION FLOATING-POINT INTERPRETIVE PACKAGE.
READS AND EXECUTES CONSECUTIVE MACHINE LANGUAGE INSTRUCTIONS OF WHICH 20 ARE PERFORMED IN THEIR DOUBLE-PRECISION FLOATING POINT ANALOG. PACKAGE IS COMPOSED OF PK INTE, PK INTD, AND PKDOUF. REQUIRES 549 STORAGE CELLS.

0704 525PKINTD AVAILABLE PRIOR TO JANUARY 1962

INTERPRETIVE DOUBLE-PRECISION FLOATING-POINT ARITHMETIC SUBROUTINE.
READS AND EXECUTES CONSECUTIVE MACHINE LANGUAGE INSTRUCTIONS OF WHICH 20 ARE PERFORMED IN THEIR DOUBLE-PRECISION FLOATING POINT ANALOG. PRINCIPAL PART OF INTERPRETIVE PACKAGE PK INDP. PK DOUF MUST BE INCLUDED IN THE ASSEMBLY. REQUIRES 249 STORAGE CELLS PLUS THOSE REQUIRED BY PK DOUF.

0704 525PKINTE AVAILABLE PRIOR TO JANUARY 1962

ENTRY AND EXIT INSERTER FOR THE INTERPRETIVE ROUTINE-- PK INTD.
FACILITATES AFTER-THOUGHT DOUBLE-PRECISIONALIZATION BY PROVIDING AUTOMATIC ENTRIES TO AND EXITS FROM PK INTD AS SPECIFIED BY A CONTROL CARD. MUST BE CO-ASSEMBLED WITH PK INTD. PART OF INTERPRETIVE PACKAGE PK INDP. REQUIRES 98 STORAGE CELLS. TIMING IS APPROXIMATELY 172.3MS. DEPENDING ON NUMBER OF SETS OF INFORMATION ON CONTROL CARD.

0704 525PKLAQ1 AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT NUMERICAL INTEGRATION SUBROUTINE
15-POINT LAGUERRE-GAUSS QUADRATURE INTEGRATION SUBROUTINE
A SHARE TYPE SUBROUTINE FOR EVALUATION OF F/X/ FOR 15 VALUES FOR X IN THE INTERVAL OF INTEGRATION MUST BE PROVIDED. EXCEPT FOR ERRORS DUE TO ROUND-OFF AND F/X/ EVALUATION, RESULT IS EXACT IF F/X/ IS EXPRESSIBLE AS A POLYNOMIAL OF DEGREE 29 OR LESS. 67 CELLS AND F/X/ SUBROUTINE.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 525PKLEQ1 AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT NUMERICAL INTEGRATION SUBROUTINE
16-POINT LEGENDRE-GAUSS QUADRATURE INTEGRATION SUBROUTINE
A SHARE TYPE SUBROUTINE FOR EVALUATION OF F/X/ FOR 16 VALUES OF X IN THE INTERVAL OF INTEGRATION MUST BE PROVIDED. EXCEPT FOR ERRORS DUE TO ROUND-OFF AND F/X/ EVALUATION, RESULT IS EXACT IF F/X/ IS EXPRESSIBLE AS A POLYNOMIAL OF DEGREE NOT GREATER THAN 31. 79 CELLS AND F/X/ SUBROUTINE.

0704 525PKLGAM AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT SUBROUTINE FOR NATURAL LOGARITHM FOR-- THE GAMMA FUNCTION.
REQUIRES NATURAL LOGARITHM SUBROUTINE /LN/ WITH SHARE STANDARD INPUT-OUTPUT, /1,4/ ERROR RETURN AND /2,4/ NORMAL RETURN EXCEPT FOR ROUND-OFF AND ERRORS DUE TO F/X/ EVALUATION, RESULT IS ACCURATE TO WITHIN TWO UNITS IN EIGHTH SIGNIFICANT DECIMAL DIGIT FOR ARGUMENT GREATER THAN 2. 48 CELLS AND LN ROUTINE.

0704 525PKNIDE AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT ORDINARY DIFFERENTIAL EQUATIONS SYSTEM
SOLVES A SYSTEM OF ORDINARY DIFFERENTIAL EQUATIONS OF ANY NUMBER, ANY ORDER , LINEAR OR NON-LINEAR. THE SYSTEM IS RESTRICTED TO ONE INDEPENDENT VARIABLE . BOUNDARY CONDITIONS ARE GIVEN IN TERMS OF INITIAL CONDITIONS. REQUIRES PK CBRT OR EQUIVALENT FLOATING-POINT CUBE ROOT SUBROUTINE. 300CELLS.

0704 525PKNID2 AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT ORDINARY DIFFERENTIAL EQUATIONS SYSTEM
SOLVES A SYSTEM OF ORDINARY DIFFERENTIAL EQUATIONS OF ANY NUMBER, ANY ORDER, LINEAR OR NON-LINEAR. THE SYSTEM IS RESTRICTED TO ONE INDEPENDENT VARIABLE. BOUNDARY CONDITIONS ARE GIVEN IN TERMS OF INITIAL CONDITIONS. NUMERICAL INTEGRATION BY ADAM,S FORMULAS. 576 CELLS.

0704 525PKNOOT AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT NTH ROOT SUBROUTINE
EVALUATES NTH ROOT OF A POSITIVE FLOATING POINT NUMBER WHERE N IS A POSITIVE OR NEGATIVE INTEGER. ACCURATE TO 7 DECIMAL PLACES. NEWTON-RAPHSON METHOD. MINIMUM TIME 3.2 MS. 70 CELLS AND 10 COMMON. OBSOLETE-DIST. 631

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 525PKSQRD AVAILABLE PRIOR TO JANUARY 1962

FLOATING-POINT DOUBLE-PRECISION SQUARE ROOT
COMPUTES THE SQUARE ROOT OF A DOUBLE-PRECISION FLOATING-POINT NUMBER. NORMAL TSX SEQUENCE. ERROR RETURN FOR NEGATIVE ARGUMENT WITH SQUARE ROOT OF THE ABSOLUTE VALUE IN AC-MQ. 52 BIT ACCURACY. REQUIRES 42 STORAGE CELLS PLUS 5 COMMON. TIMING 2.736 MS.

0704 526TVTSDA AVAILABLE PRIOR TO JANUARY 1962

TIME SERIES DECOMPOSITION AND ADJUSTMENT
FORTRAN PROGRAM TO ADJUST SEASONAL AND IRREGULAR TIME SERIES TO A FORM THAT SHOWS PRIMARILY THE TREND-CYCLICAL MOVEMENTS. SEASONAL FACTORS, IRREGULAR FLUCTUATIONS AND MANY SUMMARY MEASURES USEFUL IN TIME SERIES ANALYSIS ARE COMPUTED IN THE PROCESS. USES 16K DRUMLESS MACHINE.

0704 528BSWOT AVAILABLE PRIOR TO JANUARY 1962

BCD OUTPUT PROGRAM
WRITES A BCD RECORD ON TAPE AND/OR PRINTS IT ON THE ON-LINE PRINTER, AS DETERMINED BY SENSE SWITCHES. REQUIRES 75 CELLS PLUS 25 COMMON.

0704 529BSOUT2 AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION FLOATING POINT PRINT SUBROUTINE
CONVERTS AND PRINTS A BLOCK OF DOUBLE PRECISION FLOATING POINT NUMBERS AND/OR INTEGERS. DOUBLE PRECISION NUMBERS OCCUPY 3 CONSECUTIVE CORE LOCATIONS. THE FORM OF OUTPUT IS VARIABLE UNDER CONTROL OF A FORMAT. MODIFICATION FOR OTHER CONVERSIONS IS POSSIBLE. USES BS WOT OR UA SPH1. REQUIRES 353 STORAGE PLUS 56 COMMON.

0704 530CSHNK2 AVAILABLE PRIOR TO JANUARY 1962

HANKEL FUNCTION ROUTINE
COMPUTES THE HANKEL FUNCTION HSUBN/X/ FOR ALL INTEGER ORDERS FROM 0 TO N FOR POSITIVE X. REQUIRES CSBSL2 AND ANY LN AND EXP ROUTINES WITH ERROR RETURN. ACCURACY IS QUESTIONABLE FOR X GREATER THAN 15. SUPERSEDES CS HAKL DIST. 406.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 533CF0091 AVAILABLE PRIOR TO JANUARY 1962

THREE DIMENSIONAL LEAST SQUARES PROCEDURE.
COMPUTES THE COEFFICIENTS OF AN EQUATION EXPRESSING A DEPENDENT VARIABLE Y AS A FUNCTION OF TWO INDEPENDENT VARIABLES, X AND Z, STAND. DEV. OF Y, UNCERTAINTIES IN COEFFICIENTS, THE DEGREE OF FREEDOM IN DATA, THE NUMBER OF TERMS IN THE EQUATION, THE EXPONENTS OF X, AND THE EXPONENTS OF Z. THE DATA IS TESTED ACCORDING TO OPTIONS PROVIDED FOR IN THE INPUT AND WILD POINTS ARE REJECTED. UA EXP1, CL TAN1, UA INV1, UA ARTN, UA LN1, & UA SQRT1 ARE REQUIRED. 6970 STORAGES PLUS 2 COMMON.

0704 538NOASDP AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION ARCSIN/ARCCOS SUBROUTINE.
TO COMPUTE A DOUBLE PRECISION FLOATING POINT ARC SINE OR ARC COSINE, IN RADIANS, FROM A DOUBLE PRECISION FLOATING POINT ARGUMENT. REQUIRES 233 STORAGE CELLS PLUS COMMON THROUGH COMMON&20.

0704 539GLGAU2 AVAILABLE PRIOR TO JANUARY 1962

FORTRAN 2 INTEGRATION SUBROUTINE.
GAUSS QUADRATURE /10 POINT/ METHOD. THIS IS A MODIFICATION OF SAP SUBROUTINE GL GAUS. THE SUBROUTINE DIVIDES THE INTERVAL /A,B/ INTO N EQUAL INTERVALS AND BY THE PROPER TRANSFORMATION EACH INTERVAL IS INTEGRATED OVER THE INTERVAL /0,1/.CORR.1210

0704 540SCCAM AVAILABLE PRIOR TO JANUARY 1962

ONE CARD TAPE COPO ROUTINE
COPYING MODE IS BCD IF SS1 UP AND BINARY IF DOWN. MODE CAN BE CHANGED DURING RUNC

0704 543PFCAM AVAILABLE PRIOR TO JANUARY 1962

LINEAR SYSTEM SOLUTION IN DOUBLE-PRECISION USING--
CORE STORAGE ONLY.
MATRIX INVERSION IS ALSO PERFORMED. FLOATING POINT JORDAN ELIMINATION METHOD WITH SELECTION OF MAX. PIVOT. 414 STORAGE CELLS.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 546CA0051 AVAILABLE PRIOR TO JANUARY 1962

TRIPLE PRECISION COMPLEX ARITHMETIC PACKAGE
TRIPLE PRECISION COMPLEX ARITHMETIC PACKAGE PERFORMS BASIC ARITHMETIC OPERATIONS ON TRIPLE PRECISION FLOATING POINT COMPLEX NUMBERS. REAL AND IMAGINARY PARTS OF THE COMPLEX NUMBERS ARE REPRESENTED AS A SIGNED 70 BIT FRACTION AND A SIGNED 70 BIT EXPONENT. USES 122 CELLS PLUS 30 CELLS OF COMMON.

0704 547PFBES1 AVAILABLE PRIOR TO JANUARY 1962

MODIFIED NUBES1 PROGRAM FOR FORTRAN LIBRARY
APPLICATIONS OF A BESSEL FUNCTIONS SUBROUTINE
FORTRAN FUNCTION NAMES ARE BESJF,BESRF,BESYF,BESIF.

0704 548MUSFN4 AVAILABLE PRIOR TO JANUARY 1962

SIFON4 MURA 650 ON 704 SIMULATOR
SIMULATES AN IBM 650 WITH FLOATING POINT AND INDEXING ACCUMULATORS ON AN IBM 704 WITH 8192 WORDS OF CORE STORAGE. SIFON4 IS FROM 5 TO 10 TIMES SLOWER THAN AN OPTIMIZED 650.

0704 550CSDEV1 AVAILABLE PRIOR TO JANUARY 1962

RANDOM NORMAL DEVIATE SUBROUTINE.
COMPUTES A FLOATING POINT NUMBER FROM A NEARLY NORMAL DISTRIBUTION WITH A SPECIFIED STANDARD DEVIATION. USES THE CENTRAL LIMIT THEOREM. TIME IS .53&.40N MILLISECONDS WHERE N IS SPECIFIED IN THE CALLING SEQUENCE. N EQUAL TO 8 IS USUALLY SATISFACTORY.

0704 551CSDEV2 AVAILABLE PRIOR TO JANUARY 1962

RANDOM TABLE LOOKUP SUBROUTINE
PICKS AN ENTRY AT RANDOM FROM A GIVEN TABLE AND ASSIGNS A RANDOM SIGN TO IT. TIME IS .468 MILLISECONDS. TABLE EXTENT MUST BE A POWER OF TWO.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 556ERPLOT AVAILABLE PRIOR TO JANUARY 1962

POLAR POINT PLOT SUBROUTINE
TO REPRESENT NUMERICAL DATA BY GRAPHICAL METHODS. A 120 BCD CHARACTER HOLLERITH FORMAT IS SET UP FOR EACH LINE TO BE PLOTTED. IT CAN HANDLE UP TO SIX CURVES SIMULTANEOUSLY. OPTIONS ARE AVAILABLE FOR AUTOMATIC ORDERING AND SCALING OF THE DATA POINTS. CORR./ 696

0704 565CA0042 AVAILABLE PRIOR TO JANUARY 1962

ZEROS, EXTENDED RANGE POLYNOMIAL/ZERP/.
THIS SUBROUTINE DETERMINES THE ROOTS, REAL OR COMPLEX, OF A POLYNOMIAL OF DEGREE N WITH REAL COEFFICIENTS, USING EXTENDED RANGE ARITHMETIC. USES RAND EXTENDED RANGE PKG. AND CA EXTENDED RANGE COMPLEX PKG. TIMING APPROX. 5 SECS/ROOT. STORAGE, 660 CELLS & COMMON THRU COMMON & 25.

0704 565CA0049 AVAILABLE PRIOR TO JANUARY 1962

TRIPLE PRECISION EXPONENTIAL ROUTINE
THIS SUBROUTINE EVALUATES E TO THE X FOR X A TRIPLE PRECISION NUMBER. TIMING 149 MS/ANTILOG. SPACE REQUIRED 159 CELLS.

0704 565CA0053 AVAILABLE PRIOR TO JANUARY 1962

ZEROS,ARBITRARY FUNCTION/ZARF/
THIS SUBROUTINE DETERMINES A REAL OR COMPLEX ROOT OF AN ARBITRARY FUNCTION USING TRIPLE PRECISION ARITHMETIC. USES CA45 AND CA51. REQUIRES 451 CELLS PLUS COMMON THRU COMMON & 32.

0704 565CA0058 AVAILABLE PRIOR TO JANUARY 1962

TRIPLE PRECISION COMPLEX SQUARE ROOT
THIS SUBROUTINE OBTAINS THE SQUARE ROOT OF A TRIPLE PRECISION COMPLEX NUMBER. REQUIRES CA31 AND CA45. TIMING 150 MS/ROOT. STORAGE,73 CELLS & COMMON THRU COMMON & 32.

0704 568ELQRC2 AVAILABLE PRIOR TO JANUARY 1962

A MODIFIED NEWTON-RAPHSON POLYNOMIAL ROOT-FINDER--
WITH QUADRATIC ROOT CONVERGENCE.
THIS SUBROUTINE CALCULATES THE COMPLEX ROOTS OF POLYNOMIALS HAVING REAL COEFFICIENTS, INCLUDING ANY MULTIPLE ROOTS, WITH SINGLE PRECISION ACCURACY. ELQRC1 SHOULD BE REPLACED BY THIS IMPROVED SUBROUTINE.

0704 5700RSRT1 AVAILABLE PRIOR TO JANUARY 1962

SORT, ALGEBRAIC. KEY AND ITEM LENGTH - 1 WORD. OPEN.
NO. ITEMS MUST BE POWER OF 2. WKG STG-2*/NO. ITEMS/
REASONABLY FAST OPEN SUBROUTINE REQUIRING 49 CELLS.

0704 5700RSRT2 AVAILABLE PRIOR TO JANUARY 1962

SORT, ALGEBRAIC. KEY AND ITEM LENGTH - 1 WORD. CLOSED.
LENGTH OF STRING TO BE SORTED MUST BE A POWER OF 2. REQUIRES
STORAGE TWICE LENGTH OF STRING. REASONABLY FAST. 60 CELLS.

0704 5700RSRT3 AVAILABLE PRIOR TO JANUARY 1962

SORT, ALGEBRAIC. MULTIWORD KEYS. /WHOLE WORD KEYS ONLY/
NO. ITEMS A POWER OF 2. 1 WORD CLUES /WHICH GIVE LOC.OF KEYS/
ARE ORDERED TO MATCH SORTED KEYS. ONLY CLUES MOVED. WORDS OF
KEY MUST BE ADJACENT CELLS. WKG STG-2*/NO.CLUES/. 90 CELLS.

0704 572PFCCBC AVAILABLE PRIOR TO JANUARY 1962

ABSOLUTE AND CORRECTION CARD LOADER
ONE CARD LOADER OF ABSOLUTE BINARY AND CORRECTION CARDS.

0704 573CF0013 AVAILABLE PRIOR TO JANUARY 1962

GENERALIZED,PACKAGED,ON-LINE INPUT-OUTPUT SUBROUTINE
LOADS DECIMAL DATA FROM VARIABLE FIELD CARDS DIRECTLY INTO
CORE STORAGE WITH AUTOMATIC CONVERSION. CONVERSION MAY BE
FIXED-TO-FIXED,FIXED-TO-FLOATING,OR FLOATING-TO-FLOATING.
ALSO LOADS AND/OR PRINTS CARD IMAGES. PRINTS DECIMAL DATA IN
VARIABLE FORMAT FORM DIRECTLY FROM CORE STORAGE WITH AUTO-
MATIC CONVERSION. CONVERSION MAY BE FIXED-TO-FIXED,FLOATING-
TO-FIXED, OR FLOATING TO FLOATING. PAGE IDENTIFICATION IS
HANDLED AUTOMATICALLY AND COLUMN HEADINGS ARE OPTIONALLY
AUTOMATIC. REQUIRES 1180 CELLS & 295 COMMON.

0704 573CF0095 AVAILABLE PRIOR TO JANUARY 1962

SYMMETRIC MATRIX INVERSIONC
INVERSION OF NON-SINGULAR SYMMETRIC MATRICES OF ORDER EQUAL
TO OR LESS THAN 225. SELECTS MATRIX FROM DECIMAL CARDS AND
INVERTS IT IN COREC 3 K CORE MEMORO IS REQUIRED.

0704 574CSTUKS AVAILABLE PRIOR TO JANUARY 1962

WAVE RECORD ANALYSIS OF TWO SIMULTANEOUS RECORDS OF A--
SINGLE TIME SERIES. FOR SINGLE RECORDS THE AUTOCORRELATION,
SPECTRUM AND LOG SPECTRUM ARE COMPUTED. FOR TWO SIMULTANEOUS
RECORDS TWO CROSSCORRELATIONS, IN-PHASE CO-SPECTRUM, OUT-OF-
PHASE QUA-SPECTRUM, COHERENCE BETWEEN RECORDS, PHASE LAG OF
ONE RECORD WITH THE OTHER, BEAM WIDTH, AND DIRECTION FROM
WHICH THE WAVES ARRIVED ARE ALSO COMPUTED. OPTIONAL ALIASING
AND/OR INSTRUMENT CORRECTION. UNLIMITED SIZE OF TIME SERIES
RECORD. THE MAX. NO. OF PTS. ON THE FREQ. SCALE IS DEPENDENT
ON CORE SIZE/510 FOR 8192 CORE/.TUKEY METHOD CORR.618,627,757

0704 575GIFILE AVAILABLE PRIOR TO JANUARY 1962

END OF FILE FUNCTION
TO ACCOMPLISH A TRANSFER TO ANY DESIRED STATEMENT WITHIN A
FORTRAN PROGRAM WHENEVER AN END OF FILE IS ENCOUNTERED WHILE
READING A BINARY TAPE. REQUIRES 192 CELLS, NO COMMON.

0704 575GIGOTO AVAILABLE PRIOR TO JANUARY 1962

EXTENDED TRANSFER FUNCTION
TO ACCOMPLISH A TRANSFER FROM A FORTRAN PROGRAM TO A SHARE,
OR OTHER, PROGRAM EVEN WHEN THE FORTRAN OBJECT PROGRAM USES
AN INDEX REGISTER TO COMPUTE THE EFFECTIVE ADDRESS OF THE
TRANSFER. ROUTINE REQUIRES 25 CELLS, NO COMMON.

0704 575GITRAN AVAILABLE PRIOR TO JANUARY 1962

TRANSFER FUNCTION
TO ACCOMPLISH A TRANSFER FROM A FORTRAN PROGRAM TO A SHARE,
OR OTHER, PROGRAM AND RETURN IF DESIRED. ROUTINE REQUIRES 15
LOCATIONS, NO COMMON.

0704 577RWAC2F AVAILABLE PRIOR TO JANUARY 1962

AUTO- AND CROSS-CORRELATION FUNCTION GENERATOR,FLOATING
TO COMPUTE ONE POINT OF EITHER THE AUTO- OR CROSS-CORRELATION
FUNCTION, GIVEN A SET OF TIME-SERIES DATA FOR EQUALLY-SPACED
POINTS. 29 LOC. & 6 ERASABLE.

0704 577RWDPN2 AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION INPUT.
READS 16 DIGIT DECIMAL FLOATING POINT NUMBERS WITH CORRESPON-
DING DECIMAL SCALES AND CONVERT TO DOUBLE PRECISION FLOATING
POINT NUMBERS. INPUT CARD IS COMPOSED OF 4 FIELDS, 18 COLUMNS
TO A FIELD, OF WHICH THE FIRST 16 COLUMNS CONTAIN THE FRACTI-
ONAL PART AND THE LAST 2 COLUMNS SPECIFY THE CORRESPONDING
DECIMAL SCALE. SIGNS ARE OVERPUNCHED OVER THE FIRST DIGIT OF
THE NUMBER TO WHICH IT REFERS. CORR./578

0704 577RWDPT2 AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION OUTPUT.
OUTPUTS 6 TO 16 DIGIT DOUBLE PRECISION FLOATING POINT NUMBERS
WITH DECIMAL SCALES AND IF DESIRED, BCD WORDS. NUMBERS AND
CHARACTERS ARE POSITIONED IN A LINE OF OUTPUT AS SPECIFIED IN
THE CALLING SEQUENCE UNDER PRINT WHEEL CONTROL. DECIMAL
POINTS ARE TAKEN TO BE IMMEDIATELY TO THE LEFT OF THE LEFT-
MOST DIGIT, BUT NOT PRINTED. THE EXP. OF THE RADIX IS PRINTED
TO THE RIGHT AND APPEARS AS A 2 DIGIT INTEGER. THE FRACTIONAL
PART WILL BE NORMALIZED AND ROUNDED. CORR./578

0704 577RWPS2F AVAILABLE PRIOR TO JANUARY 1962

POWER SPECTRAL DENSITY FUNCTION, FLOATING
TO COMPUTE THE POWER SPECTRAL DENSITY FUNCTION, GIVEN
ESTIMATES OF THE AUTOCORRELATION FUNCTION FOR EQUALLY
SPACED POINTS. 180 LOC.&7 ERASABLE.

0704 577RWSC5F AVAILABLE PRIOR TO JANUARY 1962

SINE AND COSINE, FLOATING
COMPUTES SINE AND COSINE OF THE THETA&N/DELTA THETA/, WHERE
THETA AND DELTA THETA ARE GIVEN IN RADIANS IN FLOATING
POINT. TIMING 12.22MS 1ST ENTRY. 1.25MS THEREAFTER. 72
LOC.&4 ERASABLE. INCLUDES SN2F /SINE-COSINE/ SUBROUTINE.

0704 578RWND2F AVAILABLE PRIOR TO JANUARY 1962

NORMALLY DISTRIBUTED PSEUDO-RANDOM NUMBERS.
EACH ENTRANCE PRODUCES THE NEXT NUMBER /IN FLOATING PT/ IN A
RANDOM SEQUENCE OF PSEUDO-NORMALLY DISTRIBUTED NUMBERS WITH
ZERO MEAN AND UNIT STANDARD DEVIATION. REQUIRES 39 CELLS AND
3.420 MILLISECONDS.

0704 578RWND2X AVAILABLE PRIOR TO JANUARY 1962

NORMALLY DISTRIBUTED PSEUDO-RANDOM NUMBERS.
EACH ENTRANCE PRODUCES THE NEXT NUMBER /IN FIXED POINT/
IN A RANDOM SEQUENCE OF PSEUDO-NORMALLY DISTRIBUTED
NUMBERS WITH ZERO MEAN AND UNIT STANDARD DEVIATION.
REQUIRES 22 CELLS AND 2.976 MILLISECONDS.

0704 583BEL1D AVAILABLE PRIOR TO JANUARY 1962

INTERPRETER FOR 650 DOUBLE PRECISION PROGRAMS.
ACCEPTS AND PRODUCES THE SAME INFORMATION /AFTER TAPE-CARD/
AS THE LI OR THE BELL INTERPRETIVE DOUBLE PRECISION ROUTINE
/L1DP/ WRITTEN FOR THE IBM 650. PROVIDES ON THE AVERAGE
A 60-TO-1 SPEED INCREASE OVER THE 650 OPERATION. CORR./655

0704 585CA0061 AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION INPUT CONVERSION.
CONVERTS BCD IMAGES OF FLOATING DECIMAL NUMBERS TO DOUBLE
PRECISION FLOATING BINARY FORM. EACH BCD NUMBER REQUIRES 5
LOCATIONS AND IS EXPRESSED AS A SIGNED 16 DIGIT FRACTION AND
SIGNED 2 DIGIT EXPONENTC RE-UIRES 284 CELLS PLUS 16 COMMON.

0704 587NORTD AVAILABLE PRIOR TO JANUARY 1962

READ TAPE DATA.
TO EXTRACT AND STORE IN MEMORY ONLY THOSE WORDS FROM AN ITEM,
OR ITEMS ON TAPE SPECIFIED IN THE CALL SEQUENCE FOR AS MANY
RECORDS AS DESIRED. WILL BYPASS THOSE WORDS ON THE INPUT
TAPE NOT NEEDED BY THE PROGRAM. FOR EXAMPLE, TO EXTRACT
FROM A PERSONNEL MASTER FILE THE DATA NECESSARY TO RUN A
PAYROLL. USES 93 WORDS OF STORAGE AND 1 WORD OF COMMON.

0704 592NUMLEV AVAILABLE PRIOR TO JANUARY 1962

FORTRAN 2 EIGENVALUE-EIGENVECTOR SUBPROGRAM.
THIS PROGRAM IS A REVISION OF NU-MLEV FOR USE WITH FORTRAN 2.
IT COMPUTES THE EIGENVALUES AND VECTORS OF A REAL SYMMETRIC
MATRIX BY THE GIVENS METHOD. CORR./780

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 593GITRAP AVAILABLE PRIOR TO JANUARY 1962

TRAP TRACE, GI TRAP.
CONVERTS TO OCTAL AND WRITES CONTENTS OF ACCUMULATOR, MQ, QP BITS, INDEX REGISTERS, LOCATION, AND INSTRUCTION FOR EVERY EXECUTABLE TRANSFER WHILE IN TRAPPING MODE. REQUIRES 94 LOCATIONS PLUS 22 WORKING STORAGE. TIMING IS 21.25 MS PER TRANSFER.

0704 595ERSNAP AVAILABLE PRIOR TO JANUARY 1962

FORTRAN SNAP SHOT ROUTINE.
TO TAKE SNAP SHOTS AT THE PREDETEMINEND PLACES IN A FORTRAN PROGRAM.

0704 598WH0054 AVAILABLE PRIOR TO JANUARY 1962

704 ARCTAN A/B
COMPUTES FLOATING ARCTAN OF QUOTIENT OF 2 FLOATING POINT NUMBERS WITH PROPER QUADRANT ALLOCATION IN RANGE -PI TO PI. REQUIRES ARCTANGENT SUBROUTINE. USES 36 STORAGE CELLS &1 COMMON. SUPERSEDES W&03T DISTC 057.

0704 601WHSMT AVAILABLE PRIOR TO JANUARY 1962

704 SELECTIVE MONITOR TRACE.
PROVIDES DETAILED TRACE OF EVERY INSTRUCTION,/2/ TRAP TRACE OF TRANSFER INSTRUCTIONS, /3/ TRACE OF STORE INSTRUCTIONS ONLY, OR /4/ ANY COMBINATION OF THESE MODES - UNDER CARD CONTROL WITH SENSE SWITCH OPTION TO PRINT. USER MAY ELECT TO HAVE I/O SELECT INSTRUCTIONS CAUSE EXIT FROM TRACING MODE, OR TO CONTINUE TRACING WITH I/O OPS INEFFECTIVE. AC AND MQ CONTENTS PRINTED IN OCTAL AND FLOATING DECIMAL. REDUNDANT INFO SUPPRESSED. ON-LINE PRINT ONLY - WITH SPECIAL PRINTER BOARD. 1040& STORAGE CELLS, RELOCATABLE.

0704 603WH0055 AVAILABLE PRIOR TO JANUARY 1962

ARCTAN A/B, FORTRAN II VERSIONTSAP CODED.
FUNCTION SUBROUTINE FOR FORTRAN II LIBRARY. COMPUTES FL.POINT ARTNF/A,B/ IN RANGE -PI TO &PI. USES IBATN1. REQUIRES 117 STORAGE CELLS &3 C-MM-NC

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 614NUUDP1 AVAILABLE PRIOR TO JANUARY 1962

UNNORMALIZED DOUBLE-PRECISION ARITHMETIC PACKAGE 1.
PERFORMS BASIC ARITHMETIC OPERATIONS WITH ACCURACY INDICATION ON DOUBLE-PRECISION FLOATING POINT NUMBERS. THE ACCURACY IS CARRIED BY ALLOWING ZEROS TO ACCUMULATE IN THE FRACTIONAL PART, I.E. IF THERE ARE N LEADING BINARY ZEROS IN THE FRACTIONAL PART, ONLY THE REMAINING /54-N/ BITS CAN REASONABLY BE EXPECTED TO BE ACCURATE. IN ORDER TO PERFORM THE OPERATION M, THE INSTRUCTION, TSX UDP1&M,4, MUST BE GIVEN. MAXIMUM ACCURACY IS 54 BITS. USES 364 STORAGE CELLS & 10 COMMON.

0704 614NUUDP2 AVAILABLE PRIOR TO JANUARY 1962

UNNORMALIZED DOUBLE-PRECISION ARITHMETIC PACKAGE 2.
THIS CODE IS A MODIFICATION OF UDP1. IT HAS BEEN MADE TO MIMIC CA 001 IN ALL ESSENTIALS EXCEPT THAT IT CARRIES AN ACCURACY INDICATION. IT MAY BE USED IN PLACE OF CA 001 AS A TEST ON THE ACCURACY OF THE NUMBERS COMPUTED WITH CA 001. USES 341 STORAGE CELLS & 8 COMMON.

0704 617CA021A AVAILABLE PRIOR TO JANUARY 1962

LEAST SQUARES POLYNOMIAL APPROXIMATION.
DOUBLE PRECISION LEAST SQUARES POLYNOMIAL APPROXIMATION Y EQUALS F/X/ OF DEGREE M THE SOLUTION OF N SETS OF POINTS TO SPECIFIED DEGREE M TO BE THE BEST POSSIBLE FIT TO ALL THE POINTS IN THE LEAST SQUARES SENSE. REQUIRES 644 CELLS PLUS 8 COMMON.

0704 620CF0096 AVAILABLE PRIOR TO JANUARY 1962

GENERALIZED,PACKAGED,OFF-LINE INPUT-OUTPUT SUBROUTINE
ACCEPTS VARIABLE FIELD INPUT DATA FROM A BCD TAPE. CONVERTS FIXED-TO-FIXED,FIXED-TO-FLOATING,OR FLOATING-TO-FLOATING. VARIABLE FORMAT OUTPUT MAY BE ON-LINE OR OFF-LINE. CONVERTS FIXED-TO-FIXED,FLOATING-TO-FIXED,FLOATING-TO-FLOATING, BCD-TO-BCD,OR OCTAL-TO-OCTAL. PRINTS PAGE IDENTIFICATION AND HEADINGS WITH AUTOMATIC PAGE OVERFLOW.
REQUIRES 1033 CELLS & 181 COMMON.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 604TVSPRA AVAILABLE PRIOR TO JANUARY 1962

SIMULATED PLANT RECORD AUXILIARY.
TO WRITE IOWA TABLES ON BINARY TAPE.
UNKNOWN CONTINOUS DISTRIBUTIONS THIS PROGRAM

0704 609CA0034 AVAILABLE PRIOR TO JANUARY 1962

EXTENDED RANGE COMPLEX ARITHMETIC PACKAGE
PACKAGE CONTAINS SUBROUTINES TO ADDT SUB, MPY, DIV, AND TAKE SQRT OF EXTENDED RANGE COMPLEX NRS. ALSO MULTIPLIES AND DIVIDES EXT RANGE COMPLEX NRS BO EXT RANGE REAL NRS. EXT 230 CELLS & 8 COMMON.

0704 610RWDE2G AVAILABLE PRIOR TO JANUARY 1962

DBL. PREC. FLOATING PT. RUNGE-KUTTA INTEGRATION OF-- SECOND ORDER EQUATIONS. DOUBLE PRECISION VERSION OF RWDE2F. INTEGRATES A SYSTEM OF N SIMULTANEOUS, FIRST ORDER, ORDINARY DIFFERENTIAL EQUATIONS. REQUIRES 12N & 5 CELLS FOR DATA AND 255 WORDS FOR PROGRAM.

0704 610RWDE3G AVAILABLE PRIOR TO JANUARY 1962

DBL. PREC. FLOATING PT. MILNE, RUNGE-KUTTA INTEGRATION- OF SECOND ORDER EQUATIONS. DOUBLE PRECISION VERSION OF RWDE3F. INTEGRATES A SYSTEM OF N SIMULTANEOUS SECOND ORDER, ORDINARY DIFFERENTIAL EQUATIONS WITH MISSING FIRST DERIVATIVES. OPTION OF USING EITHER 4TH ORDER RUNGE-KUTTA METHOD OR 5TH ORDER MILNE METHOD IS PROVIDED. ALSO OPTION OF AUTOMATIC ERROR CONTROL WITH VARIABLE STEP-SIZE IS PROVIDED. REQUIRES 26N & 5 CELLS FOR DATA AND 856 WORDS FOR PROGRAM.

0704 611AVPOLI AVAILABLE PRIOR TO JANUARY 1962

POLYNOMIAL EXPANSION SUBROUTINE.
COMPUTES THE POLYNOMIAL RESULTING FROM THE MULTIPLICATION OF ANY NUMBER OF POLYNOMIALS OF VARYING DEGREES. REQUIRES 108 WORDS OF STORAGE

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 623ELRCL1 AVAILABLE PRIOR TO JANUARY 1962

ABSOLUTE AND RELOCATABLE OCTAL LOADER.
LOADS ABSOLUTE AND RELOCATABLE OCTAL CORRECTION CARDS. MODIFIES THE FORTRAN II BSS LOADER.

0704 624RWDL2F AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT DEFINITE INTEGRAL EVALUATION
TO EVALUATE A DEFINITE INTEGRAL GIVEN THE TABULAR FUNCTION Y/X/. SINGLE PRECISION FLOATING POINT ARITHMETIC IS USED.

0704 630WBHEX AVAILABLE PRIOR TO JANUARY 1962

HASTY EXPONENTIAL, FLOATING POINT
COMPUTES E TO THE MINUS ABSOLUTE X TO FOUR SIGNIFICANT DIGITS IN APPROXIMATELY .95 MILLISECONDS IF X IS LESS THAN 88.028 IN MAGNITUDE, RETURNS WITH ZERO IN .120 MILLISECONDS OTHERWISE. RETURN IS 1,4. 20 INSTRUCTIONS PLUS 67 CONSTANTS FOR A TOTAL OF 87 LOCATIONS PLUS 2 ERASABLES DEFINED AS COMMON AND COMMON&1.

0704 634TVFNSH AVAILABLE PRIOR TO JANUARY 1962

FORTRAN-TO-SHARE
TO CREATE SHARE SYMBOLIC PROGRAM FROM TAPE 2 OUTPUT OF FORTRAN I COMPILATION

0704 635RWDET AVAILABLE PRIOR TO JANUARY 1962

DETERMINANT EVALUATOR FORTRAN SUBROUTINE.
THIS FORTRAN SUBPROGRAM EVALUATES THE DETERMINANT OF A MATRIX A-ALPHA TIMES I WHERE A IS OF DIMENSION N TIMES N AND ALPHA IS A SCALAR. IT HAS A DIMENSION STATEMENT A/50,50/ WHICH CAN BE CHANGED ACCORDING TO NEEDS OF THE PROGRAMMER. INPUT MATRIX A IS DESTROYED IN COMPUTATION. 237 CELLS EXCLUDING ARRAY A ARE REQUIRED.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 635RWDETN AVAILABLE PRIOR TO JANUARY 1962

DETERMINANT EVALUATOR FOR NEARLY TRIANGULAR MATRICES
THIS FORTRAN SUBPROGRAM EVALUATES THE DETERMINANT OF A MATRIX A-ALPHA TIMES I WHERE A IS A NEARLY TRIANGULAR MATRIX OF DIMENSION N TIMES N AND ALPHA IS A SCALAR. IT HAS A DIMENSION STATEMENT OF A/50,50/ AND B/50/ WHICH CAN BE CHANGED ACCORDING TO NEEDS OF THE PROGRAMMER. INPUT MATRIX A IS NOT DESTROYED BY THE PROGRAM. 216 CELLS EXCLUDING ARRAYS A AND B ARE REQUIRED.

0704 635RWEIGN AVAILABLE PRIOR TO JANUARY 1962

REAL EIGENVALUES OF REAL MATRICES
THIS FORTRAN SUBPROGRAM DETERMINES THE N REAL EIGENVALUES OF A REAL MATRIX A. IT HAS A DIMENSION STATEMENT OF A/50,50/, B/50/ AND C/50/ AND USES THE COMMON REGION INPUT MATRIX A IS DESTROYED BY THE COMPUTATION. THE PROGRAM REQUIRES 3 SUBSIDIARY SUBROUTINES IN ADDITION TO THE PROGRAMS WHICH WRITE OUTPUT ON TAPE. THE PROGRAM DECK FOR EIGN ALREADY INCLUDES THE 3 SUBSIDIARIES. CORR./684

0704 635RWGLSQ AVAILABLE PRIOR TO JANUARY 1962

GENERAL LEAST SQUARES FORTRAN SUBPROGRAM.
GIVES THE LEAST SQUARES SOLUTION TO A SYSTEM OF OVER-DETERMINED LINEAR EQUATIONS BX EQUALS C WHERE B IS AN N TIMES M MATRIX WITH N GREATER THAN, OR EQUAL TO M AND C A COLUMN VECTOR OF DIMENSION N. IT HAS A DIMENSION STATEMENT A/50,25/ X/25/ AND IL/25/ WHICH CAN BE CHANGED TO NEEDS OF THE PROGRAMMER. INPUT DATA IS DESTROYED DURING COMPUTATION. REQUIRES 341 CELLS EXCLUDING ARRAYS A, X AND IL AND THE SQUARE ROOT ROUTINE.

0704 635RWGRT AVAILABLE PRIOR TO JANUARY 1962

GENERAL ROOT FINDER FORTRAN SUBROUTINE
THIS FORTRAN SUBPROGRAM FINDS THE REAL ZEROS OF ANY ANALYTIC FUNCTION F/X/. IT HAS A DIMENSION STATEMENT C/50/ WHICH CAN BE CHANGED TO SUIT NEEDS OF THE PROGRAMMER. REQUIRES 453 CELLS EXCLUDING THE ARRAY C, THE OUTPUT SUBROUTINES, THE SQUARE ROOT ROUTINE AND THE AUXILIARY PROGRAM.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 635RWMATS AVAILABLE PRIOR TO JANUARY 1962

LINEAR MATRIX EQUATION SOLVER
THIS FORTRAN SUBPROGRAM FINDS THE SOLUTION X OF A LINEAR MATRIX EQUATION BX EQUALS C WHERE THE MATRIX B IS OF ORDER N TIMES N AND THE MATRIX C IS OF ORDER N TIMES M. IF C IS THE IDENTITY MATRIX THEN X EQUALS INVERSE OF B. IT HAS A DIMENSION STATEMENT A/50,50/ AND X/25,25/ WHICH CAN BE CHANGED ACCORDING TO NEEDS OF THE PROGRAMMER. INPUT DATA IS DESTROYED DURING COMPUTATION. 418 CELLS EXCLUDING ARRAYS A AND X ARE REQUIRED.

0704 635RWNTRI AVAILABLE PRIOR TO JANUARY 1962

NEARLY TRIANGULARIZATION OF A MATRIX SUBROUTINE
THIS FORTRAN SUBPROGRAM TRANSFORMS A REAL MATRIX A INTO A NEARLY TRIANGULAR /1-SUB TRIANGULAR/ MATRIX M BY SIMILARITY TRANSFORMATIONS. IT HAS A DIMENSION STATEMENT OF A/50,50/ AND B/50/ WHICH CAN BE CHANGED ACCORDING TO THE NEEDS OF THE PROGRAMMER. THE INPUT MATRIX A IS DESTROYED DURING COMPUTATION. 339 CELLS REQUIRED EXCLUDING ARRAYS A AND B.

0704 635RWVCTR AVAILABLE PRIOR TO JANUARY 1962

EIGENVECTOR DETERMINATOR SUBROUTINE
GIVEN A REAL EIGENVALUE ALPHA OF A MATRIX A OF ORDER N TIMES N, THIS FORTRAN SUBPROGRAM DETERMINES THE CORRESPONDING REAL EIGENVECTOR V. IT HAS A DIMENSION STATEMENT A/50,50/ AND V/50/ WHICH CAN BE CHANGED ACCORDING TO NEEDS OF THE PROGRAMMER. THE INPUT MATRIX A IS DESTROYED IN COMPUTATION. 345 CELLS REQUIRED EXCLUDING ARRAYS A AND V. CORR/ 816

0704 636RWBF2F AVAILABLE PRIOR TO JANUARY 1962

BESSEL FUNCTIONS OF ORDER ZERO.
COMPUTES J ZERO AND Y ZERO OF X FROM ASYMPTOTIC FORMULAS. REQUIRES 232 CELLS PLUS 10 COMMON. SIN, SQUARE ROOT AND LOG ROUTINES INCLUDED

0704 636RWBF3F AVAILABLE PRIOR TO JANUARY 1962

BESSEL FUNCTIONS OF ORDER ONE.
COMPUTES J ONE AND Y ONE OF X FROM ASYMPTOTIC FORMULAS. REQUIRES 235 CELLS PLUS 10 COMMON. SIN, SQUARE ROOT AND LOG ROUTINES INCLUDED.

0704 636RWCF2F AVAILABLE PRIOR TO JANUARY 1962

LEAST SQUARES CURVE-FITTING ROUTINE USING ORTHOGONAL POLYNOMIALS. STATISTICAL VALUES INDICATING RELIABILITY OF THE DERIVATIVES ARE PROVIDED. WEIGHTS OTHER THAN ONE MAY BE OPTIONALLY PROVIDED. THE MINIMIZATION MAY BE OPTIONALLY CONSTRAINED TO FORCE UP TO SEVEN OF THE LOW-ORDER COEFFICIENTS TO VANISH. 388 CELLS PROGRAM STORAGE PLUS TEMPORARIES.

0704 637ANZ010 AVAILABLE PRIOR TO JANUARY 1962

FORTRAN II ON-LINE TO OFF-LINE OUTPUT MODIFYING SUBR.
FORTRAN II SUBPROGRAM TO MODIFY THE OBJECT PROGRAM RESULTING FROM PRINT STATEMENTS TO ONE EQUIVALENT IN EFFECT TO THAT RESULTING FROM WRITE OUTPUT TAPE I STATEMENTS. PROVISION IS MADE FOR RESTORING THE ORIGINAL PROGRAM IF SO DESIRED

0704 637ANZ011 AVAILABLE PRIOR TO JANUARY 1962

FORTRAN II OFF-LINE TO ON-LINE OUTPUT MODIFYING SUBR.
FORTRAN II SUBPROGRAM TO MODIFY THE OBJECT PROGRAM RESULTING FROM WRITE OUTPUT TAPE I STATEMENTS TO ONE EQUIVALENT IN EFFECT TO THAT RESULTING FROM PRINT STATEMENTS. PROVISION IS MADE FOR RESTORING THE ORIGINAL PROGRAM IF SO DESIRED

0704 637ANZ012 AVAILABLE PRIOR TO JANUARY 1962

FORTRAN II ON-LINE TO OFF-LINE INPUT MODIFYING SUBR.
FORTRAN II SUBPROGRAM TO MODIFY THE OBJECT PROGRAM RESULTING FROM READ STATEMENTS TO ONE EQUIVALENT IN EFFECT TO THAT RESULTING FROM READ INPUT TAPE I STATEMENTS. PROVISION IS MADE FOR RESTORING THE ORIGINAL PROGRAM IF SO DESIRED

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 641CSSQT1 AVAILABLE PRIOR TO JANUARY 1962

SQUARE ROOT, FLOATING POINT
FULL SINGLE PRECISION ACCURACY. TIMING 1.056 MILLISECONDS. SPACE, 39 CELLS PLUS 2 COMMON.

0704 647NPDFC1 AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION COMPLEX ARITHMETIC PACKAGE.
PROVIDES A DOUBLE PRECISION FLOATING POINT COMPLEX COMPUTING PACKAGE CONTAINING 30 BASIC ARITHMETIC AND LOGICAL COMMANDS ENABLING THE USER TO CODE IN SINGLE ADDRESS COMPLEX MODE. INSTRUCTIONS ARE OF THE SAME FORM AS THEIR 704 COMMAND EQUIVALENTS. EXTENT-679 LOCATIONS.

0704 647NPPMC2 AVAILABLE PRIOR TO JANUARY 1962

EIGENVALUE SOLUTION, REAL
TO FIND THE HIGHEST EIGENVALUE AND CORRESPONDING EIGENVECTORS OF THE MATRIX EQUATION /A/ /X SUB I/ - LAMDA SUB I /X SUB I/ WHERE /LAMDA SUB I/ IS AN EIGENVALUE AND /X SUB I/ IS THE ASSOCIATED EIGENVECTOR OF THE MATRIX /A/.

0704 647NPRWD2 AVAILABLE PRIOR TO JANUARY 1962

READ WRITE DRUM.
ROUTINE UTILIZES MULTIPLE RECORD FEATURE FOR OPTIMIZING THE TRANSFER OF THE CONTENTS OF UNIFORMLY DISTRIBUTED DRUM LOCATIONS INTO THE CONTENTS OF UNIFORMLY DISTRIBUTED CORE LOCATIONS OR VICE VERSA. ALL AFFECTED LOCATIONS ON DRUM AND IN CORE MUST BE EQUALLY SPACED, BUT THE SPECIFIC SPACING OF THE AFFECTED LOCATIONS ON THE DRUM NEED NOT BE THE SAME AS FOR THE CORE. EXTENT, 53 LOCATIONS, NO COMMON.

0704 648AVSEL1 AVAILABLE PRIOR TO JANUARY 1962

SELECTOR OF COMBINATIONS OF INPUT DATA.
ALL DATA CTIES. TO BE USED ARE STORED IN CORES, AND FROM THESE SEL1 FORMS IN AN ORDERED FASHION COMBS. OF INPUT DATA. THE SUBRTN. ASSIGNS A COMB. NO. TO EACH COMB. THE USER MAY DESIGNATE COMBS. HE WISHES SEL1 TO OMIT. AFTER SELECTING A COMB. OF INPUT DATA, SEL1 TRANSFERS CONTROL TO NORMAL RETURN WHERE DATA PROCESSING PROGRAM SHOULD BEGIN. AT THE END OF THE LATTER PROGRAM THE USER TRANSFERS BACK TO SUBRTN. WHICH SELECTS NEXT COMB. ETC. WHEN ALL COMBS. PROCESSED SEL1 WILL TRA TO FINAL RTN.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 649IBASN1 AVAILABLE PRIOR TO JANUARY 1962

A 6 DIGIT FLOATING POINT ARCSINE SUBROUTINE
INPUT..NORMALIZED FLOATING POINT ARGUMENT, OUTPUT CONTAINS AT LEAST 6 USUALLY 7 SIGNIFICANT DIGITS. COMPUTATION TIME FROM 1.64 TO 2.47 MS, 111 LOCATIONS AND 4 COMMON.

0704 650RWADD AVAILABLE PRIOR TO JANUARY 1962

PARTIAL DOUBLE PRECISION FLOATING POINT ADDITION
THIS FORTRAN SUBPROGRAM ADDS A DOUBLE PRECISION FLOAT-ING POINT NUMBER AND A SINGLE PRECISION FLOATING POINT NUMBER AND EXPRESSES THE SUM AS A DOUBLE PRECISION FLOATING POINT NUMBER. USES 22 CELLS.

0704 650RWDPFA AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION FLOATING POINT ADDITION
THIS FORTRAN SUBPROGRAM ADDS TWO DOUBLE PRECISION FLOATING POINT NUMBERS, EXPRESSING THE SUM AS A DOUBLE PRECISION FLOATING POINT NUMBER. USES 25 CELLS.

0704 650RWFDV AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION FLOATING POINT DIVISION
THIS FORTRAN SUBPROGRAM PERFORMS THE DIVISION OF ONE DOUBLE PRECISION FLOATING POINT NUMBER BY ANOTHER AND EXPRESSES THE QUOTIENT AS A DOUBLE PRECISION FLOATING POINT NUMBER. USES 136 CELLS. CORR/ 886

0704 650RWMULT AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION FLOATING POINT MULTIPLICATION
THIS FORTRAN SUBPROGRAM MULTIPLIES TWO DOUBLE PRECISION FLOATING POINT NUMBERS, EXPRESSING THE PRODUCT AS A DOUBLE PRECISION FLOATING POINT NUMBER. USES 48 CELLS

0704 650RWREAD AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION FLOATING POINT CARD INPUT
THIS FORTRAN SUBPROGRAM READS A 16 DECIMAL DIGIT /DOUBLE PRECISION/ FLOATING POINT NUMBER FROM A CARD. REQUIRES 502 CELLS. CORR/ 886

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 652RWEG2F AVAILABLE PRIOR TO JANUARY 1962

EIGENVALUES AND EIGENVECTORS OF THE PRODUCT OF A AND X. EQUALS THE WAVE LENGTH TIMES THE PRODUCT OF B AND X, WHERE A AND B ARE SYMMETRIC, AND B IS POSITIVE DEFINITE COMPUTES IN SINGLE PRECISION FLOATING POINT. THE COMPUTATION OF THE EIGENVECTORS IS OPTIONAL. CORR/ 675, 803

0704 652RWFT2F AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT TRAP ROUTINE
PROVIDES OPTIONAL METHODS OF HANDLING AC AND MQ OVER-FLOW AND UNDERFLOW WHILE IN THE FLOATING TRAP MODE. OCCUPIES 152 CELLS AND CONTAINS ITS OWN TEMPORARY.

0704 652RWHF2F AVAILABLE PRIOR TO JANUARY 1962

MULTI-MATERIAL ONE DIMENSIONAL HEAT EQUATION SOLVER
SOLVES NUMERICALLY THE ONE DIMENSIONAL HEAT FLOW EQUATION WITH VARIABLE THERMAL PROPERTIES THROUGH A LAMINATED SLAB, OF AS MANY AS SIX MATERIALS, WITH RELATIVELY GENERAL BOUNDARY CONDITIONS

0704 652RWPRT2 AVAILABLE PRIOR TO JANUARY 1962

GENERAL OUTPUT ROUTINE
SETS UP ONE LINE OF OUTPUT AS SPECIFIED IN THE CALLING SEQUENCE AND WRITES THE LINE ON TAPE 6 FOR PRINTING OR TAPE UNIT 5 FOR PUNCHING IF SWITCH 2 IS OFF, OR PRINTS OR PUNCHES THE LINE ON THE ON-LINE PRINTER OR PUNCH IF SWITCH 2 IS ON. IT IS ALSO POSSIBLE TO SET UP A LINE AS SPECIFIED IN THE CALLING SEQUENCE AND TO PRINT OR PUNCH THE LINE ON THE ON-LINE PRINTER OR PUNCH ONLY, REGARDLESS OF THE SETTING OF SWITCH 2. REQUIRES 389 CELLS PLUS 51 COMMON.

0704 653CSSQT2 AVAILABLE PRIOR TO JANUARY 1962

SQUARE ROOT, FLOATING POINT.
FULL SINGLE PRECISION ACCURACY IN 1.008 MILLISECONDS USING 41 CELLS.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 654AMCHKF AVAILABLE PRIOR TO JANUARY 1962

SET SENSE LIGHTS
FORTRAN SUBROUTINE TO TEST BITS 1-4 OF 9 LEFT ROW AND TURN ON CORRESPONDING SENSE LIGHTS.

0704 654AMPLGF AVAILABLE PRIOR TO JANUARY 1962

NTH LEGENDRE POLYNOMIAL
FORTRAN VERSION OF AMPLGN. CORR. DIST. 865

0704 654AMPLGN AVAILABLE PRIOR TO JANUARY 1962

NTH LEGENDRE POLYNOMIAL
SINGLE PRECISION FLOATING, TWO ENTRIES,ACCURACY-8DIGITS. REQUIRES 29 STORAGE CELLS AND 2 COMMON. CORR. DIST. 865

0704 654AMPLGX AVAILABLE PRIOR TO JANUARY 1962

NTH LEGENDRE POLYNOMIAL
FIXED POINT ROUTINE, TWO ENTRIES
ACCURACY - 8 DIGITS. REQUIRES 30 STORAGE CELLS AND 2 COMMON

0704 654AMWOTP AVAILABLE PRIOR TO JANUARY 1962

BCD OUTPUT PROGRAM
WRITES A BCD RECORD OF ANY LENGTH ON TAPE AND/OR PRINTS ON LINE WITHOUT THE USE OF SENSE SWITCHES. THIS IS A MODIFI-CATION OF UA SPH1.

0704 659GCTLU1 AVAILABLE PRIOR TO JANUARY 1962

TABLE READ IN & TABLE LOOKUP, INTERPOLATION SUBROUTINE FOR FUNCTIONS OF ONE, TWO, AND THREE VARIABLES. STORES ALL TABLES AS A SINGLY-SUBSCRIPTED ARRAY. PROVISION TO READ IN ADDITIONAL TABLES AS NEEDED. SUITABLE ERROR RETURNS PROVIDED FOR BY A COMPUTED GO TO. SAME STANDARD CARD FORMATS FOR ALL TABLES. TABLES ARE SEQUENCE CHECKED WHILE BEING READ IN FROM BCD TAPE OR CARD READER. CORR/770

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 661GDF020 AVAILABLE PRIOR TO JANUARY 1962

SQUARE MATRIX TRANSPOSED ON ITSELF OR DISPLACED IN CORE
MATRIX CAN BE STORED ROW-WISE OR COLUMN-WISE
ELEMENT A/I,J/ IS STORED INTO A/J,I/ OR B/J,I/
28 STORAGE LOCATIONS
80X80 MATRIX TRANSPOSED IN 615 MILLISECONDS

0704 664ANF202 AVAILABLE PRIOR TO JANUARY 1962

EIGENVALUES AND EIGENVECTORS OF A REAL SYMMETRIC MATRIX
FORTRAN II SUBROUTINE FINDS ALL SCALAR SOLUTIONS, L /INCLUDING PROPER MULTIPLICITY/, AND, OPTIONALLY, THE ASSOCIATED UNIT NORM VECTORS, X, TO THE MATRIX EQUATION AX-LX. REQUIRES 935 CELLS PLUS VARIABLE COMMON.

0704 664ANF402 AVAILABLE PRIOR TO JANUARY 1962

MATRIX INVERSION WITH SOLUTION OF LINEAR EQUATIONS
FORTRAN II SUBROUTINE SOLVES THE MATRIX EQUATION AX-B, WHERE A IS A REAL, SQUARE COEFFICIENT MATRIX AND B IS A MATRIX OF CONSTANT VECTORS. THE INVERSE MATRIX AND DETERMINANT ARE ALSO OBTAINED. A IS DESTROYED IN THE INVERSION. REQUIRES 458 CELLS PLUS VARIABLE COMMON.

0704 668MUCBL1 AVAILABLE PRIOR TO JANUARY 1962

OCTAL COLUMN BINARY CARD LOADER /THREE CARDS/.
READS A FILE OF CARDS PUNCHED IN THE OCTAL COLUMN BINARY FORM AT FULL SPEED ON THE 711 MODEL 1 OR MODEL 2 CARD READER. AN OCTAL COLUMN BINARY TRANSFER CARD IS RECOGNIZED AND CONTROL IS TRANSFERRED TO THE LOCATION SPECIFIED. THE PROGRAM IS SELF -LOADING AND USES THE FIRST 96 LOCATIONS IN MEMORY.

0704 668MUCEI1 AVAILABLE PRIOR TO JANUARY 1962

MURA COMPLETE ELLIPTIC INTEGRALS
APPROXIMATES THE VALUES OF THE COMPLETE ELLIPTIC INTEGRALS K AND E SCALED 2EXP-3. REQUIRES THE SUBROUTINE MU LOG3. 67 WORDS PROGRAM PLUS 11 WORDS COMMON. TIMING 10.3 MS.

0704 673WH0059 AVAILABLE PRIOR TO JANUARY 1962

ABSOLUTE AND CORRECTION TRANSFER CARD LOADER.
LOADS SHARE STANDARD ABSOLUTE BINARY AND C/T CARDS.
ALL CARDS MAY BE CHECKSUM VERIFIED. REQUIRES 60 LOCATIONS
AND INDEX REGISTER 4. MACHINE MUST NOT BE IN TRAPPING MODE.

0704 674RWSPAD AVAILABLE PRIOR TO JANUARY 1962

ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS
THIS PROGRAM FINDS THE APPROXIMATE SOLUTION OF A SET OF
ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS ON A TWO
DIMENSIONAL REGION WITH PRESCRIBED BOUNDARY CONDITIONS
BY THE METHODS OF FINITE DIFFERENCES AND SUCCESSIVE OVER-
RELAXATION. THE REGION MAY BE ARBITRARY IN SHAPE AND MAY
INCLUDE INTERFACES AND HOLES. THE BOUNDARY CONDITIONS MAY
BE MIXED. THE MAIN PROGRAM REQUIRES 5966 CELLS,
EXCLUSIVE OF THE THREE SUBROUTINES THE USER MUST SUPPLY.
OF THE THREE SUBROUTINES THE USER MUST SUPPLY. CORR.989

0704 676OR714S AVAILABLE PRIOR TO JANUARY 1962

72/84 AND 80/84 SIMULATION OF THE 714 CARD TO TAPE.
REQUIRES NON-STANDARD 711 CTL. PANEL, EXTRA CARDS IN DECK IF
READING 80 COL. NO CHECKING DONE. USES CE I41, NY BL1.

0704 677NA0314 AVAILABLE PRIOR TO JANUARY 1962

THERMAL ANALOZER
THIS IS A MODIFICATION TO SHARE SUBROUTINE CLTHAI WHICH SOLVE
S THE GENERAL PROBLEM OF STEADO STATE AND TRANSIENT HEAT TRAN
SFER. MULTIPLE CASES CAN BE HANDLED WITH EITHER PIRTIAL PARAM
ETER REPLACEMENT OR DOING A COMPLETE NEW PROBLEM.

0704 687IBNL1 AVAILABLE PRIOR TO JANUARY 1962

NON-LINEAR ESTIMATION /PRINCETON-IBM/
GIVEN A FUNCTIONAL RELATION AND DATA FOR N OBSERVED VALUES OF
A SINGLE DEPENDENT VARIABLE, NK CORRESPONDING VALUES FOR K
INDEPENDENT VARIABLES, AND INITIAL VALUES FOR P PARAMETERS,
THE PROGRAM /1/ PROVIDES BY AN ITERATIVE LEAST SQUARES
PROCEDURE ESTIMATES FOR THE PARAMETERS AND /2/ PROVIDES
STATISTICAL INFORMATION TO ASSESS THE WORTH OF THE ESTIMATED
PARAMETERS. USE OF THE PROGRAM FOR MORE THAN ONE DEPENDENT
VARIABLE IS POSSIBLE. THE FUNCTIONAL RELATION MAY BE NON-
LINEAR OR LINEAR IN THE PARAM. & INDEP. VAR. CORR/ 845

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 688GKTMR1 AVAILABLE PRIOR TO JANUARY 1962

TAPE MANEUVERING ROUTINE.
TMR IS A TAPE COPY ROUTINE WITH A NUMBER OF SUBROUTINES WHICH
PERMIT RECORD MANIPULATION AND MODIFICATION IN ANY OF SEVERAL
WAYS. THESE INCLUDE INDIVIDUAL WORD CHANGES AND CHECKSUM
CORRECTION, AS WELL AS RECORD READ-IN FROM CARDS WHILE
COPYING TAPES. ITS CHECKING METHOD MAKES IT A LITTLE SLOWER
THAN GMTED OR RL0044 IN SOME RESPECTS, BUT WHERE MERGING OF
SEVERAL TAPES IS DESIRED, IT IS FASTER.

0704 690GDBOT1 AVAILABLE PRIOR TO JANUARY 1962

BINARY OCTAL CARD OR TAPE LOADER
FIVE CARD HIGH ORDER SELF LOADING PROGRAM TO LOAD
ABSOLUTE SHARE STANDARD AND CAGE BINARY, OCTAL & OCTAL
TRANSFER CARDS. OPTION AVAILABLE FOR WRITING A SELF
LOADING RECORD FROM CORE BEFORE EXECUTING TRANSFER CARD.

0704 690GDNRT1 AVAILABLE PRIOR TO JANUARY 1962

N ROOT ROUTINE
COMPUTES THE NTH ROOT OF A NORMALIZED FLOATING POINT
NUMBER. ARGUMENT IN THE ACCUMULATOR AND N IN INDEX
REGISTER 1 UPON ENTRY. RESULT IN ACCUMULATOR UPON RETURN.
ERROR RETURN IF COMPLEX ROOT.

0704 690GDTIO1 AVAILABLE PRIOR TO JANUARY 1962

TAPE INPUT/OUTPUT
TO READ OR WRITE A VARIABLE LENGTH BINARY OR BCD RECORD
WITH OR WITHOUT CHECKING,AND CHECK FOR AN END OF FILE OR
END OF TAPE CONDITION.

0704 692JPGNAT AVAILABLE PRIOR TO JANUARY 1962

LAGRANGIAN INTERPOLATION ROUTINE
GIVEN A TABLE OF N PAIRS OF X AND F/X/ AND A GIVEN VALUE
OF X1, THE ROUTINE WILL USE /N-1/ THE ORDER INTERPOLATION
TO COMPUTE F/X1/. LAGRANGIAN COEFFIEIENT FUNCTIONS ARE USED.
REQUIRES 77 STORAGE LOCATIONS FOR PROGRAM AND N&6 AT COMMON.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 692JPTARN AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT UNIVARIATE SEARCH
GIVEN A BLACK BOX ROUTINE COMPUTING F/X/ FROM A GIVEN
X, THE SEARCH ROUTINE VARIES C TO OBTAIN A DESIRED VALUE
OF F/X/.
REQUIRES 208&/2N&4/ STORAGE LOCATIONS /INCLUDING JP GNAT/.
REQUIRES N&7 LOCATIONS AT COMMON.

0704 692JPWEIR AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT BIVARIATE SEARCH
GIVEN A BLACK BOX ROUTINE WITH TWO INPUT AND TWO OUTPUT
PARAMETERS, THIS ROUTINE ADJUSTS THE INPUT PARAMETERS TO THE
DESIRED VALUES OF THE OUTPUT PARAMETERS. THIS IS DONE BY
APPROXIMATION TO THE FIRST PARTIAL DERIVATIVES.
REQUIRES 208 LOCATIONS & 9SPACES AT COMMON.

0704 692JPZPOL AVAILABLE PRIOR TO JANUARY 1962

ZEROS OF COMPLEX POLYNOMIALS
COMPUTES THE ZEROS OF A POLYNOMIAL WITH COMPLEX
COEFFICIENTS USING A SINGLE PRECISION QUADRATIC
METHOD. STORAGE LOCATIONS 467 & 38 ERASABLE & 2/N&1//

0704 697MIHDI4 AVAILABLE PRIOR TO JANUARY 1962

704-SAP-CODED MATRIX DIAGONALIZATION SUBROUTINE
THIS SUBROUTINE DIAGONALIZES A REAL, SYMMETRIC MATRIX
BY MEANS OF JACOBIS METHOD WHEN THE MATRIX ELEMENTS ARE
SINGLE-PRECISION, FLOATING-POINT NUMBERS STORED IN
TRIANGULAR FORM MATRICES OF LARGE ORDER ,N, ARE
DIAGONALIZED IN A TIME PROPORTIONAL TO N CUBED AND WITH
A MINIMUM NUMBER OF ROTATION.

0704 699AMDPMM AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION MATRIX MULTIPLICATION.
MULTIPLIES TWO REAL MATRICES WHOSE ELEMENTS ARE STORED
CONSECUTIVELY BY ROWS IN CORE STORAGE USING DOUBLE PRECISION
ARITHMETIC. THE ELEMENTS OF PRODUCT MATRIX ARE STORED IN
THE SAME MANNER IN CORE STORAGE. REQUIRES 145 STORAGE PLUS
16 COMMON. CL DPA1 AND CL DPM1 MUST BE ASSEMBLED
CONCURRENTLY.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 704RWBF4F AVAILABLE PRIOR TO JANUARY 1962

BESSEL FUNCTION Y SUB N /X/.
GIVEN X AND N, THIS SUBROUTINE FINDS Y SUB N /X/ OR
ALL VALUES Y SUB 0 /X/ TO Y SUB N /X/.

0704 705MIFLT2 AVAILABLE PRIOR TO JANUARY 1962

704-SAP FLOATING-POINT TRAP UNDERFLOW CORRECTION--
SUBROUTINE. AN INITIALIZING CALLING SEQUENCE TO THIS
SUBROUTINE SETS THE COMPUTER IN THE FLOATING TRAP MODE SO
THAT WHEN SUBSEQUENT UNDERFLOW OCCURS, THE PROPER REGISTER
/AC AND/OR MQ/ IS SET TO ZERO. OVERFLOW /OR THE ABSENCE OF
THE FLOATING TRAP FEATURE IN THE COMPUTER/ CAUSES AN ERROR
RETURN TO THE INITIALIZING CALLING SEQUENCE. A RESET CALLING
SEQUENCE RESTORES REGISTER 8 AND THE PREVIOUS STATUS OF THE
FLOATING-TRAP MODE.

0704 705MIFLT3 AVAILABLE PRIOR TO JANUARY 1962

704-FORTRAN II FLOATING-PT. TRAP UNDERFLOW CORRECTION--
SUBROUTINE. THIS SAP-CODED SUBROUTINE MAY BE USED
ON A 704 WITH THE FLOATING TRAP MODE TO SET UNDER-
FLOW TO ZERO AND HALT ON OVERFLOW.

0704 705MIHDI2 AVAILABLE PRIOR TO JANUARY 1962

704-SAP FLOATING-PT. TRAP MATRIX DIAGONALIZATION--
SUBROUTINE. THIS SUBROUTINE DIAGONALIZES A REAL, SYMMETRIC
MATRIX BY MEANS OF JACOBIS METHOD WHERE THE MATRIX ELEMENTS
ARE SINGLE-PRECISION, FLOATING-POINT NUMBER STORED IN
TRIANGULAR FORM. MATRICES OF LARGE ORDER,N, ARE DIAGONALIZED
IN A TIME PROPORTIONAL TO N CUBED AND WITH A MINIMUM NUMBER
OF ROTATIONS. MIHDI2 IS ESSENTIALLY MIHDI4 MODIFIED TO TAKE
ADVANTAGE OF FLOATING POINT TRAP.

0704 705MIHDI3 AVAILABLE PRIOR TO JANUARY 1962

704-FORTRAN II SUBPROGRAM FOR MATRIX--
DIAGONALIZATION. THIS FORTRAN II SOURCE LANGUAGE
SUBROUTINE DIAGONALIZES A REAL, SYMMETRIC MATRIX
BY MEANS OF JACOBIS METHOD WHERE THE MATRIX
ELEMENTS ARE SINGLE-PRECISION FLOATING-POINT
NUMBERS. CORR. 731

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 708WHSMT2 AVAILABLE PRIOR TO JANUARY 1962

704 SELECTIVE MONITOR TRACE SYSTEM.
TO BE SET UP AT EXECUTION TIME BY MEANS OF CONTROL CARDS TO PROVIDE /1/ A DETAIL PRINTOUT OF LOC, OP, EFF ADDR,C/E/,C/AC/ C/MQ/,TAG,C/IR/, OV IND FOR EVERY INSTRUCTION, OR /2/ A TRAP TRACE OF EACH EXECUTABLE TRANSFER, OR /3/ A TRACE OF ALL STOR INSTRUCTIONS EXECUTED, OR /4/ ANY COMBINATION OF THESE MODES OVER ANY SELECTED PORTIONS OF PROG BEING CHECKED. TRACES PROGRAMS WHICH OPERATE IN TRAP MODE, AS WELL AS I/O OPERATIONS BY SIMULATION. FL DEC AC AND MQ. ON-LINE PRINT ONLY.
9038 STORAGE CELLS, RELOCATABLE.

0704 715RWCAZI AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT COMPLEX ARITHMETIC ABSTRACTION
TO FACILITATE EXECUTION OF A PROGRAM USING EITHER REAL OR COMPLEX ARITHMETIC WITHOUT MODIFICATION OF THE PROGRAM AND WITH NEGLIGIBLE LOSS OF TIME WHILE USING REAL ARITHMETIC. REQUIRES 434 CELLS AND CONTAINS ITS OWN TEMPORARIES.

0704 725PKMERE AVAILABLE PRIOR TO JANUARY 1962

TWO-DIMENSIONAL MESH FOR RELAXATION CALCULATIONS.
SYSTEM OF PROGRAMS FOR SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS BY THE SUCCESSIVE OVER-RELAXATION METHOD.
CONTAINS MESH GENERATOR, ITERATOR, OUTPUT PRINTER, INTERPOLATOR AND OTHER AUXILIARY PROGRAMS.

0704 726SCXPCD AVAILABLE PRIOR TO JANUARY 1962

704 TRANSPORTATION CODE.
704 TRANSPORTATION CODE USING JAMES MUNKERS ALGORITHM /SIAM JOURNAL, MARCH 1957/. REQUIRES 8K CORE, 4 DRUMS AND AT LEAST 1 TAPE UNIT.

0704 727IBSQD AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PREC. FLOATING PT. SQUARE-ROOT SUBROUTINE.
RELATIVE ERROR LESS THAN 2.5X10-16. 2.02 MS, 54 LOCATIONS & 4 COMMON.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 732PFMCDL AVAILABLE PRIOR TO JANUARY 1962

READING OF FORMAT STATEMENTS AT EXECUTION TIME.
FORTRAN-2 SUBROUTINE TYPE PROGRAM.

0704 733PFDUP3 AVAILABLE PRIOR TO JANUARY 1962

TAPE COPY PROGRAM.
BINARY OR BCD MODE MAY BE IMPOSED AS WELL AS INTEGRAL COPY OR NUMBER OF FILES OR NUMBER OF RECORDS TO BE COPIED CAN BE PRESET. CHECKSUM AND OPTIONAL RTT VERIFICATION IS EFFECTUATED

0704 734PFPROG AVAILABLE PRIOR TO JANUARY 1962

TAPE CREATING PROGRAM AND LOADER SUBROUTINE.
THIS IS A BSS LOADER THAT CREATES A PROGRAM TAPE FOR PROGRAMS COMPILED BY FORTRAN 2 AND EXCEEDING STORAGE CAPACITY.
SUBROUTINE PROG IS USED TO CALL IN THE PROGRAM TAPE.

0704 735PFMCFL AVAILABLE PRIOR TO JANUARY 1962

FLOATING TRAP SIMULATION.
FORTRAN-2 SUBROUTINE PERFORMING FLOATING OVERFLOW-UNDERFLOW AND DIVIDE CHEC DETECTION. CONSOLE GIVES DETAILED INFORMATION ABOUT CONDITIONS. THERE ARE POSSIBILITIES TO CONTINUE BY AUTOMATIC CORRECTION OF RESULTS.

0704 739ARPEK2 AVAILABLE PRIOR TO JANUARY 1962

BINARY SUBROUTINE IDENTIFICATION AND MEMORY ALLOCATION
READS FN II BINARY PROGRAM DECK LISTING ON-LINE OR OFF-LINE THE SUBROUTINES IN THE DECK, ALSO VECTORS,LENGTH,ENTRIES COMMON REQUIREMENTS. UPON FINDING FN II TRANSFER CARD,STATES ACTUAL NEXT AVAILABLE CELL AND LOWEST COMMON CELL REFERENCED IN PROGRAM. MAKES NO CHECK FOR MISSING SUBROUTINES.

0704 742RWLE3F AVAILABLE PRIOR TO JANUARY 1962

LINEAR EQUATION SOLVER
GIVEN A LINEAR MATRIX EQUATION AV=B, WHERE A HAS THE DIMENSIONS M X N AND B IS A COLUMN VECTOR OF DIMENSION M X 1, THIS ROUTINE FINDS THE SOLUTION V IN THE LEAST SQUARES SENSE. REQUIRES 466 CELLS OF PROGRAM AND CONSTANTS /INCLUDES AOU AND DOU/. PLUS N&5 CELLS OF COMMON.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 742RWLS3F AVAILABLE PRIOR TO JANUARY 1962

GENERAL LEAST SQUARE CURVE FITTING ROUTINE.
SOLVES THE VECTOR V IN LEAST SQUARES SENSE. REQUIRES 757 CELLS OF PROGRAM AND CONSTANTS /INCLUDES LE3F, AOU, AND DOU/ PLUS N&5 CELLS OF COMMON.

0704 743ORAZI AVAILABLE PRIOR TO JANUARY 1962

RANDOM NUMBER GENERATOR, AZIMUTHAL ANGLE. FIXED POINT.

0704 743ORCAUC AVAILABLE PRIOR TO JANUARY 1962

RANDOM NUMBER GENERATOR, CAUCHY DISTRIBUTION. FT. PT.

0704 743OREXPR AVAILABLE PRIOR TO JANUARY 1962

RANDOM NO. GENERATOR, EXPONENTIAL DISTRIBUTION. FT.PT.

0704 743ORFISH AVAILABLE PRIOR TO JANUARY 1962

RANDOM NO. GEN., NERENSON-ROSEN FISSION SPECTRUM. FT.PT

0704 743ORFLOT AVAILABLE PRIOR TO JANUARY 1962

FLOAT A FRACTION
CONVERTS A FRACTION TO FLOATING POINT FORMAT.

0704 743ORFLRN AVAILABLE PRIOR TO JANUARY 1962

RANDOM NUMBER GENERATOR, FLOATING POINT.

0704 743ORFXRN AVAILABLE PRIOR TO JANUARY 1962

RANDOM NUMBER GENERATOR, FIXED POINT

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 743ORGAUR AVAILABLE PRIOR TO JANUARY 1962

RANDOM NO. GENERATOR, GAUSSIAN DISTRIBUTION. FT. PT.

0704 743ORMAXB AVAILABLE PRIOR TO JANUARY 1962

RANDOM NO. GENERATOR, MAXWELL-BOLTZMANN DIST. FT. PT.

0704 743ORMOCO AVAILABLE PRIOR TO JANUARY 1962

CONSTANTS FOR OR MONTE CARLO PKG. /NOT A SUBROUTINE/

0704 743ORPOL1 AVAILABLE PRIOR TO JANUARY 1962

RANDOM NUMBER GENERATOR, POLAR ANGLE. FLOATING POINT.

0704 743ORTURN AVAILABLE PRIOR TO JANUARY 1962

PARTICLE SCATTERING
VECTOR ROTATING SUBROUTINE OF MONTE CARLO PACKAGE.

0704 744AMDPAS AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION MATRIX ADDITION AND SUBTRACTION.
ADDS OR SUBTRACTS TWO REAL MATRICES WHOSE ELEMENTS ARE STORED CONSECUTIVELY BY ROWS IN CORE STORE USING DOUBLE PRECISION ARITHMETIC. THE ELEMENTS OF THE SUM OR DIFFERENCE MATRIX ARE STORED IN THE SAME MANNER IN CORE STORAGE. REQUIRES 80 STORAGE PLUS 8 COMMON. CL DPA1 MUST BE ASSEMBLED CONCURRENTLY.

0704 749SCBOP1 AVAILABLE PRIOR TO JANUARY 1962

MULTIPLE REGRESSION BACK SOLUTION PROGRAM.
TO PROVIDE BACK SOLUTIONS FOR THE RESULTS OF THE MULTIPLE REGRESSION CODE SCRAP.

0704 749SCIEMR AVAILABLE PRIOR TO JANUARY 1962

INPUT EDITOR FOR MULTIPLE REGRESSION CODE SCRAP.
THIS 704 PROGRAM USES FORTRAN TO CALCULATE FUNCTION VARIABLES FROM OBSERVED VARIABLES AND PLACE THEM IN THE FORMAT REQUIRED FOR THE MULTIPLE REGRESSION CODE SCRAP.

0704 749SCRAP AVAILABLE PRIOR TO JANUARY 1962

MULTIPLE REGRESSION & CORRELATION ANALYSIS PROGRAM.
PROVIDES MULTIPLE CORRELATION COEFFICIENTS, STANDARD ERROR OF ESTIMATES,MEANS, STANDARD DEVIATIONS, REGRESSION COEFFICIENTS AND T-TABLE ENTRIES FOR UP TO 39 INDEPENDENT VARIABLES WITH AS MANY AS 400 OBSERVATIONS PER VARIABLE. REQUIRES 4K 704 WITH 1 DRUM AND AT LEAST 4 TAPES. CORR/944

0704 752GMEPAC AVAILABLE PRIOR TO JANUARY 1962

FORTRAN ERROR PACKAGE
A FORTRAN II SUBROUTINE WITH SEVERAL ENTRIES TO PROVIDE ERROR DIAGNOSTIC OUTPUT ON A BCD OUTPUT TAPE A, ERROR CONTROL, AND FLOATING POINT OVERFLOW/UNDERFLOW ADJUSTMENT DURING THE EXECUTION OF A PROGRAM. A DIAGNOSTIC CONSIST OF AN ERROR DESCRIPTION AND A SUBROUTINE NAME-STATEMENT NUMBER TRACE BACK FROM THE ERROR SOURCE TO THE MAIN LINE PROGRAM. REQUIRES FLOATING POINT TRAP AND FORTRAN II STANDARD ERROR PROCEDURE. USES 325 CORE LOCATIONS.

0704 753NUEXPI AVAILABLE PRIOR TO JANUARY 1962

EXPONENTIAL INTEGRAL
COMPUTES EI/X/, EXP/-X/*EI/X/, OR EI/X/ - LOG/X/.CLOSED SUBROUTINE ON SAP SYMBOLIC CARDS. REQUIRES 192&19 COMMON STORAGE CELLS PLUS LOG AND EXP SUBROUTINES. ALSO EXISTS AS FORTRAN 2 SUBROUTINE.

0704 753NUEXPI AVAILABLE PRIOR TO JANUARY 1962

EXPONENTIAL INTEGRAL
COMPUTES EI/X/, EXP/-X/*EI/X/, OR EI/X/ - LOG/X/. FORTRAN 2 SUBROUTINE VERSION OF NU EXPI ON RELOCATABLE BINARY CARDS INCLUDING LOG AND EXP SUBROUTINES. 292&19 COMMON STORAGE.

0704 754CEF2LD AVAILABLE PRIOR TO JANUARY 1962

GENERATE A FORTRAN II PROGRAM TAPE OR ABSOLUTE BINARY CARDS. LOADS A FORTRAN II PROGRAM ONTO A BINARY TAPE AS ONE RECORD WITH A BOOTSTRAP PREFACE, OR PUNCH OUT THE PROGRAM ON ABSOLUTE BINARY CARDS, OR BOTH.

0704 756RWINP5 AVAILABLE PRIOR TO JANUARY 1962

DECIMAL, OCTAL, BCD LOADER
READS BCD TAPE 4/WITH REDUNDANCY CHECKING/ IF SENSE SWITCH 1 IS UP, OR HOLLERITH PUNCHED CARDS ON-LINE IF SS-1 IS DOWN, CONVERTS TO BINARY AND STORES IN CORE. THE FORMAT ACCEPTABLE TO UADBC1 HAS BEEN EXTENDED SO THAT INPUT PRE-PARATION MAYBE MORE EASILY DIVORCED FROM PROGRAMMING TECHNIQUES. REQUIRES 668 WORDS OF CORE. ALL TEMPORARY STORAGES ARE SELF-CONTAINED.

0704 756RWINP5 AVAILABLE PRIOR TO JANUARY 1962

DECIMAL, OCTAL, BCD LOADER
ALLOWS SELECTIVE INPUT WITH A SINGLE CALL STATEMENT, AND ALLOWS FOR CHANGES IN VALUES WHICH WERE NOT ORIGINALLY DESIGNATED AS INPUT. REQUIRES 672 WORDS OF STORAGE WITH ALL TEMPORARIES SELF-CONTAINED. CORR/ 814

0704 759AMDPSM AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION MATRIX SCALAR MULTIPLICATION
MULTIPLIES A REAL MATRIX WHOSE ELEMENTS ARE STORED CONSECUTIVELY BY ROWS TIMES A SCALAR IN CORE STORAGE USING DOUBLE PRECISION ARITHMETIC. THE ELEMENTS OF THE PRODUCT MATRIX ARE STORED IN THE SAME MANNER IN CORE STORAGE. REQUIRES 62 STORAGE &7 COMMON. CL DPM1 MUST BE ASSEMBLED CONCURRENTLY.

0704 760GECDIS AVAILABLE PRIOR TO JANUARY 1962

CONTINUOUS DERIVATIVE INTERPOLATION SUBROUTINE
COMPUTES Y AS A FUNCTION OF X FROM A TABLE OF X AND Y VALUES SUCH THAT THE FUNCTION Y AND ITS FIRST AND SECOND DERIVATIVES ARE CONTINUOUS IN THE RANGE OF X IN THE TABLE WRITTEN AS 2 FORTRAN II SUBROUTINES.

0704 762RFD00 AVAILABLE PRIOR TO JANUARY 1962

DIFFERENTIAL EQUATION
SOLUTION OF N FIRST ORDER DIFFERENTIAL EQUATIONS USING THE EULER-CAUCHY METHOD. PROVISIONS FOR ERROR CONTROL AND PREDICTED STEP SIZE. REQUIRES 168 CELLS, 1 COMMON AND A BLOCK OF 2N&1 CELLS.

0704 762RFE00 AVAILABLE PRIOR TO JANUARY 1962

LAGRANGIAN INTERPOLATION AND/OR DIFFERENTIATION
GIVEN M TABLES YM-F/X/ WHERE X IS EQUALLY SPACED KTH ORDER INTERPOLATION AND/OR DIFFERENTIATION OF THE LAGRANGIAN FORMULA IS PERFORMED ON ALL TABLES.TABLES MUST ALL BE OF SAME FORMAT. REQUIRES 274 CELLS AND COMMON TO COMMON&47 &K.

0704 766ANC203 AVAILABLE PRIOR TO JANUARY 1962

ZEROS OF A POLYNOMIAL IN DOUBLE PRECISION
COMPUTES IN DOUBLE PRECISION THE REAL AND COMPLEX ZEROS OF A REAL POLYNOMIAL. OUTPUT OF ZEROS WITH MULTIPLICITIES AND REMAINDER TERMS AS WELL AS ORIGINAL COEFFICIENTS. OPTIONAL OUTPUT OF MODULI AND COEFFICIENTS OF POLYNOMIAL GENERATED FROM ZEROS FOUND. MODIFICATION OF ROOT-SQUARING METHOD. C203 IS A COMPLETE PROGRAM WHICH INCLUDES- BS INTP, BS CONV, BS OUT, BS LNX, BS DPSQ, BS EXP, UA CSH2, UA SPH1, MU RDI2.

0704 767UASP03 AVAILABLE PRIOR TO JANUARY 1962

FLOW TRACE PROGRAM - UA SPO 3
ON- AND/OR OFF-LINE OP-PANEL PRINT AFTER EXECUTION OF EACH TRACEABLE TRANSFER INSTRUCTION WHILE IN TRAPPING MODE. CONDITIONAL AND/OR UNCONDITIONAL ENTRANCE TO AND EXIT FROM TRAPPING MODE MADE FLEXIBLE BY CONTROL CARD. PRINTING MAY BE CONTROLLED BY INDEX REGISTER CONTENTS, CORE STORAGE LOCATION CONTENTS, COUNT-DOWN ON NUMBER OF TRANSFERS TO OR FROM SOME CORE STORAGE LOCATION, OR MANUALLY BY THE SETTING OF A SENSE SWITCH. USES CORE STORAGE LOCATIONS /00000-00777/8.

0704 768UADBC2 AVAILABLE PRIOR TO JANUARY 1962

DECIMAL-TO-BINARY CONVERSION PROGRAM - UA DBC 2
FIXED POINT, FLOATING POINT, INTEGER OR BCD CONVERSION. VARIABLE FIXED FIELD FORMAT A LA FORTRAN. FLAG COLUMNS MAY BE SPECIFIED TO CAUSE INTERRUPTION OF CONVERSION. UPON INTERRUPT NUMBERS MAY BE SCALED, REPLACED, IGNORED, ETC. LOADING IS BY BLOCK, BUT THE INTERRUPT ALLOWS INPUT TO BE LOADED INTO ARBITRARY CORE LOCATIONS. REQUIRES THE USE OF UATSM2 OR UACSH2 TO READ TAPE OR CARDS. OCCUPIES 467 CORE STORAGE LOCATIONS AND 40 WORDS OF COMMON STORAGE.

0704 769TVF2TP AVAILABLE PRIOR TO JANUARY 1962

FORTRAN II AND/OR FORTRAN I TO SELF-LOADING TAPE 1
THIS PROGRAM MAKES A SELF-LOADING TAPE 1 OF ANY NUMBER OF INDEPENDENT FORTRAN II AND/OR FORTRAN I PROGRAMS. A LOAD FUNCTION IS REQUIRED IF MORE THAN ONE PROGRAM IS TO BE LOADED. THIS FUNCTION IS DESCRIBED IN APPENDIX A OF THE WRITEUP OF TV F2TP.

0704 772ANE206 AVAILABLE PRIOR TO JANUARY 1962

LEAST SQUARE POLYNOMIAL FIT /FORTRAN II/
GIVEN A SET OF N VALUES OF X WITH WEIGHTS W, AND ONE OR MORE SETS OF CORRESPONDING VALUES OF Y, ROUTINE DETERMINES THE M COEFFICIENTS OF THE POLYNOMIAL/S/ OF DEGREE M-1 WHICH GIVES THE BEST FIT TO THE SET/S/ OF Y. THE RESIDUALS, WEIGHTED SUM/S/ OF SQUARES OF RESIDUALS, AND THE ERROR MATRIX ARE ALSO COMPUTED. REQUIRES 296 CELLS PLUS VARIABLE COMMON. SUBROUTINES POLYE1 AND XLOC INCLUDED IN DECK. USES ANF402.

0704 775RWDE6F AVAILABLE PRIOR TO JANUARY 1962

FLOATING PT. COWELL /2ND SUM/, RUNGE-KUTTA INTEGRATION OF SECOND-ORDER EQUATIONS. SOLVES A SET OF N SIMULTANEOUS SECOND-ORDER ORDINARY DIFFERENTIAL EQUATIONS, IN WHICH FIRST DERIVATIVES MAY OR MAY NOT APPEAR.

0704 775RWGLSC AVAILABLE PRIOR TO JANUARY 1962

GENERAL LEAST SQUARE CURVE FITTING ROUTINE
GIVEN AN N X M MATRIX A, AN M DIMENSIONAL ROW VECTOR B AND AN N X N DIAGONAL MATRIX S /STORED AS A ROW/ THIS ROUTINE FINDS AN N DIMENSIONAL ROW VECTOR V. IF THE USER SETS ALL S - 0 SOLVES V IN THE LEAST SQUARES SENSE.

0704 776RWAV4F AVAILABLE PRIOR TO JANUARY 1962

GENERAL ANALYSIS OF VARIANCE
TO COMPUTE AND PRINT ALL SUMS OF SQUARES ASSOCIATED WITH FACTORIAL EXPERIMENTATION. ALL SUMS OF OBSERVATIONS ENTERING INTO EACH SUM OF SQUARES ARE ALSO PRINTED. POLYNOMIAL PARTITIONING OF MAIN EFFECT SUMS OF SQUARES IS OPTIONAL. ANY DEGREE OF FRACTIONAL REPLICATION CAN BE HANDLED,AS WELL AS A HIGH DEGREE OF MULTIPLE REPLICATION. CORR/ 874

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 776RWAV5F AVAILABLE PRIOR TO JANUARY 1962

LATIN SQUARES ANALYSIS OF VARIANCE
TO COMPUTE AND PRINT ALL SUMS OF SQUARES ASSOCIATED WITH LATIN SQUARES EXPERIMENTATION. SUMS OF OBSERVATION OVER EACH LEVEL OF EACH FACTOR ARE ALSO PRINTED. POLYNOMIAL PARTITIONING IS OPTIONAL. A HIGH DEGREE OF MULTIPLE REPLICATION IS PERMISSIBLE.

0704 781WH0042 AVAILABLE PRIOR TO JANUARY 1962

SELF LOADING TAPE WRITING ROUTINE V407
TO LOAD THE INFORMATION FROM A FORTRAN OBJECT PROGRAM ONTO A MASTER PROGRAM TAPE. TO BE USED WITH ALL BUT THE DECK WHICH MAKES UP THE FINAL RECORD. A CHECK SUM IS COMPUTED FOR EAC& RECORDC

0704 781WH0043 AVAILABLE PRIOR TO JANUARY 1962

SELF LOADING TAPE WRITING ROUTINE V407
TO LOAD THE INFORMATION FROM A FORTRAN OBJECT PROGRAM ONTO A MASTER PROGRAM TAPEC TO BE USED WIT& THE DECK WHICH MAKES UP THE FINAL RECORD.

0704 782PFCR3 AVAILABLE PRIOR TO JANUARY 1962

CORRELATION AND REGRESSION ANALYSIS,
CALCULATIONS ARE PERFORMED AS SPECIFIED BY A CONTROL CARD. OPTIONAL OUTPUT FORMAT. PROVISIONS ARE MADE FOR PROGRAM INT-ERRUPTION AND RESTART. ADDITIONAL COMPUTATION MAY BE INTRO-DUCED. MAXIMUM NUMBER OF VARIABLES IS 110 /SINGLE PREC/ OR 80 /DOUBLE PREC/. NUMBER OF OBSERVATIONS IS 2**28-1.

0704 784GECDS1 AVAILABLE PRIOR TO JANUARY 1962

COLUMN BINARY DISASSEMBLY PROGRAM
THIS PROGRAM WILL READ A COLUMN BINARY ABSOLUTE OR RELOCATABLE DECK AND TRANSLATE THE INFORMATION BACK TO SYMBOLIC FORM. SEE GE RDS1

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 788IBCFTD AVAILABLE PRIOR TO JANUARY 1962

CONVERTS A FOURIER SERIES TERM TO BCD FORM.
USING TWO BINARY WORDS AND BCD WORD AS INPUT AND SIX BCD WORDS AS OUTPUT.

0704 788IBCIFS AVAILABLE PRIOR TO JANUARY 1962

COMBINES INDICES IN A FOURIER SREIES.
INPUT AND OUTPUT WILL BE IN CANONICAL REPRESENTATION.

0704 788IBCIFT AVAILABLE PRIOR TO JANUARY 1962

COMBINES INDICES IN A FOURIER TERM.
BOTH INPUT AND OUTPUT WILL BE IN THE CANONICAL REPRESENTATION

0704 788IBEFS1 AVAILABLE PRIOR TO JANUARY 1962

EVALUATES A FOURIER SERIES.
FOR GIVEN NUMERICAL VALUES OF ITS INDEPENDENT VARIABLES. THE SERIES TO BE EVALUATED MUST BE GIVEN IN EXPANDED REPRESENTATION AS DEFINED ON THE WRITE UP FOR ERFS1. TIMING U32K & 101 CYCLES, WHERE K- THE NUMBER OF INDICES PER TERM, AND T3 THE NUMBER OF TERMS IN THE SERIES TO BE EVALUATED.

0704 788IBERFS AVAILABLE PRIOR TO JANUARY 1962

EXPANDS THE REPRESENTATION OF A FOURIER SERIES.
WHICH IS GIVEN IN CANONICAL REPRESENTATION. IN THE EXPANDED REPRESENTATION THE FIRST THREE WORD LOCATIONS CONTAIN THE NUMBER OF INDICES, THE NUMBER OF SINE TERMS AND THE NUMBER OF COSINE TERMS RESPECTIVELY, SUCCEEDING LOCATIONS CONTAIN REPRESENTATIONS OF THE TERMS OF THE SERIES IN THE SAME ORDER AS IN THE GIVEN CANONICAL SERIES. TIMING NOT OVER U6LKC18DT & 130 CYCLES, WHERE K3 THE NUMBER OF INDICES PER TERMS AND T3 THE NUMBER OF 04C73005 TERMS IN THE SERIES.

0704 788IBFIR2 AVAILABLE PRIOR TO JANUARY 1962

INTERPRETIVE ROUTINE.
WHICH FACILITATES THE EXECUTION OF A SEQUENCE OF FOURIER SERIES OPERATIONS.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 784GERDS1 AVAILABLE PRIOR TO JANUARY 1962

ROW BINARY DISASSEMBLY PROGRAM
THIS PROGRAM WILL READ A ROW BINARY ABSOLUTE OR RELOCATABLE DECK WITH BINARY TRANSITION-CORRECTION CARDS AND TRANSLATE THE INFORMATION BACK TO SYMBOLIC FORM WHICH WOULD BE ACCEPTABLE TO SAP 3-7. AN OPTIONAL FORM OF OUTPUT IS A LISTING SIMILAR TO THAT PRODUCED BY THE SAP 3-7 ASSEMBLER

0704 785GEGERR AVAILABLE PRIOR TO JANUARY 1962

ERROR PROCEDURE FOR FORTRAN II
THE INCORPORATION OF THE STANDARD ERROR PROCEDURE FOR FORTRAN II INVOLVED THE WRITING OF AN ERROR SUBROUTINE AND A REVISION OF THE LIBRARY SUBROUTINES TO MAKE USE OF ERROR RETURNS. FORTRAN LIBRARY SUBROUTINES WERE MODIFIED, AND IN SOME CASES REPLACED BY BETTER ROUTINES. CORR/ 857

0704 787PKMIN2 AVAILABLE PRIOR TO JANUARY 1962

COMPUTATION OF A MINIMUM TWO-LEVEL AND-OR SWITCHING CIRCUT GENERATES A MINIMUM TWO-LEVEL SWITCHING CIRCUIT WHERE ONE LEVEL IS ALL ANDS AND THE OTHER LEVEL IS ALL ORS. DONT-CARE CONDITIONS AND MULTIPLE OUTPUT PROBLEMS ARE PERMITTED. CAN BE DIRECTLY APPLIED TO THE MINIMIZATION OF A BOOLEAN FUNCTION IN NORMAL FORM, AND TO THE MINIMIZATION OF TOPOLOGICAL COVERS OF CUBICAL COMPLEXES. PROGRAM MAY BE RUN ON A MACHINE WITH 2 OR 4 737S OR A 730 MENORY FRAME. IT ALSO REQUIRES SIX TAPES AND FOUR LOGICAL DRUMS. CORR/ 884

0704 788IBASFS AVAILABLE PRIOR TO JANUARY 1962

ADDS OR SUBTRACTS TWO FOURIER SERIES.
IN CANONICAL REPRESENTATION OBTAINING AS THE RESULT A THIRD FOURIER SERIES IN CANONICAL REPRESENTATION.

0704 788IBATFS AVAILABLE PRIOR TO JANUARY 1962

ADDS A TERM TO A FOURIER SERIES.
IN CANONICAL REPRESENTATION OBTAINING AS THE RESULT A FOURIER SERIES IN CANONICAL REPRESENTATION.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 788IBGFL1 AVAILABLE PRIOR TO JANUARY 1962

GIVEN A FOURIER HALF-SERIES IN CANONICAL REPRESENTATION GFL1 SEARCHES FOR AND CONVERTS TO BCD THE NEXT TWO TERMS IN ORDER OF MAGNITUDE OF COEFFICIENTS, THE LARGEST COEFFICIENT FIRST THE OUTPUT IS 12 BCD WORDS.

0704 788IBIFS1 AVAILABLE PRIOR TO JANUARY 1962

INTEGRATES A FOURIER SERIES IN CANONICAL REPRESENTATION REQUIRES AN UNINCORPORATED SUBROUTINE TO DETERMINE THE SPECIAL FUNCTION F OF THE INDICES.

0704 788IBMFS2 AVAILABLE PRIOR TO JANUARY 1962

MULTIPLIES TWO FOURIER SERIES.
IN CANONICAL REPRESENTATION OBTAINING AS THE RESULT A THIRD SERIES IN CANONICAL REPRESENTATION. REQUIRES THE SUBROUTINE ATFS1.

0704 788IBPDFS AVAILABLE PRIOR TO JANUARY 1962

COMPUTES THE PARTIAL DERIVATIVE OF A FOURIER SERIES.
IN CANONICAL REPRESENTATION WITH RESPECT TO ANY VARIABLE, OBTAINING AS A RESULT A SERIES IN CANONICAL REPRESENTATION. TIMING 2.040 & .756T MILLISECONDS MAXIMUM.

0704 788IBPUFS AVAILABLE PRIOR TO JANUARY 1962

PUNCHES A FOURIER SERIES ONTO BINARY RELOCATABLE CARDS. CANONICAL REPRESENTATION IS USED, BUT NO RESTRICTIONS ARE IMPOSED ON THE INDEX VECTORS. TIMING 100 CARDS PER MINUTE MAXIMUM.

0704 788IBRFST AVAILABLE PRIOR TO JANUARY 1962

READS, WITH CHECKING, A FOURIER SERIES FROM BINARY TAPE INTO CORE STORAGE, IN CANONICAL REPRESENTATION.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 788IBSFS1 AVAILABLE PRIOR TO JANUARY 1962

SEARCH A FOURIER SERIES IN CANONICAL REPRESENTATION. FOR THE COEFFICIENT OF A SPECIFIED TERM. TIMING IF P IS THE NUMBER OF TERMS, SINE OR COSINE, OF THE TYPE BEING LOOKED FOR IN THE SERIES, EXECUTION TIME DOES NOT EXCEED 55& 8P CYCLES.

0704 788IBSPFI AVAILABLE PRIOR TO JANUARY 1962

UNPACKS THE INDICES FROM FOURIER SERIES INDEX WORDS, CONVERTS THEM TO NORMALIZED FLOATING-POINT FORM, AND COMPUTES 1 & KB, WHERE I AND K ARE THE INDICES, AND B IS AN ARBITRARY PARAMETER SPFI2 IS DESIGNED FOR USE AS A SUBROUTINE OF ISF1.

0704 788IBSPF2 AVAILABLE PRIOR TO JANUARY 1962

COMPUTES A SPECIAL FUNCTION F OF THE INDICES. IN ONE TERM OF A FOURIER SERIES. USES UPF1 AS A SUBROUTINE.

0704 788IBSPS1 AVAILABLE PRIOR TO JANUARY 1962

SPLITS A FOURIER SERIES. WITH THE FOLLOWING RESULT WITH S1 AS THE INPUT SERIES, THE OUTPUT CONSISTS OF S2 WHICH ARE THOSE TERMS OF S1 WHICH ARE INDEPENDENT OF THETA, AND S3 WHICH IS THE RESULT OF SETTING THE INDEX OF THETA TO ZERO IN EACH TERM OF S1 AND S2.

0704 788IBUPFI AVAILABLE PRIOR TO JANUARY 1962

UNPACKS UP TO 6 INDICES FROM AN INDEX WORD. OF A FOURIER SERIES IN CANONICAL REPRESENTATION AND CONVERTS THEM TO NORMALIZED FLOATING POINT NUMBERS.

0704 788IBWFST AVAILABLE PRIOR TO JANUARY 1962

WRITES A FOURIER SERIES AS ONE BINARY RECORD ON TAPE. WITH LOGICAL CHECK SUM AS THE LAST WORD ON THE RECORD.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 788IBWFS1 AVAILABLE PRIOR TO JANUARY 1962

CONVERTS A FOURIER SERIES IN CANONICAL REPRESENTATION. TO BCD AND WRITES THE BCD SREIES ON ANY DESIRED TAPE. PRINTING IS OPTIONAL.

0704 789IBML1 AVAILABLE PRIOR TO JANUARY 1962

MACHINE LOADING PROBLEM OF LINEAR PROGRAMMING SOLVES A GENERALIZATION OF THE TRANSPORTATION PROBLEM IN WHICH EACH TERM OF ROW AND/OR COLUMN SUMS MAY BE WEIGHTED BY ARBITRARY NON-UNITARY COEFFICIENTS. SAP LISTING DISTRIBUTED IN S.D. 883

0704 791TVME05 AVAILABLE PRIOR TO JANUARY 1962

OPTIMIZED TAPE READ FOR FORMAT 12F6.0 THIS FORTRAN II SUBROUTINE READS FROM TAPE & CONVERTS, AT OPTIMIZED SPEED, DATA PUNCHED IN THE FORMAT 12F6.0. IT ALLOWS READING AND CONVERSION TO PROCEED AT ESSENTIALLY THE SAME SPEED NORMALLY REQUIRED FOR READING ALONE, THUS ELIMINATING THE STOP-START TIME AT INTER-RECORD GAPS.

0704 794RWNP3F AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT /N/ VARIATE PROBABILITY INTEGRAL OBTAINS THE PROBABILITY INTEGRAL FOR N/2 LESS THAN OR EQUAL N LESS THAN OR EQUAL 5/ VARIATES OF THE NORMAL FREQUENCY FUNCTION OVER POLYGONAL REGIONS. REQUIRES 279 CELLS FOR PROGRAM AND CONSTANTS PLUS 14 COMMON.CORR.1208

0704 801NOGWCP AVAILABLE PRIOR TO JANUARY 1962

AUTOMATIC CHECK POINT AND RECOVERY THIS PROGRAM KEEPS A RUNNING RECORD OF THE MAIN PROGRAM BY DUMPING THE CONTENTS OF MEMORY, TAPE UNIT POSITION AND ALL INDICATORS ON THE OPERATORS CONSOLE ONTO A MEMORY TAPE. THIS GIVES A MEANS OF RESTARTING A PROGRAM AT ANY POINT PREVIOUSLY RECORDED WITH A MINIMUM OF LOST TIME.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 804RWMIN AVAILABLE PRIOR TO JANUARY 1962

MINIMIZATION ROUTINE FOR A FUNCTION OF N VARIABLES LOCATES THE MINIMUN OF A FUNCTION OF N VARIABLES REQUIRES 272 CELLS

0704 806IBEXD1 AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION FLOATING POINT EXPONENTIAL SUBROUTINE X BETWEEN -88 AND &88, 18.67 MS FOR EXP/X/, 19.08 MS FOR EXP/-X/, 148 CELLS, LAST 8 ERASABLE

0704 807GDA011 AVAILABLE PRIOR TO JANUARY 1962

FORTRAN II DOUBLE-PRECISION FLOATING-POINT PACKAGE

0704 809PFTES1 AVAILABLE PRIOR TO JANUARY 1962

FORTRAN INPUT/OUTPUT TRANSFORMATION THIS SUBROUTINE PERMITS CHANGING ANY I/O STATEMENT/S/ FROM ON LINE TO OFF LINE AND/OR VICE VERSA. REQUIRES 55 OCTAL STORAGE CELLS&3 COMMON.

0704 812GPFMGP AVAILABLE PRIOR TO JANUARY 1962

EXTENTION OF FORTRAN 2 SOURCE LANGUAGE TO INCLUDE ABBREVIATIONS AND MACHINE LANGUAGE INSTRUCTIONS

0704 815PFTNP1 AVAILABLE PRIOR TO JANUARY 1962

NON-PARAMETRICAL TEST OF DISTRIBUTIONS. TWO SEQUENCES OF DATA BEING GIVEN COMING FROM TESTS FOR THE IDENTITY OF THESE PARENT DISTRIBUTIONS.

0704 817GIFPSR AVAILABLE PRIOR TO JANUARY 1962

FLOATING-POINT SQUARE-ROOT SUBROUTINE COMPUTES THE SQUARE ROOT OF A FLOATING-POINT NUMBER SITUATED IN THE AC AND MQ REGISTERS.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 818CESCRL AVAILABLE PRIOR TO JANUARY 1962

COMPREHENSIVE LINEAR PROGRAMMING ON THE IBM 704. SCROL IS A COMPREHENSIVE OPERATING SYSTEM FOR PERFORMING LINEAR PROGRAMMING COMPUTATIONS ON THE IBM 704. USES RS-LPS1 AS A BASE. INCORPORATES A WHOLE NEW DIMENSION OF CONTROL FOR L.P. ON 700 SERIES MACHINES.REQUIRES AT LEAST 8K CORE STORAGE 8K DRUM STORAGE, ON-LINE CARD READER, CARD PUNCH, 6 SENSE SWITCHES, 6 TAPE UNITS/PREFERABLY 7/, AND PERIPHERAL TAPE TO PRINTER. SCROL IS NOT SUITABLE FOR INCORPORATION IN ANOTHER OPERATING SYSTEM. CORR/ 831, 840, 888

0704 820RWCSHS AVAILABLE PRIOR TO JANUARY 1962

FORTRAN CARD IMAGE READ ROUTINE /CSH/S FOR FINP5 704 TO READ CARDS IF SSW 1 IS UP. 36 WDS TOTAL 0.

0704 821LRSFDT AVAILABLE PRIOR TO JANUARY 1962

SIX DEGREE OF FREEDOM DYNAMIC TRAJECTORY PROGRAM V PROGRAM USES FOURTH-ORDER RUNGE-KUTTA TYPE INTEGRATION ON 17 SIMULTANEOUS ORDINARY DIFFERENTIAL EQUATIONS TO OBTAIN A TIME HISTORY OF THE MOTIONS OF AN AERODYNAMICALLY SYMMETRICAL VEHICLE OF CONSTANT MASS IN A STANDARD ATMOSPHERE. THE EARTH IS ASSUMED SPHERICAL AND NON-ROTATING. SEE 846

0704 822TVREM AVAILABLE PRIOR TO JANUARY 1962

MAIN REGRESSION PROGRAM A MULTIPLE REGRESSION PROGRAM WHICH PERFORMS ANALYSES OF A DEPENDENT VARIABLE AND ALL LINEAR COMBINATIONS OF UP TO NINE INDEPENDENT VARIABLES. THE MAXIMUM NUMBER OF VARIATIONS DEPENDS UPON THE SIZE OF THE 704 /8K, 16K, OR 32K/. THE PROGRAM FURNISHES A MATRIX OF VARIATIONS AND CO-VARIATIONS AND ALSO THE REGRESSION COEFFICIENTS OF ALL INDEPENDENT VARIABLE COMBINATIONS ALONG WITH THE EXPLAINED VARIATIONS OF EACH COMBINATION.

0704 825JPASNQ AVAILABLE PRIOR TO JANUARY 1962

ARCSINE, ARCOSINE FLOATING POINT--QUADRANT ALLOCATION COMPUTES THE ARCSINE OR ARCOSINE OF A FLOATING POINT NUMBER WITH PROPER QUADRANT ALLOCATION. RESULT IS IN RADIANS. SEVEN SIGNIFICANT DECIMAL DIGITS ACCURACY. PROGRAM REQUIRES 86 CELLS, NO COMMON.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 825JPATNQ AVAILABLE PRIOR TO JANUARY 1962

ARCTANGENT, FLOATING POINT--QUADRANT ALLOCATION
COMPUTES THE ARCTANGENT OF A FLOATING POINT NUMBER WITH PROPER QUADRANT ALLOCATION. RESULT IS IN RADIANS. SEVEN SIGNIFICANT DECIMAL DIGITS ACCURACY. PROGRAM REQUIRES 51 PROGRAM CELLS, NO COMMON.

0704 825JPDEQ AVAILABLE PRIOR TO JANUARY 1962

DIFFERENTIAL EQUATIONS SOLVER
SOLVES SIMULTANEOUS DIFFERENTIAL EQUATIONS WITH INTERRUPTIBLE INTEGRATION ON EITHER THE INDEPENDENT OR THE DEPENDENT VARIABLES. METHOD USED IS A FOURTH ORDER RUNGE KUTTA. STORAGE REQUIREMENTS ARE 452 WORDS FOR PROGRAM, PLUS 6 WORDS OF COMMON.

0704 825JPINT AVAILABLE PRIOR TO JANUARY 1962

GENERAL INTERGRAL EVALUATOR
GENERATES THE SIMPSON RULE APPROXIMANTS FOR ANY TYPE OF INTEGRAL EXPRESSION, WHETHER ITERATED INTEGRAL, MULTIPLE INTEGRAL, VECTOR VALUED INTEGRAL FROM A VECTOR VALUED FUNCTION, OR THE INTEGRAL OF A FUNCTION OF OTHER INTEGRALS. REQUIRES 92 WORDS PLUS 1 COMMON.

0704 830MINOLD AVAILABLE PRIOR TO JANUARY 1962

PRINT BSS LOADER DIAGNOSTICS
MINOLD-A 704 SAP-CODED FORTRAN II SUBPROGRAM TO SUPPLY ON-LINE DIAGNOSTIC COMMENTS ON THE ACTIVATED ERROR STOPS OF MIBSS2 LOADER.

0704 830MIOCTF AVAILABLE PRIOR TO JANUARY 1962

OCTAL CORRECTION CARD READER
MIOCTF-A 704 SAP-CODED FORTRAN II SUBPROGRAM TO LOAD RELOCATABLE OR ABSOLUTE OCTAL CORRECTION CARDS AND COMMENT CARDS. CORRECTIONS AND COMMENTS MAY BE LOGGED ON OUTPUT TAPE 2.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 833RWBJY0 AVAILABLE PRIOR TO JANUARY 1962

BESSEL FUNCTIONS J0/X/AND Y0/X/
GIVEN X, TO APPROXIMATE THE BESSEL FUNCTIONS J0/X/AND/OR Y0/X/,REQUIRES 275 CELLS.

0704 833RWBJY1 AVAILABLE PRIOR TO JANUARY 1962

BESSEL FUNCTION J1/X/ AND Y1/X/
GIVEN X, TO APPROXIMATE THE BESSEL FUNCTIONS J1/X/ AND/OR Y1/X/,REQUIRES 278 CELLS.

0704 837ORBFNL AVAILABLE PRIOR TO JANUARY 1962

BESSEL FUNCTIONS OF THE FIRST KIND FOR NLLS.
OR NLLS MUST BE USED.MODIFIED VERSION OF CS BSL2.USES 88 . LOCATIONS IN LOWER MEMORY. CORR/ 838

0704 837ORNLLS AVAILABLE PRIOR TO JANUARY 1962

NON-LINEAR LEAST SQUARES.
ITERATES FOR THE LEAST SQUARES ESTIMATES OF PARAMETERS WHEN DATA ARE BEING FITTED WITH NON-LINEAR FUNCTIONS.THE USER PROVIDES A PROGRAM TO EVALUATE THE FUNCTION AND ITS DERIVATIVES.THE VARIANCE OF ANY FUNCTION OF THE PARAMETERS CAN BE ESTIMATED.

0704 837OROUNL AVAILABLE PRIOR TO JANUARY 1962

FLOATING-POINT OVERFLOW/UNDERFLOW ROUTINE FOR NLLS.
OR NLLS MUST BE USED.PRINTS ON-LINE THE LOCATION OF THE ORDER CAUSING FLOATING-POINT OVERFLOW OR UNDERFLOW.SETS OVERFLOWED REGISTERS TO 35 BINARY ONES WITH THE CORRECT SIGN AND UNDERFLOWED REGISTERS TO ZERO.USES 60 LOCATIONS.

0704 837ORSCNL AVAILABLE PRIOR TO JANUARY 1962

SINE AND COSINE FUNCTIONS FOR NLLS.
OR NLLS MUST BE USED.MODIFIED VERSION OF IB SIN1.USES 104 LOCATIONS IN LOWER MEMORY. CORR/ 838

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 830MIOCTN AVAILABLE PRIOR TO JANUARY 1962

OCTAL CORRECTION CARD READER
MIOCTN-A 704 SAP-CODED FORTRAN II SUBPROGRAM TO LOAD RELOCATABLE OR ABSOLUTE OCTAL CORRECTION CARDS AND COMMENT CARDS. CORRECTIONS AND COMMENTS MAY BE LOGGED ON-LINE.

0704 830MISLAM AVAILABLE PRIOR TO JANUARY 1962

FORTRAN OVERLOADER SUBPROGRAM
MISLAM-A 704 SAP-CODED SUBPROGRAM THAT ACTS AS AN OVERLOADER FOR RUNNING PROGRAMS THAT EXCEED CORE MEMORY SIZE. CORR. DIST. 866

0704 830MISTPF AVAILABLE PRIOR TO JANUARY 1962

WRITE BSS LOADER STORAGE MAP
MISTPF-A 704 SAP-CODED FORTRAN II SUBPROGRAM THAT WRITES ON TAPE 2 THE CORE MEMORY STORAGE MAP FORMED BY THE MIBSS2 LOADER.

0704 830MISTPN AVAILABLE PRIOR TO JANUARY 1962

WRITE BSS LOADER STORAGE MAP
MISTPN-A 704 SAP-CODED FORTRAN II SUBPROGRAM THAT PRINTS ON-LINE THE CORE MEMORY STORAGE MAP FORMED BY THE MIBSS2 LOADER.

0704 830MIWTPE AVAILABLE PRIOR TO JANUARY 1962

WRITE CORE IMAGE ON TAPE
MIWTPE-A 704 SAP-CODED FORTRAN II SUBPROGRAM THAT WRITES THE CONTENTS OF CORE MEMORY AS A SINGLE SELF-LOADING RECORD ON TAPE 4.

0704 832BECPK AVAILABLE PRIOR TO JANUARY 1962

COMPLEX NUMBER INTERPRETIVE SYSTEM /FLOATING POINT/
A TWO-ADDRESS COMPLEX NUMBER INTERPRETIVE SYSTEM DESIGNED TO WORK WITHIN SAP PROGRAMS. IT OFFERS A TOTAL OF TWELVE ALGEBRAIC OPERATIONS, FOUR CONTROL OPERATIONS AND THREE TRACE OPERATIONS. INDEXING IS AVAILABLE BUT IS LIMITED TO ONE INDEX REGISTER.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 837ORT05 AVAILABLE PRIOR TO JANUARY 1962

STUDENTS T AT .05 LEVEL
COMPUTES STUDENTS T AT THE .05 LEVEL FOR A FIXED OR FLOATING POINT ARGUMENT. TIMING - 1.6 MS. USES 75 LOCATIONS IN LOWER MEMORY.

0704 837ORX3NL AVAILABLE PRIOR TO JANUARY 1962

EXPONENTIAL/3/ROUTINE FOR NLLS.
OR NLLS MUST BE USED.COMPUTES E TO X, 10 TO X, LOGE X, LOG10 X, AND A TO X.INCLUDES A MODIFIED VERSION OF IB FXP. THE LOG ROUTINE RETURNS AT LEAST 7 SIGNIFICANT DIGITS.TIMING FOR LOGE X IS 2.1 MS.THE PACKAGE USES 155 LOCATIONS IN LOWER MEMORY.

0704 843ORCLK AVAILABLE PRIOR TO JANUARY 1962

ROUTINES TO READ A CHRONO-LOG CLOCK VIA 716 ECHO ENTRY TIME IN BCD AND/OR BINARY. DATE FROM SWITCHES, OPTIONAL.

0704 843ORICBH AVAILABLE PRIOR TO JANUARY 1962

INCREMENT COLUMN BINARY IMAGE OF HOLLERITH NUMBER
ADDS 1 TO 3-DIGIT HOL. NO. IMAGE IN 1 COLUMN-BINARY WORD.

0704 844MEGPL1 AVAILABLE PRIOR TO JANUARY 1962

GENERAL PROGRAM LOADER
5 CARD SELF-LOADING PROGRAM WHICH LOADS BINARY, OCTAL AND TRANSFER CARDS, ANY OF WHICH MAY BE EITHER ABSOLUTE OR RELOCATABLE. USES 167 OCTAL LOCATIONS. LOCATION IN CORE IS DETERMINED AT ASSEMBLY TIME.

0704 848ARBSS2 AVAILABLE PRIOR TO JANUARY 1962

FN II BINARY SYMBOLIC SUBROUTINE LOADER WITH FL.PT.OFL.
LOADS FORTRAN II PROGRAMS WITH SAME STOPS AS NORMAL BSS BSS LOADER. LOADS OCTAL CORRECTIONS, TWO WORDS PER CARD. ENTERS FLOATING POINT TRAP AND WILL STOP ON OVERFLOW,BUT WILL CORRECT OFFENDING REGISTER/S/ UPON UNDERFLOW.

0704 848ARCSI1 AVAILABLE PRIOR TO JANUARY 1962

FN II SINE-COSINE INTEGRAL SUBROUTINE
COMPUTES INTEGRAL //SIN/Y//Y/*DY/ FROM 0 TO X AND INTEGRAL //COS/Y//Y/*DY/ FROM INFINITY TO X, FOR X GOING FROM MINUS TO PLUS INFINITY. REQUIRES AR TOR 1. USES 606 WORDS.

0704 848ARDMP1 AVAILABLE PRIOR TO JANUARY 1962

FN II FLOATING POINT OR INTEGER DUMP SUBROUTINE
DUMPS BY BLOCK OR SINGLE VARIABLES IN EITHER FLOATING POINT OR INTEGER FORMAT. EACH DUMP WILL BE IDENTIFIED. USES 220 WORDS OF STORAGE.

0704 848ARFER1 AVAILABLE PRIOR TO JANUARY 1962

FN II ERROR WALK-BACK SUBROUTINE
WRITES ON TAPE,CONSOLE STATUS, WHERE ERROR OCCURED BY SUBROUTINE NAME AND FORMULA NUMBERS. WILL WALK BACK TO SUPERPROGRAM. REQUIRES 276 WORDS OF STORAGE. CORR/ 905

0704 848ARGEN1 AVAILABLE PRIOR TO JANUARY 1962

FN II AREA SET GENERATOR SUBROUTINE.
CHANGES ENTRY SET-UP TO HIGH-SPEED PROGRAM FOR QUICK LOOP TO STORE A GIVEN VALUE IN SEVERAL EQUAL ARRAYS. REQUIRES 35 WORDS OF STORAGE.

0704 848ARHED1 AVAILABLE PRIOR TO JANUARY 1962

PAGE HEADING OUTPUT FORTRAN II SUBROUTINE
WILL READ A HEADING CARD FROM CARDS OR TAPE,UNDER SENSE SWITCH CONTROL, MAY RECEIVE LINE FROM AR INS 2 OR AR SYM 1. WILL PRINT LINE. WILL WRITE LINE ON TAPE,THEN UNDER SENSE SWITCH CONTROL,MAY ALSO PRINT LINE. REQUIRED BY EITHER AR INS 2 OR AR SYM 1. REQUIRES AR R/L 1. USES 163 WORDS OF STORAGE PLUS SUBROUTINE.

0704 848ARINS2 AVAILABLE PRIOR TO JANUARY 1962

SINGLE DIMENSION SYMBOLIC FORTRAN II INPUT SUBROUTINE
DATA FROM CARDS OR TAPE PER SENSE SWITCH OR LITE. STORES FLOATING OR FIXED POINT AND INTEGERS PER SYMBOL GIVEN IN CALL STATEMENT. WILL GENERATE TABLES OF FLOATING POINT OR INTEGER NUMBERS. WILL SET A VECTOR TO A GIVEN FLOATING POINT OR INTEGER VALUE. WILL READ A 72-COL.LINE OF TEXT FOR HEADING PAGES OF OUTPUT. REQUIRES AR HED 1 FOR OUTPUT OF HEADING LINE. REQUIRES 492 WORDS PLUS SUBROUTINES.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 848ARNXN1 AVAILABLE PRIOR TO JANUARY 1962

FN II SIMULTANEOUS LINEAR EQUATION SOLUTION SUBROUTINE
SOLVES N * N SYSTEM OF SIMULTANEOUS LINEAR EQUATIONS BY PROCESS OF DIAGONALIZATION. USES 244 WORDS OF STORAGE

0704 848ARPLN1 AVAILABLE PRIOR TO JANUARY 1962

FN II NTH DEGREE LEAST SQU COEF COMPUTATION SUBROUTINE
COMPUTES COEFFICIENTS OF NTH DEGREE POLYNOMIAL BY LEAST SQUARES METHOD. MINIMIZING SUM OF SQUARES OF DEVIATIONS FROM AVERAGE. USES 330 WORDS OF STORAGE.

0704 848ARR/L1 AVAILABLE PRIOR TO JANUARY 1962

FORTRAN II /RTN/ AND /LEV/ WITH FLOATING TRAP TEST
THE STANDARD FORTRAN II /RTN/ AND /LEV/ ROUTINES HAVE BEEN REARRANGED TO RESTORE INDEX REGISTERS AND RESET FLOATING POINT TRAP IF IT WAS ON. REQUIRES 98 WORDS PLUS SUBROUTINES

0704 848ARSYM1 AVAILABLE PRIOR TO JANUARY 1962

MULTI-DIMENSION SYMBOLIC FORTRAN II INPUT SUBROUTINE
DATA FROM CARD OR TAPE PER SENSE SWITCH OR LITE. STORES FLOATING OR FIXED POINT AND INTEGERS PER SYMBOL GIVEN IN CALL STATEMENT. WILL GENERATE TABLES OF FLOATING POINT OR INTEGER NUMBERS. WILL SET A VECTOR TO A GIVEN FLOATING POINT OR INTEGER VALUE. WILL LOAD ALL VALUES ROW-WISE FOR MULTI-SUBSCRIPT REFERENCES ON INPUT RECORDS. WILL READ A 72- COLUMN HEADING LINE AND STORE IT IN AR HED 1 FOR LATER OUTPUT TITLE REQUIRE AR HED 1 FOR HEADING OUTPUT AND AR R/L 1 FOR CONSOLE PRESERVATION. REQUIRES 771 WORDS EXCLUDING SUBROUTINES

0704 848ARTOR1 AVAILABLE PRIOR TO JANUARY 1962

FN II FACTORIAL COMPUTATION SUBROUTINE
COMPUTES /N FACTORIAL/, GIVEN N AS A FORTRAN INTEGER. REQUIRED BY AR CSI 1. USES 50 WORDS OF STORAGE

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 849MIDIAT AVAILABLE PRIOR TO JANUARY 1962

DIATOMIC MOLECULAR INTEGRAL PROGRAM
PROGRAM CALCULATES ANY OR ALL 1 AND 2 ELECTRON 1 AND 2 CENTER INTEGRALS BETWEEN SETS OF BASIS FUNCTIONS BY NUMERICAL INTEGRATION USING THE BARNETT-COULSON METHOD FOR THE 2 CENTER INTEGRALS. THE BASIS SET MAY CONSIST OF UP TO 20 FUNCTIONS PER CENTER. A FUNCTION CONSISTS OF A LINEAR COMBINATION OF SLATER ORBITALS /16 TERMS MAXIMUM/. INDICATIONS OF INTEGRAL AND SUM CONVERGENCE ARE GIVEN. PUNCHED/PRINTED/BINARY OUTPUT.

0704 850BSORTH AVAILABLE PRIOR TO JANUARY 1962

GENERAL ORTHONORMALIZING SUBROUTINE.
A.ORTHONORMALIZES A SET OF VECTORS WITH RESPECT TO A GENERAL INNER PRODUCT. B. APPROXIMATES A GIVEN FUNCTION BY A LINEAR COMBINATION OF ARBITRARY FUNCTIONS DEFINED NUMERICALLY BY A SET OF VALUES. C.FINDS BEST /LEAST SQUARE/ POLYNOMIAL FIT TO GIVEN FUNCTIONS. D. DETERMINES ORTHONORMAL EXPANSIONS OF FUNCTIONS. E. FINDS BEST SOLUTION /IN L.S.S./ TO A SYSTEM OF M LINEAR EQUATIONS IN N UNKNOWNS./N LESS THAN OR ECUAL TO M/. CODE OCCUPIES 1111 CELLS AND USES 15 COMMON CELLS. 1221

0704 853ME0208 AVAILABLE PRIOR TO JANUARY 1962

FORTRAN OUTPUT MERGE PROGRAM
PRODUCES A SAP-LIKE LISTING FROM THE BINARY AND BCD INFORMATION PRODUCED BY A SUCCESSFUL FORTRAN SINGLE COMPILATION. USES LOAD CARD SEQUENCE W HICH TERMINATES FORTRAN COMPILATION.

0704 856CVVIPE AVAILABLE PRIOR TO JANUARY 1962

VARIABLE INFORMATION PROCESSING PACKAGE ECUIVALENCE
SAP EQUIVALENCE DECK TO BE ASSEMBLED WITH SAP ROUTINES USING CV-VIPP.

0704 856CVVIPP AVAILABLE PRIOR TO JANUARY 1962

VARIABLE INFORMATION PROCESSING PACKAGE
GENERAL PURPOSE DATA PROCESSING SUBROUTINE SYSTEM FOR 704

1 READ-WRITE BUFFERED TAPES	9 TAPE CONTROL COUNTS
2 VARIABLE LENGTH ITEMS	10 TAPE SENTINELS
3 VARIABLE PARTS OF ITEMS	11 MULTIREEL TAPE LOGIC
4 POSITION TAPES BY RCD OR FILE	12 PRINT ON-LINE
5 CHANGE COLLATING SECUENCE	13 DECIMAL SHIFTING
6 WORD BLOCK AND FIELD MOVES	14 SEQUENCE WORDS
7 BCD AND BIN CONVERSIONS	15 TABLE LOOKUP
8 DRUM USE OPTIONAL	16 FAVORABLE RUN TIME

CORR/ 925

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 858GS5412 AVAILABLE PRIOR TO JANUARY 1962

CONTINUED FRACTIONS CURVE FITTING AND INTERPOLATION
FROM A SET OF GIVEN POINTS ON A CURVE,THIS PROGRAM CALCULATES TWO EQUATIONS PASSING EXACTLY THROUGH THE POINTS.ONE EQUATION BY THE CONTINUED FRACTION METHOD, AND ONE EQUATION BY THE DIVIDED DIFFERENCE METHOD. ALSO, THE PROGRAM INTERPOLATES /OR EXTRAPOLATES/ TWO SETS OF Y VALUES /ONE FOR EACH OF THE TWO EQUATIONS CALCULATED/ FOR A GIVEN SET OF X VALUES.

0704 859GSL165 AVAILABLE PRIOR TO JANUARY 1962

LEAST SQUARES RATIONAL FUNCTION CURVE FITTING
FROM A SET OF POINTS ON A CURVE, THIS PROGRAM MAKES A SEARCH FOR THE FUNCTIONS WHICH FIT THE CURVE CLOSELY, USING A LEAST SQUARES METHOD. THE RATIONAL FUNCTIONS AND POLYNOMIALS /WHEN THE DENOMINATOR-1.0/ FITTED TO THE CURVE ARE OF THE FOLLOWING FORM--Y-/A1&A2*X&A3*X**2&A4*X**3&.../ / /1.0&B1*X&B2*X**2.../

0704 861ERTSDA AVAILABLE PRIOR TO JANUARY 1962

TIME SERIES DECOMPOSITION AND ADJUSTMENT
FORTRAN PROGRAM TO ADJUST SEASONAL AND IRREGULAR TIME SERIES TO A FORM THAT SHOWS PRIMARILY THE TREND-CYCLICAL MOVEMENTS. SEASONAL FACTORS, IRREGULAR FLUCTUATIONS AND MANY SUMMARY MEASURES USEFUL IN TIME SERIES ANALYSIS ARE COMPUTED IN THE PROCESS. BASICALLY ADAPTATION OF TENNESSEE VALLEY AUTHORITY PROGRAM /TV TSDA/ TO 8K 704. PROGRAM ALSO EXTENDED TO PERMIT /1/ ADJUSTING FOR DELIVERY DAYS AND /2/ FITTING LEAST SQUARES TREND LINE AS FORECASTING AID.

0704 863RSM001 AVAILABLE PRIOR TO JANUARY 1962

FORTRAN MATHEMATICAL PROGRAMMING SYSTEM ONE
A SYSTEM OF ROUTINES FOR LINEAR PROGRAMMING WRITTEN ALMOST ENTIRELY IN THE FORTRAN LANGUAGEC THE REVISED TIMPLEX METHOD WITH EXPLICIT INVERSE IS USED, WITH SINGLE-OR DOUBLE PRECISION OPTION. THE PREOENT OBJECT PROGRAM WAS COMPILED FOR 32K AND HANDLES PROBLEMS HAVING UP TO 97 EQUATIONS, 299 VARIABLES, AND 2499 NON-ZERO MATRIX ENTRIES. SPECIAL FEATURES INCLUDE OUTPUT FLEXIBILITY, REINVERSION, INTERRUPT ABILITY, USE OF SOSTEM TAPET AND BATC& RUNNING. 5MPHASIS WAS PLACED ON EASE.OF MODIFICATION IN THE SYSTEM DESIGN.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 869RCOCIP AVAILABLE PRIOR TO JANUARY 1962

OFFSET CIRCLE PROBABILITY FUNCTION.
COMPUTES THE OFFSET CIRCLE PROBABILITY FUNCTION, P/A,V/, EQUAL TO THE INTEGRAL FROM ZERO TO V OF X TIMES E TO THE /MINUS 1/2 TIMES THE QUANTITY A SQUARED PLUS X SQUARED/ TIMES THE MODIFIED BESSEL FUNCTION OF THE FIRST KIND OF ORDER ZERO OF AX TIMES DX FOR PARAMETER VALUES A AND V WHERE V IS GREAT ER THAN OR EQUAL TO ZERO.

0704 870ORROMN AVAILABLE PRIOR TO JANUARY 1962

BINARY INTEGER TO ROMAN NUMERAL CONVERSION.
A FORTRAN BINARY INTEGER IS CONVERTED TO A BCD ROMAN NUMERAL

0704 877ECOLOO AVAILABLE PRIOR TO JANUARY 1962

704 SURGE OBJECT LOADER
OLOO IS A ONE CARD LOADER USED TO LOAD SURGE OBJECT PROGRAMS.

0704 877ECSSOO AVAILABLE PRIOR TO JANUARY 1962

704 SURGE SYSTEM START
THE SSOO CARD IS USED TO INITIATE A 704 SURGE COMPILATION.

0704 877ECSURG AVAILABLE PRIOR TO JANUARY 1962

704 SURGE SYSTEM
THE 704 SURGE SYSTEM IS A SELF-CONTAINED COMPILER DESIGNED FOR DATA PROCESSING TYPE PROGRAMS. THE SYSTEM CONVERTS A FIX ED FORMAT SOURCE PROGRAM TO AN ABSOLUTE BINARY PROGRAM, EITHER ON ROW BINARY CARDS OR ON TAPE. THE BINARY SYSTEM DECK MAY BE USED ON 8K, 16K OR 32K MACHINES WITHOUT REQUIRING ANY MODIFICATIONS. THE SYSTEM USES 6 TAPES AND NO DRUMS. BOTH PERIPHERAL AND ON-LINE EQUIPMENT ARE USED.
CORRECTION TO DIST. 877,REFERENCE SSD-70,P-356 906

0704 878BEMIMX AVAILABLE PRIOR TO JANUARY 1962

EXTREMUM OF UNIMODAL FUNCTIONS OF ONE VARIABLE
ANY NUMBER OF FUNCTIONS MAY BE MAXIMIZED /MINIMIZED/. THE DESIRED ACCURACY MAY BE SPECIFIED, OR THE NUMBER OF FUNCTIONAL VALUES TO BE USED MAY BE SPECIFIED AND THE PROGRAM WILL CALCULATE THE EXTREMUM TO THE BEST ACCURACY THEN POSSIBLE. THE PROGRAM HAS ADDITIONAL ERROR PRINTOUTS.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 878BEMSD1 AVAILABLE PRIOR TO JANUARY 1962

ESTIMATION FROM DOUBLY TRUNCATION SAMPLES
ESTIMATES THE MEAN AND STANDARD DEVIATION OF THE ORIGINAL POPULATION FROM A DOUBLY TRUNCATED SAMPLE OF A NORMAL POPULATION WHERE THE AMOUNT OF TRUNCATION IS UNKNOWN AND THE TRUNCATION POINTS ARE KNOWN.
THE COVARIANCE MATRIX OF THE ESTIMATES BASED ON THE ASYMPTOTIC PROPERTIES OF THE ESTIMATES IS ALSO GIVEN.

0704 879MI4BCD AVAILABLE PRIOR TO JANUARY 1962

MANIPULATE BCD-CODED DATA, INCLUDING I/O
704 SAP-CODED FORTRAN SUBPROGRAMS.

0704 880IBINT1 AVAILABLE PRIOR TO JANUARY 1962

INTERVAL ARITHMETIC SUBROUTINE
AN ARBITRARY SEQUENCE OF THE FOUR ARITHMETIC OPERATIONS IS PERFORMED ON INTERVALS BY INTERPRETATION OF THE CALLING SEQUENCE. ROUND-OFF ERROR IS INCLUDED IN THE RESULTANT INTERVALS. EACH INTERVAL IS REPRESENTED BY ITS TWO ENDPOINTS. EACH ENDPOINT IS IN SINGLE-PRECISION NORMALIZED FLOATING-POINT FORM. UNDERFLOW IS AUTOMATICALLY ELIMINATED. OVERFLOW RESULTS IN PROGRAMMED INTERRUPTION. REQUIRES 456 LOCATIONS. AVERAGE EXECUTION TIME ABOUT 1.7 MS. PER OPERATION.

0704 880IBRRP1 AVAILABLE PRIOR TO JANUARY 1962

REAL ROOTS OF A REAL POLYNOMIAL USING INTERVAL ARITH.
PROGRAM IS IN THE FORM OF AN INTERNAL SUBROUTINE. OUTPUT IS A SEQUENCE OF CLOSED FINITE INTERVALS, EACH CONTAINING AT LEAST ONE, AND HOPEFULLY ONLY ONE. REAL ROOT OF THE POLYNOMIAL. THE INTERVALS ARE MADE AS SMALL AS POSSIBLE, CONSISTENT WITH ACCOUNTING FOR ALL ROUND-OFF ERROR. COEFFICIENTS OF THE POLYNOMIAL MAY ALSO BE INTERVALS. USES IB INT1 FOR INTERVAL ARITH. REQUIRES 470 LOCATIONS EXCLUSIVE OF INT1.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 880IBRRP2 AVAILABLE PRIOR TO JANUARY 1962

REAL ROOTS OF A REAL POLYNOMIAL USING INTERVAL ARITH.
PROGRAM IS SELF-LOADING AND PROVIDES EXTERNAL DECIMAL INPUT AND OUTPUT. OTHERWISE IT IS LIKE IB RRP1, WHICH IS USED AS A SUBROUTINE.

0704 880IBSME1 AVAILABLE PRIOR TO JANUARY 1962

SOLUTION OF MATRIX EQUATION AX-B USING INTERVAL ARITH.
PROGRAM IS IN THE FORM OF AN INTERNAL SUBROUTINE. THE ELEMENTS OF OUTPUT MATRIX X ARE CLOSED FINITE INTERVALS WHICH CONTAIN THE ELEMENTS OF THE EXACT SOLUTION, ROUND-OFF ERROR ACCOUNTED FOR. USEFUL FOR MATRICES OF SMALL ORDER, SAY 15 OR LESS. USES FORM OF GAUSS ELIMINATION. EMPLOYS IB INT1 FOR INTERVAL ARITHMETIC. REQUIRES 491 LOCATIONS EXCLUSIVE OF IB INT1.
EXECUTION TIME ABOUT .6M/6MN&2MM&M&6N/ MILLI-SECONDS, WHERE A IS MXM AND B IS MXN.

0704 880IBSME2 AVAILABLE PRIOR TO JANUARY 1962

SOLUTION OF MATRIX EQUATION AX-B USING INTERVAL ARITH.
PROGRAM IS SELF-LOADING AND PROVIDES EXTERNAL DECIMAL INPUT AND OUTPUT. OTHERWISE IT IS LIKE IB SME1, WHICH IS USED AS A SUBROUTINE.

0704 881HKATM1 AVAILABLE PRIOR TO JANUARY 1962

ARDC ATMOSPHERE SUBROUTINE
COMPUTES 7 ATMOSPHERIC PROPERTIES /DENSITY, SPEED OF SOUND, TEMPERATURE, MOLECULAR-SCALE TEMPERATURE, PRESSURE, COEFFICIENT OF VISCOSITY, AND MOLECULAR WEIGHT/ AS FUNCTIONS OF ALTITUDE, BASED ON THE 1959 AND 1956 ARDC MODEL ATMOSPHERES. VALUES DIFFER FROM THE 1959 MODEL ONLY ABOVE 300,000 FEET. USE OF THE 1956 MOLECULAR WEIGHT EQUATIONS FOR ALTITUDES GREATER THAN 300,000 FEET CAUSES MOLECULAR WEIGHT AND TEMPERATURE TO VARY FROM THE 1959 MODEL. REQUIRES EXP, LOG, AND SQRT SUBROUTINES. 176 STORAGE CELLS & 7 COMMON.

0704 884PKHMEE AVAILABLE PRIOR TO JANUARY 1962

EIGENVALUES AND EIGENVECTORS OF A HERMITIAN MATRIX.
JACOBI,S METHOD IS USED. THE MATRIX ELEMENTS ARE SINGLE-PRECISION, NORMALIZED FLOATING-POINT NUMBERS. THE ELEMENTS MAY BE GIVEN IN EITHER RECTANGULAR OR POLAR FORM AND THE OUTPUT MAY BE OBTAINED IN EITHER FORM. THE SUBROUTINE REQUIRES 998 LOCATIONS PLUS 23 LOCATIONS OF COMMON AND /7/2N2 - 1/2N & 1/ LOCATIONS PROVIDED BY USER.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 884PKKWIC AVAILABLE PRIOR TO JANUARY 1962

KEY WORD IN CONTEXT
EACH WORD IN A SERIES OF BIBLIOGRAPHY TITLES IS LOOKED UP IN A TABLE TO DETERMINE ITS STATUS AS EITHER A KEY WORD OR A COMMON WORD. FOR EACH KEY WORD FOUND 60 CHARACTERS OF THE SURROUNDING TITLE AS PUT OUT WITH THE EMBEDDED KEY-WORD BEGINNING AT THE 256TH CHARACTER. THE TOTAL KEY WORD IN CONTEX OUTPUT MAY BE STORED TO PRODUCE AN INDEX FOR THE BIBLIOGRAPHY AUTHOR AND SOURCE INFORMATION ATTENDANT TO EACH TITLE IS CONDENSED IN A STANDARD FASHION TO 11 CHARACTERS FOR OUTPUT WITH EACH KEY WORD IN THE CORRESPONDING TITLE.

0704 891MURKY4 AVAILABLE PRIOR TO JANUARY 1962

MURA FIXED POINT RUNGE-KUTTA
SOLVES A SET OF N SIMULTANEOUS FIRST ORDER DIFFERENTIAL EQUATIONS. 48 WORDS OF PROGRAM PLUS 3 COMMON PLUS 3N WORDS OF STORAGE. TIMING /4.12N&0.59&4/AUXILLIARY TIME// MS. PER INTEGRATION STEP.

0704 895TAVILB AVAILABLE PRIOR TO JANUARY 1962

VIPP INSERT LEADING BLANKS.
MODIFIES BCD FIELDS FORM LEFT TO RIGHT UNTIL END OF FIELD OR ENCOUNTERING CHARACTER OTHER THAN ZERO, BLANK, PLUS ZERO, MINUS ZERO, PLUS SIGN, OR MINUS SIGN.
REFERENCE MO CV VIPP.

0704 897AAERF2 AVAILABLE PRIOR TO JANUARY 1962

ERROR FUNCTION
EVALUATES ERROR FUNCTION /3.6 MS/ AND/OR NORMAL FREQUENCY FUNCTION /4.0 MS/. REQUIRES 60 LOCATIONS PLUS 2 COMMON. TURNS OFF AC OVERFLOW INDICATOR. VOIDS 436

0704 897AAPDS1 AVAILABLE PRIOR TO JANUARY 1962

POWER DENSITY SPECTRUM
THE SUBROUTINE COMPUTES THE RMS,ARITHMETIC MEAN, AND THE POWERS AT A SPECIFIED FREQUENCY INTERVAL FOR A SET OF DATA THE NUMBER OF DATA POINTS AND THE TIME INCREMENT AT WHICH THE POINTS ARE OBTAINED ARE REQUIRED. THE PROGRAM USES 246 CELLS.

0704 898NUDUMP AVAILABLE PRIOR TO JANUARY 1962

FORTRAN DUMP PROGRAM
THIS SUBROUTINE PRINTS ON OR OFF-LINE DESIGNATED VARIABLE THE NAME OF THE PROGRAM CALLING DUMP AND THE FORMULA NUMBERS.

0704 899MEFEND AVAILABLE PRIOR TO JANUARY 1962

FORTRAN END CARD SEARCH.
FEND SEARCHES A FORTRAN SOURCE PROGRAM TAPE AND STOPS WHEN IT DISCOVERS AN END CARD.

0704 899MEFOTW AVAILABLE PRIOR TO JANUARY 1962

FORTRAN TAPE WRITE PROGRAM.
FOTW WRITES A TAPE FROM A FORTRAN BINARY DECK WHICH CAN BE LOADED BY THE USE OF FLIBL, THE FORTRAN LIBRARY LOADER.

0704 899METOUT AVAILABLE PRIOR TO JANUARY 1962

SELF LOADING TAPE WRITE PROGRAM.
TOUT IS A 3 CARD MODIFICATION TO MEGPL1, THE GENERAL PROGRAM LOADER, TO FACILITATE GENERATION OF SELF-LOADING PROGRAM TAPES. USES 21 OCTAL LOCATIONS DIRECTLY BEHIND MEGPL1.

0704 900NUFRED AVAILABLE PRIOR TO JANUARY 1962

FRACTION REDUCTION TO NORMAL FORM
THIS SUBROUTINE REDUCES A FRACTION TO ITS NORMAL FORM USING A MODIFIED EUCLIDIAN ALGORITHM.

0704 901NUHLU AVAILABLE PRIOR TO JANUARY 1962

MODIFIED QUASI-TRIDIAGONAL MATRIX ROUTINE.
THIS FORTRAN SUBROUTINE SOLVES BY A DIRECT METHOD THE MATRIX EQUATION QV-G WHERE Q IS A QUASITRIDIAGONAL MATRIX. THE METHOD EMPLOYS A PARTITIONED DECOMPOSITION OF Q INTO A PRODUCT OF LOWER AND UPPER TRIANGULAR MATRICES. CORR/ 917

0704 909MPMAPM AVAILABLE PRIOR TO JANUARY 1962

FORTRAN MAP AND MISSING SUBROUTINE PRINT-OUT PROGRAM
PRINTS ON-LINE A MAP OF SUBROUTINE NAMES AND THEIR OCTAL ADDRESSES OR PRINTS OUT MISSING SUBROUTINE NAMES.

0704 910NUWTB AVAILABLE PRIOR TO JANUARY 1962

TO WRITE 2 DIMENSIONAL ARRAY BINARY INFO ON TAPE
TO WRITE TWO-DIMENSIONAL ARRAY OF BINARY INFORMATION ON TAPE,PRECEDED BY TWO INTEGERS GIVING THE NUMBER OF ROWS AND COLUMNS AND FOLLOWED BY A CHECK SUM. A COMPANION PROGRAM NU RTB READS THE BINARY TAPE AND CHECKS THE SUM.

0704 911NURTB AVAILABLE PRIOR TO JANUARY 1962

TO READ AND CHECK NU WTB-WRITTEN RECORDS
TO READ AND CHECK RECORDS OF INFORMATION WHICH HAVE BEEN WRITTEN BY NU WTB. ALSO DETECTS END-OF-FILE.

0704 912ASAS80 AVAILABLE PRIOR TO JANUARY 1962

RELOCATABLE OCTAL-COLUMN BINARY ON LINE FORTRAN LOADER
LOADS FORTRAN RELOCTABLE AND SAP ABSOLUTE COLUMN BINARY CARDS . WILL NOT LOAD ROW BINARY CARDS. PROGRAM CORRECTIONS, NEW PROGRAM BREAKPOINT DEFINITIONS AND COMMON STORAGE REASSIGNMENTS CAN BE MADE BY RELOCATABLE OR ABSOLUTE OCTAL CORRECTOR CARDS. USES 240 LOCATIONS.

0704 913NCKRFP AVAILABLE PRIOR TO JANUARY 1962

KWIC REPORT FOR PRINTING OR PUNCHING
READS SORTED KWIC OUTPUT FROM NC KSP2 AND WRITES A TAPE TO PUNCH OR PRINT. THE TAPE IS IN THE SAME FORMAT AS THE ORIGINAL KWIC OUTPUT.

0704 914NCKSP1 AVAILABLE PRIOR TO JANUARY 1962

KWIC SORT PROGRAM FIRST PART
SORT PROGRAM FOR THE KEY WORDS OF THE PK KWIC PROGRAM. WRITTEN IN SURGE FOR 8K 704. NC KRFP IS NECESSARY TO WRITE THE ACTUAL REPORT. USES NC KSP2 TO COMPLETE THE DECK. NC KSP1 PRECEDES NC KSP2 AS ONE COMPLETE DECK.

0704 902NULUCY AVAILABLE PRIOR TO JANUARY 1962

EXTENDED FORTRAN 2 BSS LOADER
AN EXTENDED BINARY SYMBOLIC SUBROUTINE LOADER WHICH, IN ADDITION TO THE FEATURES OF THE FORTRAN 2 BSS LOADER, PROVIDES OPTIONS FOR THE FOLLOWING
/A/WRITING OF A SELF-LOADING PROGRAM TAPE
/B/READING IN OF MORE BINARY OBJECT PROGRAM CARDS
/C/GENERATION OF A MAP OF THE BINARY SYMBOLIC SUBPROGRAMS IN MEMORY IMMEDIATELY AFTER LOADING EITHER CARDS OR TAPE

0704 904SISCAN AVAILABLE PRIOR TO JANUARY 1962

BCD TAPE-CARD READING FOR MULTIPLE SCAN.
FORTRAN SUBROUTINE SAVES RECORDS READ FROM CARDS OR TAPE. MAKES POSSIBLE REREADING FROM STORAGE WITH DIFFERENT FORMATS OR LISTS, AS CALLED BY SOURCE PROGRAM. REPLACES /TSH/ /CSH/ AND /STH/.

0704 907NUBACK AVAILABLE PRIOR TO JANUARY 1962

BACK TRACE SUBROUTINE WHICH DESCRIBES FLOW OF CONTROL
TO PERFORM A BACK TRACE WHICH DESCRIBES THE FLOW OF CONTROL THROUGH ALL LEVELS OF SUBROUTINES FROM THE MAIN PROGRAM DOWN TO THE POINT WHERE CONTROL WENT TO BACK,GIVING THE NAMES OF ALL SUBROUTINES,THE EXTERNAL AND INTERNAL FORMULA NUMBERS AND THE CURRENT VALUES OF ALL ARGUMENTS

0704 908NURATN AVAILABLE PRIOR TO JANUARY 1962

RATIONAL NUMBER ARITHMETIC
TO PERFORM ARITHMETIC OPERATIONS ON RATIONAL NUMBERS. ACH RATIONAL NUMBER A1/A2 HAS AN EXACT REPRESENTATION IN A SINGLE WORD OF CORE STORAGE IN TERMS OF A1 AND A2 REDUCED TO LOWEST TERMS.RESULTS OF ALL OPERATIONS ARE TESTED FOR OVERFLOW AND DIVISION BY ZERO.

0704 909MPBSSM AVAILABLE PRIOR TO JANUARY 1962

RELOCATABLE FORTRAN BSS LOADER
LOADS BINARY CARDS,BOTH ABSOLUTE AND RELOCATABLE,AND WRITES SYMBOL TABLE ON DRUM 1 FOR USE BY MP-MAPM.

0704 914NCKSP2 AVAILABLE PRIOR TO JANUARY 1962

KWIC SORT PROGRAM SECOND PART
SECOND PART OF NC KSP1 NECESSARY BECAUSE ONE BINARY DECK CANNOT EXCEED 100 CARDS / SEE NC KSP1 /

0704 915TVMRCA AVAILABLE PRIOR TO JANUARY 1962

MULTIPLE REGRESSION, COMPREHENSIVE ANALYSIS
INCORPORATES ALL NORMAL PHASES OF STATISTICAL REGRESSION ANALYSIS. STARTING WITH DATA LISTING OF ALL VARIABLES, COMPUTATION PROCEEDS THRU LEAST SQUARES FITTING. STANDARD STATISTICAL COEFFICIENTS, STANDARD ERRORS, SUMS OF SQUARES, AND AVERAGES ARE COMPUTED AND PRINTED. PREDICTIONS AND RESIDUAL ERRORS FOR EACH ITEM IN DATA LISTING ARE COMPUTED AND PRINTED. OPTIONAL FEATURES INCLUDE USE OF SYNTHETIC OBSERVATIONS AND ALSO RE-EVALUATION OF ANY NUMBER OF ANY COMBINATION OF VARIABLES. CORR/1167

0704 918MEPYRS AVAILABLE PRIOR TO JANUARY 1962

FORTRAN II BINOMIAL COEFFICIENT SUBROUTINE
FOR NON-NEGATIVE, INTEGRAL NUMBERS LESS THAN 131, COMPUTES A SET OF BINOMIAL COEFFICIENTS BY ADDITION IN THE FORTRAN SINGLE-PRECISION FLOATING-POINT MODE AND STORES THEM IN A ONE DIMENSIONAL ARRAY. MAXIMUM ACCURACY IS MAINTAINED DURING THE COMPUTATION. WITH INCLUDED BINARY CORRECTION CARD, INNERMOST LOOP IS 13 CYCLES /ON 704/ AND IS EXECUTED N/N-1//2 TIMES. 6562 IN COMMON.

0704 919MEPYRF AVAILABLE PRIOR TO JANUARY 1962

FORTRAN II BINOMIAL COEFFICIENT FUNCTION SUBPROGRAM
FOR NON-NEGATIVE,INTEGRAL NUMBERS LESS THAN 131,COMPUTES ANY BINOMIAL COEFFICIENT BY ADDITION IN THE FORTRAN SINGLE-PRECISION FLOATING-POINT MODE AND PLACES IT IN THE ACCUMULATOR. STORES A SPECIAL SET OF BINOMIAL COEFFICIENTS IN COMMON, ENABLING ME-PYRF UNDER CERTAIN CONDITIONS TO SIMULATE ME-PYRS.MAXIMUM ACCURACY IS MAINTAINED DURING THE COMPUTATION WITH INCLUDED BINARY CORRECTION CARD, INNERMOST LOOP IS 13 CYCLES /ON 704/ AND IS EXECUTED M/2N-M-1//2 TIMES. 74&134 COM CORR/ 950

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 926TAVIPM AVAILABLE PRIOR TO JANUARY 1962

VIPP MERGER. SECOND PHASE OF A GENERAL PURPOSE TAPE SORTER FOR THE IBM 704. FIRST PHASE IS M1 TA VIPS. PROGRAM CHARACTERISTICS INCLUDE
/1/ABILITY TO MERGE VARIABLE LENGTH ITEMS.
/2/ABILITY TO MERGE ON ANY PORTIONS OF AN ITEM.
/3/CONTROL CHECKSUM TO GUARANTEE THE MERGE.
/4/RECOVERY PROCEDURE.
/5/TAPE COUNTS FOR TAPE ERROR DIAGNOSIS.
/6/2,3,4-WAY TAPE MERGE LOGIC.
/7/FAVORABLE TIMING.

0704 926TAVIPS AVAILABLE PRIOR TO JANUARY 1962

VIPP SORTER. FIRST PHASE OF A GENERAL PURPOSE TAPE SORTER FOR THE IBM 704. SECOND PHASE IS M3 TA VIPM. PROGRAM CHARACTERISTICS INCLUDE
/1/ABILITY TO SORT VARIABLE LENGTH ITEMS.
/2/ABILITY TO SORT NON-VIPP TAPES.
/3/ABILITY TO SORT ON ANY PORTIONS OF AN ITEM.
/4/CONTROL CHECKSUM TO GUARANTEE THE SORT.
/5/RECOVERY PROCEDURE.
/6/TAPE COUNTS FOR TAPE ERROR DIAGNOSIS.
/7/FAVORABLE TIMING.

0704 929OLDPSC AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION SIN-COS ROUTINE
COMPUTES A DOUBLE PRECISION FLOATING POINT SINE OR COSINE OF A DOUBLE PRECISION FLOATING POINT ARGUMENT. THE ARGUMENT MUST BE IN RADIANS. 291 STORAGE CELLS & 26 COMMON.

0704 930GMDYAN AVAILABLE PRIOR TO JANUARY 1962

GMR DYANA DYNAMICS ANALYZER-PROGRAMMER
A PROGRAMMING SYSTEM FOR THE STUDY OF LUMPED-PARAMETER VIBRATION SYSTEMS AND OTHER DYNAMICS SYSTEMS. PART 1 FOR TIME VARYING SOLUTIONS. NONLINEAR/DISCONTINUOUS PARAMETERS ALLOWED USES RKG INTEGRATION. PART 2 FOR FREQUENCY RESPONSE OF LINEAR SYSTEMS. IN EACH CASE DYANA PRODUCES COMPLETE FORTRAN PROGRAM FOR THE SOLUTION OF A PARTICULAR PHYSICAL SYSTEM AND/OR SET OF DIFF. EQNS. ALSO PRODUCES SPECIFICATION SHEET INDICATING FORMAT OF NUMERICAL DATA TO BE USED WITH GENERATED FORTRAN PROGRAM. USES 4 TAPE UNITS, 8K STORAGE. CORR./1189

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 931PKCBR2 AVAILABLE PRIOR TO JANUARY 1962

CUBE ROOT SUBROUTINE
EVALUATES THE CUBE ROOT OF A NORMALIZED FLOATING POINT NUMBER TIMING, 2.580 MILLISECONDS. OBSOLETES PK CBRT.

0704 931PKCOMP AVAILABLE PRIOR TO JANUARY 1962

MEMORY COMPARISON DUMP
COMPARES PROGRAM ON CARDS OR TAPE WITH SAME PROGRAM IN CORE. CORE CONTENTS /AND OPTIONALLY CARD OR TAPE CONTENTS/ OF UN-LIKE WORDS DUMPED WITH CORE LOCATIONS. NON COMPARISON DUMPS ALSO MADE. DUMPS IN MNENIONIC OCTAL OR FLOATING DECIMAL ON LINE OR ON 120 OR 72 CHARACTER TAPE. LOSES CELLS 0 TO 13. PANEL AND CORE MAY BE RESTORED. PROGRAM MAY BE CALLED FROM DRUM.

0704 931PKEXPD AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION FLOATING POINT EXPONENTIAL ROUTINE.
GIVEN A DOUBLE PRECISION FLOATING POINT ARGUMENT IN THE AC-MQ ,PKEXPD COMPUTES THE EXPONENTIAL OF THE ARGUMENT, AND LEAVES THE RESULT IN THE AC-MQ. ANSWER HAS AT LEAST 53 GOOD BITS. ARGUMENT MUST BE LESS THAN 88 IN MAGNITUDE. TIME-8 MS, SPACE 256 CELLS & 13 COMMON.

0704 931PKMTZR AVAILABLE PRIOR TO JANUARY 1962

N-STRIP TRAPEZOIDAL RULE INTEGRATION/EQUAL INTERVALS/
A SHARE TYPE SUBROUTINE FOR THE EVALUATION OF F/X/ FOR THE N VALUES OF X LYING IN THE INTERVAL MUST BE PROVIDED. SUB-ROUTINE CAN BE CONVENIENTLY USED WITH PK TZDR TO OBTAIN TRAP-EZOIDAL RULE FOR TWICE THE NUMBER OF STRIPS, SIMPSONS RULE, ETC. REQUIRES 46 LOCATIONS IN FULL VERSION, 42 IN STRIPPED VERSION. TIMING FOR FULL VERSION IS 1.296&/.336&S/*N M.S., WHERE S IS THE AVERAGE TIME REQUIRED TO EVALUATE F/X/ ONCE.

0704 931PKPSIN AVAILABLE PRIOR TO JANUARY 1962

PSUEDO-INVERSE SUBROUTINE
OBTAINS THE PSUEDO-INVERSE OF A SQUARE OR RETANGULAR MATRIX. PSUEDO-INVERSE HAS THE PROPERTY THAT IN ANY SYSTEM OF EQUATIONS AX-B, PSUEDO-INVERSE TIMES THE B VECTOR REPRESENTS BEST SOLUTION OF THE SYSTEM IN A LEAST SQUARES SENSE.
CORR/ 1010

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 932 EOODD AVAILABLE PRIOR TO JANUARY 1962

704 OCTAL-DECIMAL DUMP
DUMPS ONE OR MORE REGIONS OF CORE IN OCTAL AND/OR FLOATING DECIMAL ONTO TAPE FOR TAPE-CONTROLLED PRINTER. PROVISION IS MADE FOR RESTORATION OF CORE, SELECTION OF OUTPUT TAPE, IDENTIFICATION OF OUTPUT, AND STACKING# SK9PS Z5RO BLOCKS. FULL TAPE SPEED. BINARY DECK INPUT AND CONSOLE CONTROL.

0704 937ERCONV AVAILABLE PRIOR TO JANUARY 1962

LP/90 TO SCROL 704 INPUT CONVERTER
PROGRAM CONVERTS SHARE STANDARD LINEAR PROGRAMMING INPUT DATA FROM LP/90 FORMAT TO SCROL 704 FORMAT. LP/90 FORMAT PERMITS THE USE OF 6 CHARACTER ROW MNEMONICS AND ELIMINATES THE NECESSITY OF SPECIFYING SLACK VECTORS IN THE INITIAL BASIS AND IN THE MATRIX.

0704 958MIMS AVAILABLE PRIOR TO JANUARY 1962

704 MACRO-SAP ASSEMBLER.
A FASTER VERSION OF UASAP3-7 THAT PROVIDES A FASTER AND MORE FLEXIBLE ASSEMBLER. INCLUDES OF MACRO INSTRUCTION FACILITIES, CONDITIONAL COMPILATION, AND SYMBOL REDEFINITION.

0704 959MICND AVAILABLE PRIOR TO JANUARY 1962

A CONDENSER ROUTINE FOR SYMBOLIC INFORMATION.
A CONDENSED SAP LIBRARY TAPE IS PREPARED FOR USE WITH MIMS. SYMBOLIC INSTRUCTIONS ARE COMPRESSED, REMARKS REMOVED, AND PACKED INTO A FIXED LENGTH OUTPUT BLOCK. THE ROUTINES ON THE CONDENSED LIBRARY TAPE ARE STORED AT ABOUT 20 TIMES THE PRESENT DENSITY.

0704 960MIEDS1 AVAILABLE PRIOR TO JANUARY 1962

AN EDITOR FOR SAP SYMBOLIC DECKS.
A SYMBOLIC MASTER DECK IS EDITED BY INSERTIONS AND DELETIONS TO PRODUCE AN UPDATED SYMBOLIC DECK.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 962SQSIMQ AVAILABLE PRIOR TO JANUARY 1962

SIMULTANEOUS EQUATIONS SOLVER
THIS IS A SELF CONTAINED FORTRAN PROGRAM DESIGNED TO OBTAIN A VECTOR SOLUTION OF N SIMULTANEOUS LINEAR EQUATIONS IN N UNKNOWNS. TAKES A CARD INPUT WITH COEFFECIENTS OF VARIABLES AND VECTORS PUNCHED IN BCD WITH VARIABLE FIELD WIDTH.

0704 963IB3FES AVAILABLE PRIOR TO JANUARY 1962

FORECASTING BY ECONOMETRIC SYSTEMS
ESTIMATES THE COEFFICIENTS OF A SYS. OF LINEAR STOCHASTIC EQUATIONS BY LIMITED-INFORMATION,TWO-STAGE LEAST-SQUARES, AND FULL-INFO. COVARIANCES OF ESTIMATES ARE COMPUTED. ALSO REDUCED-FORM EQUATIONS FOR COMPLETE SYS. CAN HANDLE UP TO 30 EQUATS. IN 30 DEPENDENT VARIABLES AND 35 INDEPEN-DENT VARIABLES FOR 1000 OBSERVATIONS. CORR/ 1015,1106

0704 963IB4FES AVAILABLE PRIOR TO JANUARY 1962

FORECASTING BY ECONOMETRIC SYSTEMS
ESTIMATES THE COEFFICIENTS OF A SYS. OF LINEAR STOCHASTIC EQUATIONS BY LIMITED-INFORMATION,TWO-STAGE LEAST-SQUARES, AND FULL-INFO. COVARIANCES OF ESTIMATES ARE COMPUTED. ALSO REDUCED-FORM EQUATIONS FOR COMPLETE SYS. CAN HANDLE UP TO 70 EQUATS. IN 70 DEPENDENT VARIABLES AND 70 INDEPEN-DENT VARIABLES FOR 5000 OBSERVATIONS. CORR/ 1015,1106

0704 969PKIPO1 AVAILABLE PRIOR TO JANUARY 1962

INTERGER PROGRAMMING 1.
INDEPENDANT FORTRAN PROGRAM FOR SOLVING INTERGER PROG. PROBLEMS, I.E. L/PROGRAMMING PROBLEMS WITH RESTRICTION THAT VARIABLES INVOLVED BE INTERGERS. REQUIRES 32K MEMORY AND ACCEPTS PROB. WITH ONE OBJECTIVE FUNCTION, UP TO 100 VARIABLES, AND AS MANY AS 200-N CONSTRAINTS, WHERE N IS THE NUMBER OF VARIABLES. ALL COEFFICIENTS IN PROBLEM FORMULA-TION MUST BE INTERGERS, METHOD USED IN DESCRIPTION IN R.E. GOMORY, ALL-INTERGER PROGRAMMING ALGORITHM, IBM RESEARCH REPORT RC-189.

0704 969PKIP81 AVAILABLE PRIOR TO JANUARY 1962

INTEGER PROGRAMMING 1
AN 8K MEMORY VERSION OF PK IP01. HANDLES PROBLEMS WITH ONE OBJECTIVE FUNCTION, UP TO 35 VARIABLES, AND AT MOST 75-N CONSTRAINTS, WHERE N IS THE NUMBER OF VARIABLES.

0704 970PKIP02 .AVAILABLE PRIOR TO JANUARY 1962

INTEGER PROGRAMMING 2
INDEPENDENT FORTRAN PROG. FOR SOLVING INTEGER PROGRAMMING PROBS. METHOD USED IS BASICALLY THE ALL-INTEGER ALGORITHM EMPLOYED IN PK IP01, BUT CONTAINS MODIFICA.WHICH PERMIT SOLUTION OF SOME PROBS. INTRACTABLE FOR IP01. RUN TIME PER ITERATION IS INCREASED, BUT NUMBER OF ITERATIONS IS GENERALLY REDUCED, WITH THE RESULT THAT THE CODE IS FASTER FOR DIFFICULT PROBLEMS, SLOWER ONLY ON SIMPLE PROBLEMS. MACHINE AND PROBLEM RESTRICTIONS ARE SAME FOR IP01 1237

0704 970PKIP82 AVAILABLE PRIOR TO JANUARY 1962

INTEGER PROGRAMMING 2
AN 8K MEMORY VERSION OF PK IP02, WITH THE PROBLEM SIZE RESTRICTIONS OF IP81. THAT IS, PROBLEMS MAY HAVE AT MOST 35 VARIABLES AND 75-N CONSTRAINTS, WHERE N IS THE NUMB. OF VARIABLES. CORR. 1237

0704 971PKIP03 AVAILABLE PRIOR TO JANUARY 1962

INTEGER PROGRAMMING 3
INDEPENDENT FORTRAN PROG. FOR SOLVING INTEGER PROGRAMMING PROBS. GENERALLY MORE EFFECTIVE THAN IP01 OR IP02 EXCEPT ON DEGENERATE PROBLEMS. REQUIRES 32K MEMORY, 1 TAPE, TAPE-TO-PRINTER. NUMB. OF VARIABLES, N, MAY NOT EXCEED 100, AND TOTAL NUMBER OF OBJECTIVE FUNCTIONS AND CONSTRAINTS HAS AN APPROXIMATE LIMIT OF 190-N. EMPLOY METHODS OF R.E. GOMORYS REPORTS--PRINCETON-IBM MATHEMATICS RESEARCH PROJECT TECHNICAL REPORT NO. 1 AND IBM RESEARCH REPORT RC-189.

0704 973RSBP01 AVAILABLE PRIOR TO JANUARY 1962

LINEAR PROGRAMMING WITH UPPER BOUNDS ON VARIABLES
THIS LINEAR PROGRAMMING SOSC WILL SOLVE PROBLEMS THAT HAVE UPPER BOUND RESTRICTIONS ON SOME OR ALL THE VARIABLES. THE ALGORITHM IS A MODIFICATION 06 T 5 R5V9S54 2947357 METHOD WITH THE INVERSE IN PRODUCT FORM. NO EQUATIONS ARE WRITTEN FOR THE BOUNDS. THEY ARE HANDLE4 1S SP5391L 41T1# MAXIMUM PROBLEM SIZE IS 256 E-UATC AND 11T232 VARIABLES. CODE DOES A MINIMUM AMOUNT OF TAPE READING. JOB CAN BE INTERRUPTED. RESTART PROCEDUREST REINVERSION 06 BAS9ST 1N4 PR9NTOUT OF D/J VALUES ARE SPECIAL FEATURES.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 977ALELPT AVAILABLE PRIOR TO JANUARY 1962

ELLIPTIC INTEGRAL, COMPLETE AND INCOMPLETE.
THIS SUBROUTINE WILL EVALUATE THE INCOMPLETE ELLIPTIC INTEGRALS OF THE FIRST AND SECOND KIND GIVEN PHI AND K. IT WILL ALSO EVALUATE THE COMPLETE ELLIPTIC INTEGRALS OF THE FIRST AND SECOND KIND, GIVEN K.
THEMETHOD USED IN THE EVAUATION GIVES IMPROVED ACCURACY FOR K NEAR ONE.

0704 979NUBES3 AVAILABLE PRIOR TO JANUARY 1962

BESSEL FUNCTION OF COMPLEX ARGUMENT AND ORDER.
TO COMPUTE THE BESSEL FUNCTIONS J AND Y FOR COMPLEX ARGUMENT AND COMPLEX ORDER. 704 FORTRAN SOURCE LANGUAGE AND USES METHOD OF NU BES1

0704 980ANZ013 AVAILABLE PRIOR TO JANUARY 1962

VARIABLE METRIC MINIMIZATION
THIS FORTRAN ROUTINE DETERMINES LOCAL MINIMA OF DIFFERENTIABLE FUNCTIONS OF N VARIABLES.THE PROGRAM EMPLOYS THE VARIABLE METRIC METHOD FOR MINIMIZATION.IN THE PROCESS OF LOCATING EACH MINIMUM ,A MATRIX H WHICH CHARACTERIZES THE BEHAVIOR OF THE FUNCTION ABOUT THE MINIMUM IS DETERMINED.FOR A REGION IN WHICH THE FUNCTION DEPENDS QUADRATICALLY ON THE VARIABLES,NO MORE THAN N ITERATIONS ARE REQUIRED.ROUTINE REQUIRES 6,137 STORAGES. VOIDED BY ZO ANFZ013 SDA 1117

0704 988 NU OUT AVAILABLE PRIOR TO JANUARY 1962

GENERALIZED OUTPUT SUBROUTINE 9
THIS PROGRAM IS A ROUTINE TO OUTPUT A TWO-DIMENSIONAL ARRAY IN A FAIRLY GENERAL FORMAT.

0704 1003GNBSPF AVAILABLE PRIOR TO JANUARY 1962

BACKSPACE FILE,FORWARD SPACE FILE. TO MOVE A BINARY OR DECIMAL TAPE FORWARD OR BACKWARD A SPECIFIED NUMBER OF FILES. AT THE COMPLETION OF THIS SUBROUTINE, THE TAPE WILL BE POSITIONED READY TO READ OR WRITE THE FIRST RECORD OF THE FILE REQUESTED

IBM 0704 PROGRAM LIBRARY ABSTRACT **B — 704**

0704 1004GNPACB AVAILABLE PRIOR TO JANUARY 1962

PUNCH ABSOLUTE COLUMN BINARY.
PUNCHES ON- LINE ABSOLUTE COLUMN BINARY CARDS IN THE STANDARD SHARE FORMAT SO THAT THEY MAY BE LOADED BY THE FORTRAN II BSS LOADER. ALTHOUGH THE CARDS PUNCHED ARE ABSOLUTE CARDS, THE LOADING ADDRESSES MAY BE THE SAME AS OR DIFFERENT THAN THE LOCATIONS FROM WHICH THE DATA IS BEING PUNCHED

0704 1006RSIPL5 AVAILABLE PRIOR TO JANUARY 1962

INFORMATION PROCESSING LANGUAGE V INTERPRETIVE SYSTEM
INTERPRETS AND EXECUTES PROGRAMS WRITTEN IN IPL-V LANGUAGE, AS DESCRIBED IN -INFORMATION PROCESSING LANGUAGE V MANUAL, SECTIONS I AND II

0704 1008 IBCTR AVAILABLE PRIOR TO JANUARY 1962

CHEBYSHEV TRUNCATION SYSTEM 1
COMPUTES POLYNOMIAL, RATIONAL AND CONTINUED FRACTION APPROXIMATIONS TO ANALYTIC FUNCTIONS, DOUBLE PRECISION ACCURACY, INPUT...POWERSERIES COEFFICIENTS, REQUIRED ACCURACY OR NUMBER OF COEFFICIENTS SPECIFIED IN CALL. SEQU., RESULTS CAN BE TESTED AT UP TO 106 POINTS

0704 1012ORCBL AVAILABLE PRIOR TO JANUARY 1962

ON-LINE LOADER FOR COL. BIN. ABS. AND TSF. CARDS
UPPER, LOWER VERSIONS OF DS CBL1 WITH PROVISIONS FOR 7/9 PCH.

0704 1013ORCTTS AVAILABLE PRIOR TO JANUARY 1962

CARD TO TAPE SIMULATOR AND ROW TO COLUMN CONVERTER.
72/84 AND 80/84 SIMULATION OF HOLLERITH AND COLUMN BINARY 714, ALSO ROW TO COLUMN CONVERSION. CORR/ 1C89

0704 1017AND107 AVAILABLE PRIOR TO JANUARY 1962

NUMERICAL INTEGRATION BY MIDPOINT PROCEDURE-
WITH PREFERENTIAL INTERVAL PLACEMENT.
FORTRAN II FUNCTION SUBPROGRAM EVALUATES THE INTEGRAL OF A FUNCTION BETWEEN TWO LIMITS WITH MAXIMUM ERROR SUPPLIED BY THE USER. PROGRAM PLACES INTERVALS WHERE NEEDED BY ESTIMATING THE SECOND DERIVATIVE OF THE FUNCTION. ITERATIONS NOT USED. INTEGRATION IS DONE IN ONE STEP. ONE DIMENSIONAL. PROGRAM USES 286 LOCATIONS. NO COMMON STORAGE USED.

IBM 0704 PROGRAM LIBRARY ABSTRACT

0704 1028GC0001 AVAILABLE PRIOR TO JANUARY 1962

EXPLICIT SOLUTION OF THE GENERAL CUBIC EQUATION
VIETA SUBSTITUTION IS MADE USING NORMALIZED POLYNOMIAL. ROOTS ARE OBTAINED BY METHOD OF DEL FERRO. 289 LOCATIONS PLUS 159 FOR REQUIRED SUBROUTINES.

0704 1029ANF203 AVAILABLE PRIOR TO JANUARY 1962

EIGENVALUES AND EIGENVECTORS OF REAL SYMMETRIC MATRICES
A GENERAL PROGRAM BUILT AROUND SUBROUTINE ANF202 DIST. 664 WHICH USES GIVENS METHOD. COMPILED WITH DIMENSION 98 BUT CAN BE RECOMPILED WITH DIMENSION 16 TO RUN ON 4K 704. OPTIONAL INPUT PRINT-OUT AND CHECKS OF VALUES AND VECTORS BY SUBSTITUTION INTO MATRIX EQUATION

0704 1030ANF403 AVAILABLE PRIOR TO JANUARY 1962

MATRIX INVERSION AND LINEAR EQUATIONS
A GENERAL PROGRAM BUILT AROUND SUBROUTINE ANF402 DIST. 664 WHICH USES GAUSS-JORDAN ELIMINATION. COMPILED WITH DIMENSION 20 BUT CAN BE RECOMPILED WITH DIMENSION 19 TO RUN ON A 4K 704. OPTIONAL INPUT PRINT-OUT AND CHECKS OF INVERSE AND SOLUTION VECTORS.

0704 1035SCLAGR AVAILABLE PRIOR TO JANUARY 1962

LAGRANGE INTERPOLATION
USES 7 POINTS, THREE PRECEEDING AND THREE AFTER VALUE -LIMIT OF 25C POINTS IN TABLE

0704 1040 JPASLF AVAILABLE PRIOR TO JANUARY 1962

ASSOCIATED LEGENDRE FUNCTIONS 1
THIS PROGRAM COMPUTES THE ASSOCIATED LEGENDRE FUNCTIONS P/M,N/ WHERE N IS LESS THAN OR EQUAL TO M. THE PROGRAM REQUIRES THAT UNITED AIRCRAFT UA SQR4 BE ASSEMBLED WITH IT. REQUIRES 162 WORDS OF CORE STORAGE.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 1041 JPZOMI AVAILABLE PRIOR TO JANUARY 1962

ZERO, MINIMUM SOLVER 1
SOLVES THE CLASS OF PROBLEMS WHICH CAN BE STATED AS
FI/X1...XN/-ZERO / MINIMUM I-1...N
WHERE ANY COMBINATION OF ZEROS AND/OR MINIMUMS ARE POSSIBLE
TO SOLVE SIMULTANEOUSLY.

0704 1042 JPBICO AVAILABLE PRIOR TO JANUARY 1962

BINOMIAL COEFFICIENTS 1
COMPUTES /N,M/-/N//N-1/... / //M//M-1/...///N-M//N-M-1/...//
BY USING STIRLINGS APPROXIMATIONC LA S8160 AND GE LN MUST
BE ASSEMBLED WITH BICOC 130 STORAGE LOCATIONS ARE USED.

0704 1043JPSRCH AVAILABLE PRIOR TO JANUARY 1962

SIMULTANEOUS PARTIAL DIFFERENTIAL EQUATIONS SOLVER
SOLVES T&E PROBLEM -& T&E &-RM
ABSF/FI/XI...XN/-YI /WANTED// LESS OR EQUAL EI/I-1...N/
WHERE FI IS NON-LINEAR. STANDARD NEWTON-RAPHSON WHERE THE
PARTIALLING IS DONE NUMERICALLY BY PERTURBIN7 T85 XI.
STORAGE REQUIRED IS 484 WORDS & 8 WORDS OF COMMON.

0704 1048JPGIN AVAILABLE PRIOR TO JANUARY 1962

GAUSS APPROXIMANT GENERATOR
THIS SUBROUTINE IS CAPABLE OF GENERATING THE GAUSS
APPROXIMANT FOR ANY TYPE OF INTEGRAL EXPRESSION, WHETHER IT
BE AN ITERATED INTEGRAL, VECTOR VALUED INTEGRAL OF A VECTOR
VALUED FUNCTION, OR THE INTEGRAL OF A FUNCTION OF OTHER
INTEGRALS, OR ANY COMBINATION OF THESE. USES 227 LOCATIONS.

0704 1050RSQP1 AVAILABLE PRIOR TO JANUARY 1962

QUADRATIC PROGRAMMING CODE
THE CODE WILL SOLVE THE QUADRATIC PROGRAMMING PROBLEM OF
MINIMIZING A QUADRATIC FUNCTION OF NONNEGATIVE VARIABLES
SUBJECT TO LINEAR CONSTRAINTS. THE NUMBER OF CONSTRAINTS
PLUS VARIABLES MUST BE LESS THAN 253. THE PROGRAM WILL
OPERATE ON A 704 WITH A MINIMUM OF 8K, 4 DRUMS, AND 6
TAPES. THE CODE, WITH THE ADDITION OF TWO CARDS, CAN RUN
ON A 7090 WITH COMPATIBILITY.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 1054BSSEAC AVAILABLE PRIOR TO JANUARY 1962

GENERAL LOGICAL CORE SORT SUBROUTINE FOR 32K704
SORTS INTO LOGICAL SEQUENCE A BLOCK OF N CONSECUTIVE ITEMS
OF W WORDS EACH, USING AS THE SORT KEY K CONSECUTIVE BITS
OR CHARACTERS STARTING AT ANY BIT OR CHARACTER IN THE ITEM
KEEPING ITEMS WITH IDENTICAL KEYS. CORR/1153

0704 1056TVME21 AVAILABLE PRIOR TO JANUARY 1962

BCD TO BINARY INTEGER CONVERSION
TO CONVERT A BCD INTEGER OF 10 CHARACTERS OR LESS TO A
BINARY INTEGER.

0704 1057TVMEPK AVAILABLE PRIOR TO JANUARY 1962

FN II BCD TAPE OUTPUT FOR FORMAT 12F6.0,4I2
THIS IS A FORTRAN II SUBROUTINE TO WRITE A BCD TAPE WITH
/THE TEXT OF THIS LINE HAS BEEN LOST/
IDENTIFICATION PER RECORD USING THE FORMAT 12F6.0,4I2.
LEADING ZEROES ARE SUPPRESSED AND DECIMAL POINTS ARE NOT
PRINTED. BECAUSE DECIMAL POINTS ARE NOT PRINTED, SIX
DIGITS OF INFORMATION PER FIELD MAY BE WRITTEN.

0704 1058WLRELI AVAILABLE PRIOR TO JANUARY 1962

MULTI-PURPOSE ESTIMATION FOR RELIABILITY STUDIES
THIS PROGRAM IS USED IN RELIABILITY STUDIES AND HAS BEEN
WRITTEN TO IMPLEMENT SEVERAL STATISTICAL ANALYSES OF
COMPONENT FAILURE FROM DATA CONSISTING OF INDEPENDENT OBSER-
VATIONS ON A SINGLE RANDOM VARIABLE.

0704 1059WLFAIL AVAILABLE PRIOR TO JANUARY 1962

ANALYZING SYSTEM FAILURE DATA
THIS 704 PROGRAM WAS WRITTEN TO IMPLEMENT THE STATISTICAL
ANALYSIS OF THE FAILURE PROPERTIES OF COMPUTER SYSTEMS WHICH
IS GIVEN IN -THE THEORY & MEASUREMENT OF COMPUTER SYSTEM
RELIABILITY- /IN PRESS/.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 1061PKPSTP AVAILABLE PRIOR TO JANUARY 1962

PI-STAR PROGRAM
THE PI-STAR PROGRAM INCLUDES A DATA LOADER AND A TAPE PRINT
ROUTINE IN ADDITION TO THE PI-STAR SUBROUTINE. THE PROGRAM
READS IN THE INJECTIVE WORD AND THE PRIMITIVE FUNCTIONS GEN-
ERATES THE FUNCTION INFORMATION LIST AND THE CALLING SEQUENCE
PARAMETERS, AND TRANSFERS TO THE PI-STAR SUBROUTINE. UPON
RETURN FROM THE SUBROUTINE, TRANSFER IS MADE TO THE TAPE
PRINT ROUTINE TO PRINT THE OUTPUT ORDER LIST IN BINARY AND
THE ANSWER ARRAYS IN 1-0-X NOTATION.

0704 1062PKPST AVAILABLE PRIOR TO JANUARY 1962

PI-STAR SUBROUTINE
SUBROUTINE TO TRANSFORM AN 1R&909 98 64
A BOOLEAN FUNCTION OR FUNCTIONS INTO A NORMAL FORM EXPRESSION
OR EXPRESSIONS. OTHERWISE EXPRESSED, IT GIVES THE FUNCTION OR
FUNCTIONS DESCRIBED BY A BOOLEAN TREE OR GRAPH.

0704 1070RMELFK AVAILABLE PRIOR TO JANUARY 1962

COMPLETE ELLIPTIC INTEGRALS OF THE FIRST KIND
THIS SUBROUTINE EVALUATES THE COMPLETE ELLIPTIC INTEGRALS
OF THE FIRST KIND FOR DIFFERENT VALUES OF THE MODULUS K.
USES NATURAL LOG SUBROUTINE LAS820 OR THE EQUIVALENT
THAT USES COMMON THROUGH COMMON & 2.
REQUIRES 55 STORAGE CELLS & 7 COMMON

0704 1071NUEFMT AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT TRAP ROUTINE 704 FORTRAN SAP CODED.
THIS SUBROUTINE PROVIDES ENTRY TO THE FLOATING-POINT TRAP
MODE AND SETS UP THE NECESSARY PROCEDURE FOR DETERMINING
WHETHER A FLOATING POINT OVERFLOW OR UNDERFLOW TOOK PLACE
AND THE ACTION TO BE TAKEN. THE ROUTINE ALSO PROVIDES FOR
AN EXIT FROM THE FLOATING POINT TRAP MODE

0704 1072NUSCHR AVAILABLE PRIOR TO JANUARY 1962

SOLUTION OF RADIAL SCHRODINGER EQUATION
THIS IS A FORTRAN PROGRAM TO CALCULATE THE EIGENVALUES
AND EIGENFUNCTIONS OF THE RADIAL SCHRODINGER EQUATION.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 1073BCDIFF AVAILABLE PRIOR TO JANUARY 1962

SECOND ORDER DIFFERENTIAL EQUATION SUBROUTINE
THIS SUBROUTINE WILL COMPUTE, STEP-BY-STEP, A FOURTH ORDER
APPROXIMATION TO THE SOLUTION OF A SYSTEM OF SECOND ORDER
DIFFERENTIAL EQUATIONS WITHOUT EXPLICIT FIRST DERIVATIVES.
ROUTINE USES 412/OCTAL/ OR 266/DECIMAL/ LOCATIONS PLUS 10
LOCATIONS IN ERRASIBLE COMMON.

0704 1075ANF104 AVAILABLE PRIOR TO JANUARY 1962

A GENERAL PROGRAM FOR COMPLEX MATRIX INVERSION
FORTRAN DECIMAL INPUT-OUTPUT STRUCTURE BUILT AROUND
SUBPROGRAM ANF103 FOR THE INVERSION OF COMPLEX MATRICES
OF ORDER 20 OR LESS.

0704 1076ANE208 AVAILABLE PRIOR TO JANUARY 1962

A GENERAL LEAST SQUARES FITTING PROCEDURE
FORTRAN GENERAL PROGRAM USES NEWTON-RAPHSON ITERATION
TO FIT ARBITRARY FUNCTION OF M PARAMETERS TO A GIVEN
SET OF N OBSERVED VALUES WITH ASSOCIATED ERRORS.

0704 1077GC0003 AVAILABLE PRIOR TO JANUARY 1962

FITTING TO SELECTED TERMS OF A GENERAL POLYNOMIAL
A METHOD OF OBTAINING THE BEST COEFFICIENTS IN THE LEAST
SQUARES SENSE TO ARBITRARILY SELECTED TERMS OF A MULTIVARIATE
POLYNOMIAL. REQUIRES 197 LOCATIONS PLUS 40 FOR EXP /2, AND
426 FOR XSIMEQ.

0704 1079NOTIA AVAILABLE PRIOR TO JANUARY 1962

TRACE INSTRUCTION ALTERATION
THIS TRACING PROGRAM IS A POWERFUL TOOL FOR IDENTIFYING
SOURCE OF TRANSFER TO AN UNINTENDED LOCATION OR OF UNDESIR
ALTERATION OF MEMORY. BY MEANS OF IT THE MACHINE IS DIVERTED
TO A MEMORY DUMP AT FIRST TRAPPED TRANSFER OCCURRING
IMMEDIATELY BEFORE TRANSFERRING TO A SPECIFIED EFFECTIVE
ADDRESS OR AFTER ONE OF SEVERAL DESIGNATED LOCATIONS BECOMES
ALTERED FROM SPECIFIED CONTENTS.

0704 1081LROSRA AVAILABLE PRIOR TO JANUARY 1962

OPEN SUBROUTINE ADDITIONS TO FORTRAN EDIT DECK
PRIMARY USE IN COMPILING LIAR

0704 1085UMPLOT AVAILABLE PRIOR TO JANUARY 1962

GENERAL PURPOSE PLOTTING SUBROUTINE
RAPID PLOTTING OF NUMERIC INFORMATION FOR FORTRAN, SAP, OR MAD CALLING PROGRAMS. A CORE REGION CONTAINS A SEGMENT OF OR COMPLETE GRAPH IMAGE. THE ROUTINE PREPARES A FLEXIBLE CARTESIAN GRID BUT ANY BCD CHARACTERS /TITLES, SPECIAL GRIDS, AN NUMBER OF PLOTTING CHARACTERS FOR ANY NUMBER OF UNSORTED DATA POINTS/ CAN BE PLACED. GRID AND CHARACTER PLACING AND TAP WRITING FOR A FULL PAGE 200 POINT PLOT REQUIRES 1.8 SEC. ANY NUMBER OF COPIES OF THE GRAPH CAN BE WRITTEN ON ANY DECIMAL OUTPUT TAPE FOR PRINTING OR PUNCHING IN ABOUT 1. SEC. EACH.

0704 1092RSM1AS AVAILABLE PRIOR TO JANUARY 1962

MATHEMATICAL PROGRAMMING SYSTEM I-ALL SOLUTIONS
THESE ROUTINES CONSTITUTE AN AUGMENTATION OF THE RSFM1 ROUTINE FOR LINEAR PROGRAMMING. THEY PERMIT THE FINDING OF ALL OPTIMAL SOLUTIONS OF A LINEAR PROGRAMMING PROBLEM OR OF ALL VERTICES OF A POLYHEDRON GIVEN BY INEQUALITIES. AN EFFICIENT NON-EXHAUSTIVE ALGORITHM IS USED.

0704 1096TVSMPL AVAILABLE PRIOR TO JANUARY 1962

SYSTEM IMMEDIATELY MAKING PROGRAMMING LANGUAGE EASY
SIMPLE IS A 704 AUTOMATIC CODING SYSTEM WHICH PRODUCES OBJECT PROGRAMS FOR THE IBM 1401 DATA PROCESSING SYSTEM. THE SIMPLE COMPILER IS WRITTEN IN FORTRAN WITH SOME EXTENSIONS /SEE APPENDIX A OF SIMPLE MANUAL/, AND IS COMPILED ON THE 704 THE LANGUAGE PROVIDES FOR ANY OR ALL OF THE FOLLOWING - /1/HIGH-LOW-EQUAL COMPARE/2/COLUMN BINARY, /3/ PUNCH FEED READ,/4/ MULTIPLY-DIVIDE /SUBROUTINES ARE PROVIDED FOR THESE IF NOT BUILT-IN 1401 HARDWARE/, AND /5/ MOVE RECORD. A SUB-ROUTINE IS PROVIDED TO HANDLE TAPE ERRORS. CORR 1140

0704 1101UMMAD AVAILABLE PRIOR TO JANUARY 1962

MAD TRANSLATOR AND ASSOCIATED SUBROUTINES
TRANSLATOR FOR THE MAD /MICHIGAN ALGORITHM DECODER/ LANGUAGE. STATEMENTS INCLUDE BOOLEAN EXPRESSIONS, SIMPLE AND COMPOUND CONDITIONALS, GENERAL ITERATION STATEMENTS, AND SYMBOL MANIPULATION FACILITIES. VERY RAPID TRANSLATION. SUBROUTINES, SUCH AS INPUT-OUTPUT, WHICH ARE CALLED BY OBJECT PROGRAMS, ARE INCLUDED. BINARY CARDS PRODUCED BY TRANSLATOR ARE IN STANDARD RELOCATABLE FORM. TRANSLATOR IS IN THE FORM OF A SUBROUTINE AND CAN BE IMBEDDED IN ANY SYSTEM USING BSS LOADER.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 1103PKSEQ AVAILABLE PRIOR TO JANUARY 1962

SEQUENTIAL CIRCUIT PROBLEM SOLVING
THE PURPOSE OF THE SUBROUTINE IS FOURFOLD,NAMELY- GENERATES A MOORE OR MEALY STATE DIAGRAM- COMPUTES A SET OF EQUATIONS AND THE -DONT CARE CONDITIONS- FROM EITHER A MOORE OR MEALY STATE DIAGRAM- REDUCES A SEQUENTIAL MACHINE REPRESENTED BY EITHER A MOORE STATE DIAGRAM,A SERIES OF INPUT -OUTPUT SEQUENCES,OR A HUFFMAN FLOW TABLE- GENERATES A MOORE STATE DIAGRAM FROM A SET OF EQUATIONS AND THE -DONT CARE CONDITIONS- AND REDUCE THE STATE DIAGRAM.

0704 1104PKMIN4 AVAILABLE PRIOR TO JANUARY 1962

COMPUTATION OF A MIN 2 LEVEL &/OR SWITCHING CIRCUIT
GENERATES A MINIMUM TWO-LEVEL SWITCHING CIRCUIT W85R5 ONE LEVEL IS ALL ANDS AND THE OTHER LEVEL IS ALL ORS. -DONT-CARE-CONDITIONS AND MULTIPLE OUTPUT PROBLEMS ARE PERMITTED. CAN ALSO BE DIRECTLY APPLIED TO THE MINIMIZATION OF A BOOLEAN FUNCTION IN NORMAL FORM. PROGRAM MAY BE RUN ON A MACHINE WITH 2 OR 4 737S OR A 738 MEMORY FRAME. IN ADDITION, IT REQUIRES FIVE TAPES.

0704 1109NUTPL1 AVAILABLE PRIOR TO JANUARY 1962

QUASI-TRIDIAGONAL MATRIX ROUTINE
THIS PROGRAM SOLVES THE MATRIX EQUATION QV-G WHERE Q IS A QUASI-TRIDIAGONAL MATRIX

0704 1110NUGEN1 AVAILABLE PRIOR TO JANUARY 1962

GENERATE MATRICES TO BE SOLVED BY NU TPL1
TO GENERATE AND WRITE THE MATRICES NECESSARY TO SOLVE THE EQUATION QC-G BY USING NU TPL1

0704 1119ERNLR AVAILABLE PRIOR TO JANUARY 1962

NON-LINEAR REGRESSION PROCEDURE WITH DIFFERENTIAL EQNS.
GIVEN M SIMULTANEOUS DIFFERENTIAL EQUATIONS WHICH ARE NON-LINEAR IN EITHER OR BOTH THE N INDEPENDENT VARIABLES AND THE K UNKNOWN COEFFICIENTS AND GIVEN MN VALUES OF OBSERVED DATA,

THE PROGRAM GIVES BY AN ITERATIVE MULTIPLE REGRESSION TECHNIQUE THE LEAST SQUARE ESTIMATES OF THE UNKNOWN COEFFICIENTS AND INFORMATION ON THE PRECISION OF THESE COEFF. TWO FORTRAN II SUBROUTINES DESCRIBING THE DIFFERENTIAL EQNS. AND INITIAL ESTIMATES OF THE COEFFICIENTS MUST BE PROVIDED. 32K CORE AND TWO TAPES REQUIRED

0704 1129AQALL1 AVAILABLE PRIOR TO JANUARY 1962

SINGLE OR DOUBLE INTERPOLATION SUBROUTINE
GIVEN SOME FUNCTION WITH ONE OR TWO INDEPENDENT VARIABLES, X AND Z. THIS ROUTINE PERFORMS KXTH AND LXTH INTERPOLATION TO CALCULATE THE DEPENDENT VARIABLE Y. THE DEGREE OF INTERPOLATION IS VARIABLE IN BOTH DIRECTIONS FROM 1 TO 7. LAGRANGE INTERPOLATION IS USED THROUGHT THIS ROUTINE. FUNCTIONS MAY BE EITHER CONTINUOUS OR DISCONTINUOUS.

0704 1134ELFIOP AVAILABLE PRIOR TO JANUARY 1962

FORTRAN INPUT/OUTPUT PACKAGE
PROVIDES GREATER INPUT AND OUTPUT FLEXIBILITY WITH 704 FORTRAN II. IT ALLOWS VARIABLE LENGTH TAPE RECORDS UP TO 1500 WORDS, BINARY OR BCD. ERROR, END OF FILE, AND PHYSICAL END OF TAPE INDICATIONS MAY BE USED FOR BRANCHING. MULTIPLE FORMAT STATEMENTS ARE USED IN DESCRIBING TAPE RECORDS. REQUIRES 1500 WORDS OF UPPER STORAGE FOR I/O BUFFER

0704 1143IB4PRM AVAILABLE PRIOR TO JANUARY 1962

AUTOPROMT
AUTOMATIC TOOL PATH GENERATION FOR NUMERICAL CONTROL OF MACHINE TOOLS. SELF-CONTAINED SYSTEM ACCEPTS SYMBOLIC DESCRIPTION OF THREE-DIMENSIONAL SHAPES IN AUTOPROMT LANGUAGE. COMPILES TOOL CENTERS REQUIRED FOR MACHINING. OUTPUT ON MAGNETIC TAPE. CORR/1155

0704 1144NC 138 AVAILABLE PRIOR TO JANUARY 1962

MODIFIED PK KWIC PROGRAM /SDA 884/
INCLUDES WRAP-AROUND FEATURE
THIS IS ONE OF A SET OF 9 PROGRAMS CURRENTLY USED BY CHEMICAL ABSTRACTS SERVICE TO PRODUCE CHEMICAL TITLES. THE COMPLETE SET INCLUDES NC 139, NC 140, NC 141, NC 142, NC 143, NC 144, NC 145, AND NC 146.

0704 1144NC 139 AVAILABLE PRIOR TO JANUARY 1962

PROGRAM TO SORT THE KEY WORDS FROM NC138

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 1144NC 140 AVAILABLE PRIOR TO JANUARY 1962

READS THE FINAL SORTED TAPE FROM NC 139 AND WRITES A TAPE TO PRINT WHICH GIVES THE FREQUENCE OF EACH KEY WORD.

0704 1144NC 141 AVAILABLE PRIOR TO JANUARY 1962

READS THE SORTED KEY WORDS FROM NC 139 AND WRITES A TAPE TO PRINT IN A SPECIAL FORMAT

0704 1144NC 142 AVAILABLE PRIOR TO JANUARY 1962

SORTS THE BIBLIOGRAPHY TAPE FROM NC 138

0704 1144NC 143 AVAILABLE PRIOR TO JANUARY 1962

READS THE SORTED BIBLIOGRAPHY TAPE FROM NC 142 AND WRITES A TAPE TO PRINT IN A SPECIAL FORMAT

0704 1144NC 144 AVAILABLE PRIOR TO JANUARY 1962

READS THE FINAL SORTED BIBLIOGRAPHY TAPE FROM NC 142 WRITES ANOTHER TAPE AND SORTS IT

0704 1144NC 145 AVAILABLE PRIOR TO JANUARY 1962

READS THE SORTED AUTHOR CROSS INDEX TAPE AND WRITES ANOTHER TO PRINT IN A SPECIAL FORMAT

0704 1144NC 146 AVAILABLE PRIOR TO JANUARY 1962

SKIPS ONE FILE ON A DECIMAL TAPE AND PUNCHES THE SECOND FILE

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 1147ECRKOP AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT OPTIMIZED RUNGE KUTTA
FEATURING AN OPTIONAL ERROR CONTROL FOR
DETERMINING THE INTEGRATION INTERVAL SIZE.
SOLVES A SET OF N FIRST ORDER DIFFERENTIAL
EQUATIONS. DETERMINES AN INTEGRATION STEP SIZE
DEPENDENT ON A VARIABLE ERROR CONTROL.
FIXED STEP SIZES MAY BE USED.A MODIFICATION
OF MU RKY3. 218 WORDS OF PROGRAM & 12N OF STORAGE.

0704 1156LRRONO AVAILABLE PRIOR TO JANUARY 1962

ROCKET NOZZLE PROGRAM
THIS PROGRAM WILL DEVELOP, BY THE METHOD OF CHARACTERISTICS,
A CONVERGING-DIVERGING SUPERSONIC NOZZLE CONTOUR FOR INVISCID
FLOW WHICH HAS OPTIMUM SPECIFIC IMPULSE FOR SPECIFIED AREA
RATIO AND AMBIENT PRESSURE. IT INCLUDES VARIATION OF
ISENTROPIC EXPONENT.

0704 1157TU9005 AVAILABLE PRIOR TO JANUARY 1962

NUMERICAL INTEGRATION OF UNEQUALLY SPACED POINTS
EVALUATES THE INTEGRAL OF A SET OF UNEQUALLY SPACED POINTS
BY EITHER OF TWO METHODS /1/ USING DIVIDED DIFFERENCES
THROUGH THE FOURTH DIFFERENCE OR /2/ USING THE
TRAPEZOIDAL RULE

0704 1165PNSLIB AVAILABLE PRIOR TO JANUARY 1962

A 1401 PROGRAM TO MAINTAIN THE SHARE LIBRARY ABSTRACTS
ON TAPE. THE PROGRAM WRITES A TAPE LOADER, AN UPDATING
PROGRAM, A LISTING PROGRAM AND THE EXISTING ABSTRACTS ON A
TAPE. THIS TAPE IS THEN SELF-LOADING AND CAPABLE OF UPDATING,
COPYING AND LISTING ITSELF. THE LISTING MAY COVER ALL
PROGRAMS, 709-PROGRAMS ONLY, 7090-PROGRAMS ONLY OR 709- AND
7090-PROGRAMS TOGETHER. FORTRAN PROGRAMS AND COMMENTS WILL
APPEAR IN ALL LISTINGS. REQUIRES A 4K 1401 WITH 2 TAPES,
STORE ADDRESS REGISTER, HIGH-LOW-EQUAL COMPARE, SENSE
SWITCHES AND COLUMN BINARY.

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 1168TVPCPE AVAILABLE PRIOR TO JANUARY 1962

PRINCIPAL COMPONENTS PREDICTION ECUATION.
FN 22 PROGRAM TO EVALUATE AN EQUATION BY FITTING DATA USING
MULTIVARIATE TECHNIQUE OF COMPONENT ANALYSIS. METHOD DIFFERS
FROM MULTIPLE REGRESSION IN THAT COEFFICIENTS WHICH ARE
DERIVED REPRESENT ORTHOGONAL CONTRIBUTIONS OF RESPECTIVE
TERMS OF EQ., THUS SUPPRESSING EFFECTS OF CORRELATIONS AMONG
INDEPENDENT VARIABLES. AN EIGENVALUE-EIGENVECTOR ANALYSIS OF
CHARACTERISTIC EQ. OF MATRIX OF CORRELATIONS EXPRESSES
RELATIONSHIP BETWEEN INDEPENDENT VARIABLES AND ORTHOGONAL
COMPONENTS.ADAPTION OF CA 0054 USED AS SUBROUTINE. CORR.1207

0704 1181ANG502 AVAILABLE PRIOR TO JANUARY 1962

PSEUDO-RANDOM NUMBER GENERATOR
GIVEN A NORMALIZED FLOATING POINT NUMBER Z-SUBN BETWEEN -1
AND &1, THE NUMBER Z-SUB/N&1/ IS PRODUCED, WHERE Z-SUBI IS
A SEQUENCE OF UNIFORMLY DISTRIBUTED PSEUDO-RANDOM NUMBERS ON
THE INTERVAL /-1,1/.

0704 1183GDCOR1 AVAILABLE PRIOR TO JANUARY 1962

SIX CARD UPPER LOADER
LOADS FILE OF STANDARD 709 COLUMN BINARY CARDS
WITH SHARE STANDARD OCTAL CORRECTION CARDS
FROM CHANNEL A CARD READER

0704 1184ININIB AVAILABLE PRIOR TO JANUARY 1962

PROCESS CONTROL COMPUTER ASSEMBLY FOR IBM 704
INIB PRODUCES,FROM IBM 1620-1710 S.P.S. CARDS,AN ASSEMBLY
WITH LISTING AND CARDS USING THE IBM 704 FOR RUNNING ON
THE IBM 1620, 1710, AND OTHER CONFIGURATIONS OF IBM
PROCESS CONTROL COMPUTE-&.

0704 1186IBDST2 AVAILABLE PRIOR TO JANUARY 1962

MULTICOMPONENT DISTILLATION PROGRAM.
SOLVES PLATE-TO-PLATEMULTI COMPONENT DISTILLATION,BUBBLE,
DEW,AND FLASH POINT PROBLEMS FOR UP TO 23 COMPONENTS ON
8K MACHINE

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 1187IBTEQ2 AVAILABLE PRIOR TO JANUARY 1962

BENEDICT-WEBB-RUBIN EQUATIONS OF STATE.
APPLIES THE B-W-R EQUATIONS TO THE SOLUTION OF DISTILLATION
PROBLEMS,FOR USEAS A SUBROUTINE WITH IB DST2,REQUIRING A
16K MACHINE

0704 1188GMCP AVAILABLE PRIOR TO JANUARY 1962

CRITICAL PATH PROGRAMMING METHOD
THIS PROGRAM INPLEMENTS THE ALGORITHM OF J.E. KELLEY, THAT
SERVES AS THE BASIS OF THE PROJECT CONTROL TECHNIQUE CALL-
ED CRITICAL PATH PROGRAMMING BY MAUCHLT ASSOCIATES. THE
ALGORITHM GENERATES A SERIES OF CHARACTERISTIC SCHEDULES
FOR A PROJECT BY ASSIGNING TO EACH ACTIVITY A COST-DURA
TION OPERATING POINT FOR EACH GENERATED SCHEDULE. FOR A
GIVEN SCHEDULE, ITS COST IS THE LEAST POSSIBLE FOR THE
ASSOCIATED PROJECT DURATION USES 10 TAPES IN GMR OPER SYS

0704 1190PKIPM3 AVAILABLE PRIOR TO JANUARY 1962

INTEGER PROGRAMMING 3, 7090
CONV.OF PKFIPO3 FOR 7090 USING FORTRAN EM. 1247

0704 1190PKIP93 AVAILABLE PRIOR TO JANUARY 1962

INTEGER PROGRAMMING 3, 7090
CONVERSION OF PKFIPO3 FOR 7090 WHICH DOES NOT REQUIRE FORTRAN
MONITOR SYSTEM. CORR. 1246

0704 1191PKIPM2 AVAILABLE PRIOR TO JANUARY 1962

INTEGER PROGRAMMING 2, 7090
CONV.OF PKFIPO2 FOR 7090 USING FORTRAN EM. CORR. 1237

0704 1191PKIP92 AVAILABLE PRIOR TO JANUARY 1962

INTEGER PROGRAMMING 2, 7090
CONVERSION OF PKFIPO2 FOR 7090 WHICH DOES NOT REQUIRE FORTRAN
MONITOR SYSTEM. CORR. 1237

IBM 0704 PROGRAM LIBRARY ABSTRACT
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0704 1192PKIPM1 AVAILABLE PRIOR TO JANUARY 1962

INTEGER PROGRAMMING 1, 7090
CONVERSION OF PKFIPO1 FOR 7090 USING FORTRAN MONITOR SYSTEM.

0704 1192PKIP91 AVAILABLE PRIOR TO JANUARY 1962

INTEGER PROGRAMMING 1, 7090
CONVERSION OF PKFIPO1 FOR 7090 WHICH DOES NOT REQUIRE FORTRAN
MONITOR SYSTEM.

0704 1193AFFAP AVAILABLE PRIOR TO JANUARY 1962

FAP ASSEMBLY PROGRAM FOR THE IBM 704
THIS PROGRAM IS WRITTEN ON THE FORTRAN SYSTEM TAPE.
IT ASSEMBLES WITH THE 704,704 AND 709 PROGRAMS WRITTEN IN THE
FAP LANGUAGE. CORR. 1226,1227.

0704 1209RWEX2F AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT EXPONENTIAL.THE SUBROUTINE IS ENTERED
WITH THE NORMALIZED FLOATING POINT ARGUMENT IN THE
ACCUMULATOR AND EXITS WITH THE FLOATING POINT EXPONENTIAL
IN THE ACCUMULATOR.SPACE REQUIRED 36&3 COMMON.
TIMING IS 2.196MS.

0704 1220NSABC AVAILABLE PRIOR TO JANUARY 1962

AUTOMATIC CODER, COMPATIBLE WITH SAP
AUTOMATIC CODING SYSTEM WHOSE SOURCE LANGUAGE INCLUDES SAP
CODING AS WELL AS STATEMENTS IN MATHEMATICAL LANGUAGE AND
ENGLISH. TRANSLATES AUTOMATIC CODE TO SAP CODE, WHICH IS THEN
ASSEMBLED, USING UA SAP. INCLUDES 82 SUBROUTINES ON SYSTEM
LIBRARY TAPE. AUTOMATIC CODE LANGUATE LIKE FORTRAN, WITH
RESTRICTION TO SINGLE SUBSCRIPTS. HANDLES MIXED ARITHMETIC.
CONTAINS DATA PROCESSING PACKAGE. HAS MORE GENERAL SUBROUTINE
LOGIC. OBJECT PROGRAM ON BINARY CARDS WITH SAP LISTING.

0704 1224UCSCUL AVAILABLE PRIOR TO JANUARY 1962

SHARE CATALOG UPDATER, LISTER. 1401 PROGRAM.
REQUIRES 4K 1401 WITH ADV. PROG., H-L-E, AND 2 TAPES
PROGRAM CAN PERFORM FOUR FUNCTIONS.
1, UPDATE THE CATALOG FILE ON TAPE WITH INPUT CATALOG CARDS.
2, SEQUENCE CHECK THE INPUT CATALOG CARDS BEFORE UPDATING.
3, LIST THE CATALOG BY THE CLASSIFICATION CODE.
4, LIST THE CATALOG ITEMS FORM ANY INSTALLATION.
IF DESIRED, JUST THE TITLES MAY BE LISTED.

0704 1231TVTPPR AVAILABLE PRIOR TO JANUARY 1962

704 PROGRAM TO GENERATE 1401 T/P PROG. ON OUTPUT TAPES.
TO MINIMIZE OPERATOR ATTENTION IN 1401 PRINT OPERATION FROM 704 OUTPUT TAPE THROUGH PROGRAMMED 1401 INSTRUCTIONS WRITTEN ON THE TAPE AT THE TIME OF 704 COMPUTATION. THE 1401 TAPE-TO-PRINT INSTRUCTIONS PRECEDE ANY OUTPUT INFORMATION, AND THE PRINT OPERATION REQUIRES ONLY THE MOUNTING OF THE TAPE AND PRESSING THE LOAD TAPE BUTTON.

0704 1232AAICE4 AVAILABLE PRIOR TO JANUARY 1962

INTEGRATION WITH CONTROLLED ERROR
AAICE4 IS DESIGNED TO BE USED IN CONJUNCTION WITH AN INTEGRATION SUBROUTINE/AA INT1 IF DESIRED/ TO PROVIDE A NUMERICAL SOLUTION OF AN NTH ORDER SYSTEM OF LINEAR AND/OR NON-LINEAR DIFFERENTIAL EQUATIONS EXPRESSED AS A SYSTEM OF N FIRST ORDER EQUATIONS. THE LOCAL ERROR GENERATED BY THE NUMERICAL PROCESS IS CONTROLLED BY ADJUSTING THE INTEGRATION STEP SIZE BASED ON THE RELATIVE ERROR AS ESTIMATED BY EXTRAPOLATION TO ZERO STEP SIZE.

0704 1233AAINT1 AVAILABLE PRIOR TO JANUARY 1962

SECOND,THIRD,AND FOURTH ORDER RUNGE-KUTTA INTEGRATION
AA INT1 IS A FORTRAN II SUBROUTINE DESIGNED TO BE USED IN CONJUNCTION WITH AA ICE4 TO PROVIDE A SECOND,THIRD,OR FOURTH ORDER RUNGE-KUTTA SOLUTION OF AN NTH ORDER SYSTEM OF LINEAR AND/OR NON-LINEAR DIFFERENTIAL EQUATIONS EXPRESSED AS A SYSTEM OF N FIRST ORDER EQUATIONS.

0704 1234AAWEG2 AVAILABLE PRIOR TO JANUARY 1962

WEGSTEIN ITERATION
GIVEN AN IMPLICIT EQUATION OF THE FORM X-F/X/,AA WEG2 WILL FIND A VALUE FOR X WHICH WILL PROVIDE A SPECIFIED ACCURACY IN EITHER A RELATIVE OR ABSOLUTE SENSE.

0704 1244ANC001 AVAILABLE PRIOR TO JANUARY 1962

A GENERAL PROGRAM FOR SYSTEMS EVALUATION
GIVEN A DESCRIPTION OF THE BLOCK DIAGRAM OF A SYSTEM AND THE TRANSFER FUNCTIONS OF EACH COMPONENT OF THE SYSTEM, THIS COMPLETE PROGRAM COMPUTES THE TRANSFER FUNCTION OF THE SYSTEM AND CALCULATES THE ATTENUATION AND PHASE ANGLE FOR GIVEN VALUES OF FREQUENCY. SIMPLE FEEDBACK LOOPS ARE PERMITTED IN THE SYSTEM. THE PROGRAM AS SUBMITTED IS DESIGNED FOR A 32K MEMORY.

ABRAC - 01

704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
ABRAC - 01 is a three-dimensional few-groups neutron diffusion program which treats the effects of water moderator density changes (resulting from flow variations and boiling) on neutron flux distributions and depletion. Thermal and hydraulic calculations performed within the code limit its applicability to water-cooled and moderated cores having one upflow coolant pass. ABRAC - 01 is essentially the DRACO - 1 program with a thermal and hydraulic calculation added immediately after the power and flux normalization routine and just prior to the depletion routine.

(4) Restrictions or Limitations:
Maximum number of mesh parallelepiped is 2685 or 4750 for machines of 16K or 32K words of core storage, respectively. Ten tape units are required.

(5) Approximate Performance:
For a core represented by a 16x16x26 mesh (two group), the running time might be from 1.5 to 2.0 hr. per iteration. Three to four iterations may be required.

(6) References:
1. W. M. Jacobi, T. J. Lawton, S. H. Meanor, J. R. Parrette, ABRAC - An IBM-704 Three Dimensional Nuclear - Thermal Depletion Program with Distributed Void Effects", WAPD-TM-203, March, 1960.
2. J. Redfield, Computer Code Abstract No. 13, Nuclear Science and Engineering: 10, 205-206 (1961).

APCOI

704 Nuclear Code

(1) Code Originated by:
Westinghouse-Bettis Plant

(2) Computer:
704

(3) Description of Code:
The APCOI code processes the flux tapes from a PDQ02 problem and its adjoint. The integrals

$$\int_R \phi_i^* \phi_j \, dA$$

are obtained in an x-y geometry for all compositions supplied and for all possible combinations of groups i and j.

(4) Restrictions or Limitations:
A 32K memory is required. The flux and adjoint flux calculations must correspond as far as geometry, mesh structure, groups, and number of compositions.

(5) Approximate Performance:
Running time to process the flux tapes from a two-group, 30 x 30 PDQ02 problem and its adjoint is approximately 1.2 minutes with no pointwise product edits, and approximately 4.8 minutes when all pointwise product edits are included.

(6) References:
1. H. G. Gelbard, CPM-M-135 (1958).

(7) Material Available:
1. CPM-M-135.
2. Binary deck.

Note: The information given above was abstracted from CPM-M-135.

ART - 04

704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
Replaces ATBAC - See Page II.3 for details

(6) References:
Letter, 7-31-58.

ATBAC

704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
Obtains detailed information concerning thermal conditions within a reactor core during transient operations. The method used applies particularly to plate type pressurized water reactors. The model used is that of a hot channel in a parallel flow path with the normal channels. A single normal channel is analyzed for heat transfer with pressure drop, with flow characteristics in the channel being determined a priori by the loop containing the reactor, heat exchangers, and pumps. The pressure drop across the normal channel then determines the flow conditions in the hot channel, in conjunction with the hot channel heat transfer. In this way it is possible to simulate such varied transients as complete and staggered loss of flow, cold water accident, and rod pump accident.

(4) Restrictions or Limitations:
In normal usage the code is limited to a two-pass core with a maximum of 25 points per pass. Great caution must be used in selecting a value of Δt so that no instability is introduced into either the heat transfer or kinetics equations. The IBM equipment includes an 8K core, two tape units, and one drum unit.

(5) Approximate Performance:
A typical 30-point, 3-second transient with no scram will run about 15-20 minutes.

(6) References:
1. B. L. Anderson, T. J. Lawton, E. V. Somers, J. M. Weaver, "ATBAC - An IBM - 704 Code for Reactor Thermal Transients", WAPD-TM-20, June, 1957.
2. E. V. Somers, Westinghouse Scientific Paper 100-FF 1037-PL,1956.

BINTO

704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
Calculates steady state temperatures in a one- or two-pass cylindrical reactor core. It requires as input the radial and axial power distributions and rules for combining them into three-dimensional power distributions, local peaking factors, hot-channel factors, and geometric data.

(5) Approximate Performance:
5 minutes.

(6) References:
1. Internuclear Co., Calyton 5, Mo., "Calculation of Temperatures in a Two Pass Cylindrical Core using an IBM-704 Computer", INTERNUC 8.
2. R. R. Schiff, Westinghouse Electric Corp., Phg., "Steady-State Thermal Analysis Code", WAPD-S5W-NA-145.
3. IBM 701/704/709 Bulletin No. 5, Jan. 1958, p. 5.
4. NCG Newsletter No. 5, p. 4.

CANDLE — 704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
One space dimension and time few-group depletion code for rectangular, cylindrical, and spherical geometry. Fast group constants are computed from effective one-velocity microscopic cross sections. Thermal microscopic cross sections and self-shielding factors are supplied as input data. The WANDA calculation is used to determine the corresponding eigenvalues and flux shape. Criticality may be maintained by varying the transverse buckling, a homogeneous poison, or the location of a boundary between a poisoned and unpoisoned region. The flux is normalized to a specified power and assumed to be constant for a specified length of time. The isotopic densities are recomputed at the end of this time using the normalized flux. A maximum xenon calculation is optional at each time step.

(4) Restrictions or Limitations:
Max of 25 regions and 250 mesh intervals with either two or four groups. At most 25 time steps can be done automatically. Only the uranium, plutonium, and fission product chains along with two burnable poisons are considered time dependent with a maximum of 30 elements in all. Code requires 8K core, four tape units, and one drum unit.

(5) Approximate Performance:
From 15 min. to 4 hrs. Average of 30 min.

(6) References:
1. L. Culpepper, E. Gelbard, G. Hoffman, O. Marlowe, D. McCarty, P. Ombrellaro, D. Saalbach, "CANDLE - A One-Dimensional Few-Group Depletion Code for IBM 704", WAPD-TM-53 (Add.1), WAPD-TM-53 (Add. 2), May 1957.
2. IBM 701/704/709 Bulletin No. 5, Jan. 1958, p. 9.

CEPTR — 704 Nuclear Code

(1) Code Originated by:
Combustion Engineering, Inc.

(2) Computer:
704

(3) Description of Code:
This program is designed to solve the one-dimensional, mono-energetic P_3 approximation to the transport equation in cylindrical geometry. The cylinder is assumed to be infinitely long and symmetric with respect to rotations about the Z axis. The external boundary condition may be specified as reflecting or vacuum or as a special type of cell condition. Any material region of the problem may be specified as having all zero cross sections, that is, an interval void. An external isotropic source may be specified by region or point wise. The code utilizes the first four spherical harmonics of the scattering cross section.

(4) Restrictions or Limitations:
Problems are limited to a maximum of 150 spatial mesh points and 10 material regions. Code performance is most satisfactory for problems with radii of 5 or fewer mean free paths.

(5) Approximate Performance:
Maximum problem runs in approximately 1.5 minutes.

(6) References:
CEND MPC-20.

COFIT — 704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
Fits by least squares the curve $y = A \cos B(x-C)$ to from 4 to 500 points of observed data, computing the parameters A, B, C, and the standard devisions of the estimates of A, B, C.... S_A, S_B, S_C. It is also possible to investigate the error in a region about the final values of A, B, C, by computing the sums of the squares of the residuals at a series of points in the neighborhood.

(5) Approximate Performance:
500 point problem ≈ 8 min.

(6) References:
1. B.L. Anderson, T. J. Lawton, "COFIT - A Least Squares Cosine Fitting Program for the IBM - 704", WAPD-TM-26, October, 1956.

COGENT — 704 Nuclear Code

(1) Code Originated by:
Combustion Engineering, Inc.

(2) Computer:
704

(3) Description of Code:
The COGENT Code solves the one-dimensional neutron diffusion equation for 30 coupled energy groups with an external neutron source. The code will handle slab, cylindrical or spherical geometry. COGENT provides for a maximum of ten isotopes and six scattering matrices. The external source may be specified region-wise constant, group-wise constant, region-wise by group, or point-wise by group. As output, in addition to the point-wise fluxes the code provides flux weighted macroscopic constants.

(4) Restrictions or Limitations:
Problems are limited to a maximum of 101 spatial mesh points and 4 material regions. 16K 704, 5 tape units, 1 drum unit.

(5) Approximate Performance:
Average problem requires approximately 40 minutes.

(6) References:
CEND MPC-18.

CURE — 704 Nuclear Code

(1) Code Originated by:
GE Knolls Atomic Power Lab.

(2) Computer:
704

(3) Description of Code:
Solves age-diffusion equations for neutron flux distribution in a reactor for r-z, rθ, or x-y geometry. Multiplication of the reactor is computed. Includes calculation of averaged three-group macroscopic cross-sections from physical compositions according to prescriptions of R. W. Deutsch. Irregular boundaries, variable mesh spacing, and deletion of points are permitted in the spatial mesh. Several versions are available from KAPL which differ in speed, use of machine, size of problem, and input.

(4) Restrictions or Limitations:
The code permits at most 40 compositions and allows about 700 space points for an 8K memory.

(5) Approximate Performance:
3 min./source iteration for 700 pts., 3 groups.

(6) References:
1. E. L. Wachspress, "CURE: A Generalized Two-Space Dimension Multigroup Coding of the 704", KAPL-1724, May 1957.
2. IBM 701/704/709 Bulletin No. 5, January 1958.

DRACO — 704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
Depletion version of TKO

(6) References:
Letter, July 31, 1958.

EURIPUS - 3 and DAEDALUS — 704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
EURIPUS - 3 calculates the one-dimensional spatial density of neutrons slowing-down past a given energy in an infinite homogeneous medium consisting of hydrogen and one other isotope with arbitrary mass and energy-dependent differential-elastic and absorption cross-sections. DAEDALUS determines the corresponding spatial distribution of angular integrals of an

(Continued on next page)

arbitrary function times the vector flux density. Spatial moments of all density functions are furnished directly. The neutron source may be monoenergetic with either isotropic or monodirectional angular distributions, or else the source may be that from deuterons bombarding deuterons.

(4) Restrictions or Limitations:
A 32K core memory is required, and 5 tape units are required.

(6) References:
1. H. J. Amster, H. G. Kuehn, J. Spanier, "EURIPUS - 3 and DAEDALUS -- Monte Carlo Density Codes for the IBM-704", WAPD-TM-205, February, 1960.

EXFIT

704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
Fits a set of observed data, y_i, to a curve of the form $y = Ae^{Bx}$ where each y_i value may be weighted by some y_i. It is possible to compute the parameters A and B and the estimate of the error in each parameter. The maximum allowable number of points in 500.

(4) Restrictions or Limitations:
Requires a 4096 word core. No drums or tapes are used. No account is taken of "wild" points and their inclusion may result in a poor fit.

(5) Approximate Performance:
2 minutes for 30-40 point problem.

(6) References:
1. B. L. Anderson, T. J. Lawton, "COFIT - A Least Squares Cosine Fitting Program for the IBM-704", WAPD-TM-26, October, 1956.
2. B. L. Anderson, T. J. Lawton, "ESFIT", CPM-M-67, June, 1957.

FIRE

704 Nuclear Code

(1) Code Originated by:
Los Alamos Scientific Labratory

(2) Computer:
704

(3) Description of Code:
Numerical solution of diffusion equation for slab, cylinder or spherical geometry; with Hydrogen, inelastic scattering, continuous slowing down.

(5) Approximate Performance:
1-1/2 minutes

(6) References:
1. LA-2161
2. Summary, September 1958.

FLEER

704 Nuclear Code

(1) Code Originated by:
GE Knolls Atomic Power Lab.

(2) Computer:
704

(3) Description of Code:
FLEER will solve the three-group, two-dimensional neutron diffusion equation in a triangular coordinate system. Up to 14,000 mesh points are allowed. The outer boundary of the point mesh must be a parallelogram. A special 120 degree periodic boundary condition is allowed on two of the sides. Available boundary conditions are flux zero, current zero, and a logarithmic boundary condition. Few-group cross sections are calculated within the code. Flux iteration is accomplished by a "bent" line relaxation technique.

(4) Restrictions or Limitations:
A 32K memory is required, as well as 7 tapes and 4 drums.

(5) Approximate Performance:
Approximate running time for a problem is about 40 minutes per 1000 points.

(Continued on next column)

(6) References:
1. J. L. Fletcher, J. P. Jewett, E. D. Reilly, Jr., "FLEER: A Two-Dimensional Mesh Diffusion Program for the IBM 704", KAPL-2086 (1960).

(7) Material Available:
1. KAPL-2086.
2. Binary deck.

Note: The information above was abstracted from KAPL-2086.

FLIP

704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
P3, P5, P7, double P1, double P2, double P3 approximation, slab geometry, one energy group.

(6) References:
1. Letter 7/31/58.
2. Paper OIC-1161 UN 639 (Supp.), E. H. Barciss.

FLT

704 Nuclear Code

(1) Code Originated by:
GE Knolls Atomic Power Lab.

(2) Computer:
704 (FORTRAN)

(3) Description of Code:
FLT was developed specifically for the calculation of flow transients occurring in a multi-loop flow system closed by a common flow path. The program is based on a multi-loop model of up to three inertially symmetric flow loops with one canned rotor, variable frequency, induction motor driven pump per loop having a separate motor power supply.

(4) Restrictions or Limitations:
An 8K memory is required.

(5) Approximate Performance:
The problem should run between .06 hrs and .1 hrs for any accident with final time of 6.0 seconds and just transient output.

(6) References:
1. G. H. Borrmann, R. D. Burgess, B. L. Strain, R. B. Taylor, "FLT, An IBM-704 Digital Computer Program for the Calculation of Multi-Loop Flow Transients", KM-DIG-TD-14 (1961).

(7) Material Available:
1. KM-DIG-TD-14 (This document contains a listing of the FORTRAN source program).

Note: The information above was abstracted from KM-DIG-TD-14.

F0020

704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704 - FORTRAN

(3) Description of Code:
F0020 is a thermal analysis code developed to reduce transient test data for a single, vertical, rectangular coolant channel. Modes of heat transfer for water at 2000 psia covered by this code include: (1) forced convection (turbulent flow), (2) nucleate boiling, (3) departure from nucleate boiling, (4) partial film boiling, and (5) film boiling. The code is written in FORTRAN.

(4) Restrictions or Limitations:
The code will accommodate a plate mesh, and associated heat generation weighting factors, of a maximum of 50 axial and 10 radical modes.

In order to insure numerical stability, a limitation is imposed upon the length of the time step.

This code requires a 32K core memory and two tape units.

(Continued on next page)

(5) Approximate Performance:
For a sample problem, the 704 running time was 3.3 minutes for the calculation and normal point-out of the 3.3 minutes of running time, approximately 1.5 minutes were used in writing the output on tape.

(6) References:
1. J. B. Callaghan, J. S. Williams, Jr.; "F0020 - An IBM-704 Thermal Transient Analysis Code", WAPD-TM-145, January, 1959.

F003L — 704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
Fits, by an iterative least squares technique, the function Ae^{Bx} plus C to a set of observed, weighted data. The three parameters and an estimate of the standard deviations on the parameters are calculated.

(6) References:
1. B. L. Anderson, T. J. Lawton, "COFIT - A Least Squares Cosine Fitting Program for the IBM-704", WAPD-TM-26, October, 1956.

704 Nuclear Code

Nuclear Codes

1. Name of Code: HAFEVER

2. Computer: IBM 704
Programming System: FORTRAN II

3. ABSTRACT:

Nature of problem solved: Caluculation of the energy exchange inelastic scattering cross section (integrated over angle) according to the Hauser-Feshbach theory as modified by D. Goldman. This modification includes the effect of spin-orbit coupling on the transmission coefficients.

HEAT — 704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
HEAT is a code which finds a one-dimensional solution to the general heat transfer equation. Specifically written for application in reactor fuel rod design, the code requires cylindrical geometry conditions and input parameters of surface temperature and power density. The conductivity may be assumed to be a function of temperature.

(4) Restrictions or Limitations:
The maximum number of points for which temperature values may be distributed throughout a maximum of 25 regions. An 8K core memory is required.

(5) Approximate Performance:
The approximate running time for a typical problem varies from 1.0 to 2.0 minutes.

(6) References:
1. C. M. King, R. F. Boyle, "HEAT - A One-Dimensional Heat Transfer Equation Code for the IBM - 704", WAPD-TM-155, January, 1959.

HECTIC — 704 Nuclear Code

(1) Code Originated by:
Aerojet-General Nucleonics

(2) Computer:
704

(3) Description of Code:
HECTIC is a computer program for calculating heat transfer rates and temperatures in the fuel elements of typical gas-cooled nuclear reactors. Effects of turbulent interchange between flow passages are considered. The computation procedure amounts to a "nodal" or "lumped parameter" type calculation.

(4) Limitations or Restrictions:
An 8K memory is required.

(5) Approximate Performance:
A full-size run requires approximately 15 minutes.

(6) References:
1. W. C. Reynolds, D. W. Thompson, C. R. Fisher, "HECTIC, An IBM 704 Computer Program for Heat Transfer Analysis of Gas-Cooled Reactors", AGN-TM-381 (1961).

(7) Material Available:
1. AGN-TM-381.
2.

Note: The information given above was abstracted from AGN-TM-381.

HERD - 1, 2 and 3 — 704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
The HERD codes furnish a numerical approximation to the solution of the one-dimensional, one-velocity neutron transport equation (scattering and sources assumed to be isotropic) in slab geometry using the method of discrete ordinates. Let $F(x, \mu)$ represent the vector flux with $\mu = \cos\theta$, and let $x = A$ be the boundaries. The HERD codes differ in the boundary conditions imposed:

HERD 1 $F(o,\mu) = F(o,-\mu)$ and A is an axis of symmetry.
HERD 2 $F(o,\mu)$ is specified for $o < \mu < 1$ and A is an axis symmetry.
HERD 3 $F(o,\mu)$ is specified for $o < \mu < 1$ and $F(a,\mu) = o$ for $-1 < u < o$.

The primary purpose of HERD 2 and 3 is to compute blackness coefficients.

(4) Restrictions or Limitations:
Either a 16K or 32K core memory may be used. Limitations on the size problem which may be run depend upon the size of core used, and depend on the number of angles at which the vector flux may be calculated. Details are given on page 2 of Reference 6 (1.).

(5) Approximate Performance:
The average running time for most problems is between 0.5 and 5.0 minutes.

(6) References:
1. L. A. Hageman, "HERD 1, 2, and 3 - IBM-704 Codes Used to Solve the One-Dimensional, One-Velocity Transport Equation with Isotropic Scattering", WAPD-TM-162, January, 1959.

MUFT 4

704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
Computes the energy distribution of neutrons having a given Fourier mode in an infinite medium. MUFT IV is essentially the same as the 650 nuclear code MUFT III. Modifications incorporated into MUFT IV were designed to improve the treatment of non-hydrogenous moderation, and to take into consideration the effect of resonance self-shielding on the production of fission neutrons.

(4) Restrictions or Limitations:
100 or less lethargy groups averaged over 3 few groups; 15 or less isotopes; any value for the total buckling; one approximation per problem.

(5) Approximate Performance:
11 seconds.

(6) References:
1. R. L. Hellens, R. W. Long, B. H. Mount, "Multigroup Fourier Transform Calculation - Description of MUFT-III Code", WAPD-TM-4, July, 1956.
2. H. Bohl, E. M. Gelbard, G. H. Ryan, "MUFT - 4 - Fast Neutron Spectrum Code for IBM-704", WAPD-TM-72, July, 1957.

PDQ - 2

704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
The program solves the few-group neutron diffusion equations for one to four lethargy groups over a rectangular region of the (x,y) or (r,z) plane. Variable mesh intervals are allowed. The inner iterations are performed by the method of over-relaxation and include a special method of determining the over-relaxation factors for each group.

(4) Restrictions or Limitations:
Outer boundary of mesh must be rectangular and material interfaces may occur only on mesh lines. Maximum of 35 different materials, but each may appear in many regions of the mesh. Maximum of 1250 to 6500 mesh points, depending upon core storage available. Requires one drum unit and six tape units.

(5) Approximate Performance:
Less than 1 hour for a two-group 2500-point problem.

(6) References:
1. R. S. Varga, "Numerical Solution of the Two-Group Diffusion Equation in x-y Geometry", WAPD-159, August, 1956.
2. G. G. Bilodeau, W. R. Cadwell, J. P. Dorsey, J. G. Fairey, R. S. Varga, "PDQ -- An IBM-704 Code to Solve the Two-Dimensional Few-Group Neutron-Diffusion Equations", WAPD-TM-70, August, 1957.

PDQ - 3

704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
Similar to PDQ - 2 except that a single-line over-relaxation is used.

(4) Restrictions or Limitations:
Requires 32K core memory.

(6) References:
1. W. R. Cadwell, J. P. Dorsey, H. B. Henderson, J. M. Liska, J. P. Mandell, M. C. Suggs, "PDQ - 3 -- A Program for the Solution of the Neutron Diffusion Equation in Two Dimensions on the IBM-704, WAPD-TM-179.

PECAN

704 Nuclear Code

(1) Code Originated by:
Aerojet - General Nucleonics

(2) Computer:
704

(3) Description of Code:
The PECAN Cycle analysis code calculates various thermodynamic cycle data for gas turbine power plants, based on a given set of design parameters. The calculations enable optimization of a specific power plant design to a major requirement such as weight, economy, or output.

(4) The code is restricted to the use of a gaseous working fluid within a temperature range of 300° R to 2300° R, but is otherwise general.

(6) References:
1. S. Luchter, W. J. O'Donnell, W. C. Reynolds, "PECAN-Cycle Analysis Code for Gas Turbine, Nuclear or Conventional Power Plant", AGN TM-391, April, 1961.

PIMG

704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
One-Dimensional P1 multigroup

(6) References:
Letter, 7/31/58.

POLYPHEMUS

704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
A Monte Carlo study of the penetrations of monoenergetic, mono-directional, isotropic source neutrons from 1 mev to 10 mev through finite water slabs. The program was designed to provide two groups of shielding parameters; the neutron dose rates and dose buildup factors for the several energies. Because it was primarily a production code, emphasis was placed on speed rather than completeness of information.

(5) Approximate Performance:
7 minutes per 1000 histories

(6) References:
1. NCG Newsletter No. 5, page 5.
2. IBM 701/704/709 Bulletin No. 5, January 1958, p. 21.
3. WAPD-TM-54, "POLYPHEMUS - A Monte Carlo Study of Neutron Penetrations Through Finite Water Slabs", F. Obenshain, A. Eddy, et al., January 1957.
4. WAPD-TN-517 (Navy)- Part I, and WAPD-TN-517(Navy)- Part II, A. Foderaro, F. Obenshain, NEPTUNE, 1955.

PROP and JET

704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
These programs form the power distribution for a reactor core in three dimensions from previously determined one and two-dimensional power shapes. Thermal data are calculated for various axial traverses, and the results can be sorted to determine the worst areas for further study. PROP, the first of the two codes, operates on the nuclear data determined by TURBO. It combines the (x,y) radial power shapes from several time steps in each of several TURBO problems on a single tape in a convenient form for further calculations. JET then combines any selected group of these radial power shapes with a single axial power shape which has been previously determined by a one-dimensional axial study. The JET code also performs thermal criteria and power sharing calculations.

(4) Restrictions or Limitations:
This program requires either a 16K or 32K core memory. The core to be studied may have as many as 100 axial mesh intervals and 25 axial regions. It may have up to 63 radial regions, and, depending on machine size, up to 3750 or 6500 interior radial mesh points. As many as 62 of these regions and 3200 or 6000 of the radial mesh rectangles may contain fuel.

(5) Approximate Performance:
The running time for a problem having 1512 fueled rectangles, 35 axial internals, 6 radial fuel regions, and 10 axial regions is less than 1-hr. total.

(6) References:
1. J. G. Fairey, J. E. Meyer, J. B. Callaghan, S. H. Meanor, A. V. Pace, R. B. Smith, "PROP and JET -- A Program for the Synthesis and Survey of Three-Dimensional Power Shapes on the IBM-704", WAPD-TM-116, May, 1958.

PS

704 Nuclear Code

(1) Code Originated by:
GE-Knolls Atomic Power Laboratory

(2) Computer:
704

(3) Description of Code:
Given CURE (two-dimensional) three-group flux and adjoint calculation results (on tapes in binary) and cross-section increments by material region. PS computes the corresponding reactivity increments over regions specified in the input.

(4) Restrictions or Limitations:
Geometry - 2 - dimensional, x-y, r-z, r-θ; limited to three group results with at least 40 material regions.

(5) Approximate Performance:
About 5 minutes.

(6) References:
1. Letter January 17, 1958.

QUERY

704 Nuclear Code

(1) Code Originated by:
Combustion Engineering, Inc.

(2) Computer:
704

(3) Description of Code:
This program is used to calculate resonance escape probabilities using the procedure described by Adler, Hinman and Nordheim. The code allows three types of reactor compositions; homogeneous - metal fuel and heterogeneous - oxide fuel. The code will also calculate the effective resonance integral for each resonance using either the narrow resonance (NR), or the narrow resonance, infinite mass approximation (NRIA).

(4) Restrictions or Limitations:
16K 704, 2 tape units.

(5) Approximate Performance:
Average problem takes approximately .25 minutes per resolved resonance.

(6) References:
F. T. Adler, G. W. Hinman, L. W. Norheim; "The Quantitative Evaluation of Resonance Integrals", GA-350, SEND MPS-19.

RANCH

704 Nuclear Code

(1) Code Originated by:
Westinghouse-Bettis Plant

(2) Computer:
704

(3) Description of Code:
The RANCH code numerically solves the one-dimensional, one-velocity neutron transport equation in slab geometry. The source is assumed to be isotropic, but anisotropic scattering is permitted. The method of discrete ordinates is used with the iteration process accelerated by overrelaxation to obtain the solution.

(4) Restrictions or Limitations:
A 32K memory and one tape unit are required. Up to 50 regions are permitted, and the number of mesh points permitted depends upon the number of angles used, and varies from 1,250 points for 4 angles to 833 points for 12 angles.

(5) Approximate Performance:
An 8 angle, 100-point problem requiring 40 iterations for convergence took 3.1 minutes.

(6) References:
1. L. A. Hageman, J. T. Mandel, "RANCH, An IBM-704 Program Used to Solve the One-Dimensional, Single Energy Neutron Transport Equation with Anisotropic Scattering", WAPD-TM-268 (1961).

(7) Material Available:
1. WAPD-TM-268.
2. Binary deck.

Note: The information above was abstracted from WAPD-TM-268.

REM

704 Nuclear Code

(1) Code Originated by:
GE Knolls Atomic Power Lab.

(2) Computer:
704

(3) Description of Code:
This code is a version of CURE which differs from it in that (1) it permits interior (region) and exterior boundaries to run diagonally, as well as horizontally and vertically in the mesh, (2) it does not permit deletion of points, (3) it will presently handle only (x, y) geometry. It is required that an additional index be included for each combination of 2 different compositions along an interior diagonal line.

(5) Approximate Performance:
3 min./source iteration for 700 points, 3 groups.

(6) References:
1. KAPL-1724, CURE
2. Summary, September 1958.

The SET Codes

704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
The SET codes (SET 02 and SET 03) obtain a numerical solution to the problem of stresses in a pressure vessel with an ellipsoidal head. The codes are based on a finite-difference approximation to the Love-Weissner equations which are the basis of the bending theory of thin shells. The SET 02 code uses a direct method to solve the system of difference equations while the SET 03 code uses an iterative method.

(4) Restrictions or Limitations:
A typical problem is run on the SET 02 code much faster than on the SET 03 code. On the other hand, the SET 02 is subject to round off errors when the mesh is sufficiently refined, while the method used in the SET 03 code is inherently "stable". A 32K core memory is required 1 as well as 2 tapes. No drums are required.
Restrictions:
1. Number of intervals in ellipse: $5 \leq n \leq 500$
2. Number of regions in ellipse: ≤ 10
3. Number of regions in cylinder: ≤ 10

(6) References:
1. G. G. Bilodena, J. B. Callaghan, H. Kraus, "The SET Codes-IBM 704 Codes for the Calculation of the Stresses in a Pressure Vessel with an Ellipsoidal Head", WAPD-TM-174, June, 1959.

SIMPL-1

704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
Determines 1-, 2-, 3-, or 4-group fluxes due to source in multiplying medium. Solves inhomogeneous P_3 or double P_1 one-group problem with proper choice of parameters.

(4) Restrictions or Limitations:
1 to 4 groups, 25 regions, 250 mesh intervals.

(5) Approximate Performance:
1 minute.

(6) References:
L. M. Culpepper, E. M. Gelbard, J. Davis, J. Pearson, "The IBM 704 SIMPL Codes", WAPD-TM-107, January 1958.

SIMPL - 2

704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
Determines scalar flux for one group P_3 or double P_1 problem with proper choice of parameters.

(4) Restrictions or Limitations:
A maximum of 50 regions and 500 mesh intervals are permitted.

(5) Approximate Performance:
1 minute.

(6) References:
L. M. Culpepper, E. Gelbard, J. Davis, J. Pearson, "The IBM 704 SIMPL Codes", WAPD-TM-107, January 1958.

SNG

704 Nuclear Code

(1) Code Originated by:
Los Alamos Scientific Labratory

(2) Computer:
704

(3) Description of Code:
The program is a neutron diffusion code which solves the neutron transport equations in the stationary case, using the S_n method (LA-1891), and assuming isotropic scattering and one-dimensional geometry. The present version of the code has been modified to reduce the number of iterations required in a given problem by better than a factor of two. The code is readily applicable to any S_n approximation of reasonable order (constants for n = 2, 4, 6, and 8 supplied), to any one-dimensional geometry (plane, spherical or infinite cylindrical in symmetry), and to the three eigen-values: reactivity, outer dimension, or exponential rate. The program was written using the Los Alamos Flow Code System (FLOCO).

(6) References:
1. The report is a revision of T-1-119 issued November 24, 1956, describing a code for solving the neutron transport equation in the stationary case using the S_n method (LA-1891), and assuming isotropic scattering and one-dimensional geometry.
2. IBM 701/704/709 Bulletin No. 5, January 1958, p. 23.
3. NCG Newsletter No. 3, 3/1/57, page 22.
4. NCG Newsletter No. 5, 9/1/57, page 4.

SOFOCATE

704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
By solving the Wigner-Wilkins differential equation, the code determines the neutron spectrum in a homogeneous mixture where the absorption cross sections of the constituents may vary arbitrarily with energy. The code will always compute the macroscopic absorption cross section, $\nu\Sigma_f$, the flux averaged diffusion constant and microscopic fission cross sections. In addition, any desired function may be averaged over the resultant flux even though it may not be present in the mixture.

(4) Restrictions or Limitations:
Energy limit is 2.0 ev; only two choices of mesh.

(5) Approximate Performance:
30 seconds.

(6) References:
1. H. Amster, R. Suarez, the Calculation of Thermal Constants Averaged over a Wigner-Wilkins Flux Spectrum: Description of the SOFOCATE Code, WAPD-TM-39, January 1957.
2. IBM-701/704/709 Bulletin No. 5, January 1958, page 25.

SPAN - 2

704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
The SPAN - 2 code calculates the uncollided gamma flux at a point outside a right circular cylinder which is surrounded by cylindrical shell shields and above which are plane slab shields. The cylinder is assumed to contain a source of gamma radiation which varies in the radial and axial directions only. Field points may be located in a plane through the axis of the cylinder. The method of integration used is three-dimensional Gaussian quadrature.

The code's primary applications are expected to be in radiation heating problems and in calculating gamma dose rates.

(4) Restrictions or Limitations:
A 32K core memory is required.
Restrictions:
a. The number of mesh intervals may not exceed 78 in the r direction or 113 in the z direction. The total number of mesh intervals may not exceed 6500.
b. The number of energy levels cannot exceed 30.
c. The number of side shields cannot exceed 30.
d. The number of top shields cannot exceed 30.
e. There may be 1, 2, or 3 regions inside the core. The sum of thicknesses of these regions must be equal to the core radius.
f. The number of materials in any region cannot exceed 9.

(5) Approximate Performance:
Typical computing and editing time for a 20 field point problem, in which there are 10 side and 10 top shields, is four minutes per energy level.

(6) References:
1. P. A. Gillis, T. J. Lawton, K. W. Brand, "SPAN - 2 - An IBM 704 Code to Calculate Uncollided Flux Outside a Circular Cylinder". WAPD-TM-176, August, 1959.

SPIC - 1

704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(Continued on next page

(3) Description of Code:
The SPIC - 1 code calculates the fast-neutron dose rate or the thermal neutron flux at a point outside a right circular cylindrical source which is surrounded by cylindrical shell shields and is capped by plane slab shields. The fast neutron attenuation kernel is empirical and is in the form of a linear combination of single exponentials which has been fitted to the experimental fast-neutron dose rate distribution in pure water. Empirical neutron removal cross-sections are used to represent the attenuation by shells of non-hydrogenous materials located in the water.

(4) Restrictions or Limitations:
A 32K core memory is required. Other limitations are those of the SPAN - 2 code.

(5) Approximate Performance:
Typical computing and editing time for a 20-field-point-problem, in which there are 10 side and 10 top shields, is 6.5 minutes.

(6) References:
1. P. Gillis, "SPIC - 1 - An IBM - 704 Code to Calculate the Neutron Distribution Outside a Right-Circular Cylindrical Source", WAPD-TM-196, November, 1959.

STDY-3

704 Nuclear Code

(1) Code Originated by:
Westinghouse-Bettis Plant

(2) Computer:
704 (FORTRAN)

(3) Description of Code:
STDY-3 is a computer program designed for the thermal analysis of a pressurized water nuclear reactor during steady-state operation. It performs a complete steady-state, parallel channel thermal analysis of a rectangular water channel core with a plate-type fuel element.

(4) Restrictions or Limitations:
A 16K memory is required, as well as three tape units and a logical drum.

(5) Approximate Performance:
Typical computing time for a two-pass core containing a hot channel in each pass is 0.72 minutes.

(6) References:
1. R. S. Pyle, "STDY-3", Computer Code Abstract No. 5, Nuclear Science and Engineering, 9, p. 102, 1961.
2. WAPD-TM-213.

Note: The information given above was abstracted from Reference 1.

SWAP MU and NU

704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
The code is designed to compute the uncollided particle flux as a function of the distance from a homogeneous cylinder containing a uniform isotropic source distribution, assuming that the attenuation of the particles is exponential, both within the cylinder as well as in the attenuating shells or slabs.

(5) Approximate Performance:
About (26N plus 150) /6 seconds, where N is number of cases.

(6) References:
N. L. Barnett, "Swap Mu and Nu", WAPD-P-707, Oct., 1956.

TEMP - 2

704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
The TEMP - 2 program solves the difference form of the one-dimensional transient heat-conduction for a body with an arbitrary initial temperature distribution and either the temperature, its normal gradient, or a combination of the two specified on the boundaries. An implicit difference scheme is used. The thermal stresses resulting from the temperature distribution are then obtained by a regionwise application of the analytical stress expressions of Reference 6 (2) below.

(4) Restrictions or Limitations:
The size of the core memory required is not given in Reference 6 (1), but it is believed to be 32K. The program provides for minimum of 7 and a maximum of 251 mesh points which may be distributed over a minimum of 3 and a maximum of 25 regions.

(5) Approximate Performance:
The solution of a 41-point problem requires about 5 seconds of computer time per time step.

(6) References:
1. L. M. Culpepper, D. Jortner, "TEMP - 2, a One-Dimensional Thermal Stress Program for the IBM 704", WAPD-TM-214, April, 1960.
2. S. Timoshenko and J. N. Goodiea, Theory of Elasticity, 2nd. Edition, McGraw-Hill, New York, 1951, p. 399.

TKO

704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
Three-dimensional, few group diffusion code.

(6) References:
Letter 7-31-58.

TRIP - 1

704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
The TRIP - 1 program is designed to solve the P_3 equations in X-Y geometry. Only one-group cell problems are treated. The cell is assumed to be rectangular, with regionwise constant cross-sections. The source is isotropic and regionwise flat. Anisotropic scattering is dealt with rigorously (within the limits of a P_3 approximation). Simultaneous line over-relaxation is used to solve the difference equations.

(4) Restrictions or Limitations:
A 32K core memory is required. Nine tape units are required. No more than 2500 interior mesh points are allowed.

(6) References:
1. E. Gelbard, J. Davis, J. Dorsey, H. Mitchell, J. Mandel, "TRIP - 1, A Two-Dimensional P-3 Program in X-Y Geometry for the IBM - 704", WAPD-TM 217, July, 1960.

TURBO

704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
Two space dimensions and time version of CANDLE for x-y (TURBO 1 and 3), and r-z (TURBO 2 and 4) geometry. Otherwise same as CANDLE except that the PDQ spatial calculation is used. Maximum xenon calculation is TURBO-3 for x-y or TURBO-4 for r-z.

(4) Restrictions or Limitations:
Max of 35 compositions. Number of mesh points limited by size of core according to the number pairs 8K-2500, 16K-3750, 32K-6500; with a minimum of 8192 words of core storage. Automatically calculates one time step with provision for continuing later. No automatic criticality search is provided. Also requires ten tape units and one drum unit.

(5) Approximate Performance:
Approximately 1.5 hours per time step.

(6) References:
1. B. H. Mount, "TURBO", CPM-M-80, 9-3-57 (Preliminary description).
2. E. Gelbard, M. Culpepper, D. McCarty, C. King, T. Lawton, J. Fairey, O. Marlowe, J. Callaghan, "TURBO - A Two Dimensional Few-Group Depletion Code for the IBM 704", WAPD-TM-95.

TURF 6

704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
Transient temperatures and stresses in axially symmetric solid or hollow bodies.

(6) References:
1. Letter 7-31-58.
2. ADD-57-8 and ADD-58-12 describing the program are available with the program from IBM.

TUT - T5

704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
The TUT - T5 code provides, for a one-energy model, a means of calculating a regionwise distribution of capture probabilities in a two-dimensional quarter-cell. The method used is the Monte Carlo method, in which neutron histories are simulated by the code and then used to provide estimates for the integrals which define the capture probabilities.

(4) Restrictions or Limitations:
A 32K core memory is required. As many as 32 regions can be treated, all of different material content; however, the content of each region must be uniform. The number of neutron histories must be less than or equal to 1000.

(5) Approximate Performance:
Running times may be from one to two hours. A method of estimating the time required is given in the reference cited below.

(6) References:
1. J. Spanier, H. Kuehn, W. Guilinger, "TUT -T5 - A Two-Dimensional Monte Carlo C lculation of Capture Probabilities for the IBM - 704", WAPD-TM-125, November, 1959.

UFO

704 Nuclear Code

(1) Code Originated by:
G. E. Knolls Atomic Power Lab.

(2) Computer:
704

(3) Description of Code:
Three-dimensional few group neutron diffusion code in x-y-z geometry. Variable mesh spacings along all three directions with zero flux or specified current boundary conditions for any of the six boundary planes are permitted.

Mesh planes per direction (I, J, or K)	$>$	3
Mesh points per plane	$\leq$	4000
Material compositions	$\leq$	512
Point types (Q)	$\leq$	1900
Groups	$\leq$	5
I.J.K + 7Q	$\leq$	30,200

(5) Approximate Performance:
Thirty-five (35) minutes pre-iteration calculations plus 15 minutes per source iteration (1st two iterations) or 12 minutes per source iteration (beyond second) plus 15 minutes for edits. Times are for a 12,000 - point mesh, 3-group problem.

(6) References:
KAPL - 1999.

WANDA 2, 3

704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
Solves the few-group diffusion equation in one space dimension for rectangular, cylindrical, or spherical geometry by setting either the flux or its derivative to zero on the boundaries. The parameters must be continuous within a region, but may have a finite discontinuity at the interfaces between regions. The mesh width must be constant within a region. An initial source guess is required to start the iteration process. Convergence may be defined either by a percentage deviation in the eigen value or by a percentage deviation between successive source vectors.

(4) Restrictions or Limitations:
Requires an 8K core memory, 1 drum unit, and 1 tape unit.

(5) Approximate Performance:
1-15 minutes, average 3 minutes.

(6) References:
1. O. J. Marlowe, C. P. Saalbach, L. M. Culpepper, D. S. McCarty, "WANDA -- A One-Dimensional Few Group Diffusion Equation Code for the IBM-704", WAPD-TM 28, November, 1956.
2. O. J. Marlowe, E. M. Gelbard, WAPD-TM-28 (Addendum), September, 1957.

WANDA -4

704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
An improved version of WANDA - 3 which eliminates use of the drum unit and provides an automatic extrapolation procedure to accelerate convergence of the iteration process.

(4) Restrictions or Limitations:
An 8K core memory is required as well as one to four tape units.

(6) References:
1. O. J. Marlowe, "WANDA -- A One-Dimensional Few-Group Diffusion Equation Code for the IBM-704", WAPD-TM-28 (Addendum 2), July, 1959.

WB TSG - 1 704 Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
704

(3) Description of Code:
Computes in one-dimensional form the tangential, axial, and radial thermal stresses for cylinders with internal heat generation.

(5) Approximate Performance:
20 minutes.

(6) References:
1. D. M. Davis, B. H. Mount, "The Calculation of Thermal Stress in Cylinders with Internal Heat Generation", Description of WB-TSG-1 Code, WAPD-TM-59, May, 1957.
2. G. Sonneman, D. M. Davis, "Stress in Long Thick-Walled Cylinders Caused by Pressure and Temperature Gradients", WAPD-TM-570.
3. NCG Newsletter No. 5, p. 5.
4. IBM 701/704/709 Bulletin No. 5, Jan., 1958, p. 31.

ZOOM 704 Nuclear Code

(1) Code Originated by:
University of California, Radiation Lab.

(2) Computer:
704

(3) Description of Code:
Solves the one-dimensional multigroup neutron diffusion equation for slabs, cylinders or spheres. A maximum of 10 materials, 30 regions (or zones) may be used. A higher order differencing is used for the Laplacian and a general transfer matrix is permitted.

(5) Approximate Performance:
10 minutes.

(6) References:
UCRL 5293-T-Preliminary (UCRL 5293 available in about 1 month), September 1958.

2DXY 704 Nuclear Code

(1) Code Originated by:
Aerojet-General Nucleonics

(2) Computer:
704, (FLOCO-II-D)

(3) Description of Code:
The 2DXY program solves the homogeneous or inhomogeneous multigroup transport equation in xy geometry. Vacuum, surface source, or reflecting boundary conditions are available as options. In the homogeneous case the user may request the computation of reactivity, period, critical concentrations of some composition or the critical thickness of a zone. The S_n approximation is used.

(4) Restrictions or Limitations:
Scattering must be isotropic.

(5) Approximate Performance:
One and one-half hours for 6 group, 1000 mesh points on the 7090 (using the binary editor).

(6) References:
1. J. Bengston, S. T. Perkins, T. W. Sheheen, and D. W. Thompson, "2DXY - A Two-Dimensional Cartesian Coordinate S_n Transport Calculation", AGN-TM-329, 1961.
2. B. Carlson, C. Lee, and J. Worlton, "The DSN and TDC Neutron Transport Codes", LAMS-2346, 1961.
3. S. T. Perkins, T. W. Sheheen, D. W. Thompson, "2DXY", Computer Code Abstract No. 18, Nuclear Science and Engineering, 10, p. 408, 1961.

(Continued on next column)

(7) Material Available:
1. Binary Editor Deck (7090).
2. FLOCO II F Binary Deck (7090).
3. 2DXY Deck (7090).
4. Sample Problem Input Deck (7090).
5. AGN TM-392.

Notes: 1. The above information was taken from Reference 3.
2. This code was contributed through the Argonne Code Center. The binary editor program referred to above is essentially a compatibility package for the 7090.

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: AF-001-1

PROGRAM NAME: CHANGE-CARD-LOAD

PURPOSE: To load program cards into memory in the same manner as the standard lower load program. Also, to allow special patch cards to be loaded as if they were normal instruction cards.

MACHINE: 702 ____ 705 X Model I or II Other ____ (Specify)

#Tapes ____ #Printer ____ TRC ____ Drum ____

Card Reader X 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder X Symbolic ____ Actual ____

Other ____ (Specify)

PROGRAM TYPE: Complete Program X

Macro-Instruction ____ Label ____

Subroutine ____ Label ____

CONTRIBUTED BY:
Headquarters, USAF
AFASC-3E
Washington 25, DC

April 1958, Bulletin 57 - 45

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: AF-002-0

PROGRAM NAME: MEMORY PUNCH OUT

PURPOSE: To punch out program decks incorporating change cards to cut down the size of program decks and serial number cards in the deck. This removes the danger of change cards getting out of sequence. It has an advantage over IBM's Punch Memory 51 utility program in that control cards need not be made to designate memory to be punched. It will also punch out a greater portion of memory than Punch Memory 51.

MACHINE: 702 ____ 705 X Model I Other ____ (Specify)

#Tapes ____ #Printer ____ TRC ____ Drum ____

Card Reader X 760 ____ Other Option - punch or tape unit

PROGRAM LANGUAGE: Autocoder ____ Symbolic ____ Actual X

Other ____ (Specify)

PROGRAM TYPE: Complete Program X

Macro-Instruction ____ Label ____

Subroutine ____ Label ____

CONTRIBUTED BY:
George Widding
Headquarters USAF
AFASC 3E
Washington 25, D. C.

(August 1957, Bulletin 50 - 105)

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: AF-003-1

PROGRAM NAME: HQ USAF Tape Input-Output Package. Includes EOF-TRA Sub-routines, Checkpoint Option, Input-Output Macro-Instructions and Restart Program

PURPOSE:
This set of sub-routines and macro-instructions provides for complete handling

(Continued on next column)

of tape input and output. The sub-routines are designed primarily to process tapes using the HQ USAF tape identification system but tapes lacking headers and trailers may be processed. The major parts of the package are:

a. Input/output macros to read a tape, write a tape, read-while-write a tape, read and deblock blocked records, and block-up and write blocked records.

b. A sub-routine (IDENT) that provides for TRA operations, output tape labelling and input tape label verification.

c. A sub-routine (IDWCP) that in addition to the IDENT functions includes a check point routine. Check points are taken automatically at EOF but may be taken at any other time desired. Provision is made for program interrupt.

d. A restart program for use with IDWCP. This is a separate program that enables you to restart to any check point taken by IDWCP. The routine checks tape labels, today's data, repositions tapes, and restores memory and ASU's 01-13. Since the restart begins with memory cleared it is useful in situations where long runs are interrupted.

MACHINE: 702 ____ 705 X Model I or II Other ____ (Specify)

#Tapes ____ #Printer ____ TRC ____ Drum ____

Card Reader ____ 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder X Symbolic ____ Actual ____

Other ____ (Specify)

PROGRAM TYPE: Complete Program ____

Macro-Instruction ____ Label ____

Subroutine X Label IDWCP

CONTRIBUTED BY:
Headquarters, USAF

Any questions should be addressed to:
George Widding, AFASC-3E-1
Data Processing Division
Headquarters, USAF, Washington 25, D.C.

Distribution No. 4

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: AF-011-0

PROGRAM NAME: TAPE PRINT OUT

PURPOSE: To accomplish a transformation of data from tape to tape in a manner facilitating a more efficient visual interpretation of the data, when listed.

MACHINE: 702 ____ 705 X Model I or II Other ____ (Specify)

#Tapes ____ #Printer ____ TRC ____ Drum ____

Card Reader X 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder X Symbolic ____ Actual ____

Other ____ (Specify)

PROGRAM TYPE: Complete Program X

Macro-Instruction ____ Label ____

Subroutine ____ Label ____

CONTRIBUTED BY:
George Pike
Headquarters, USAF
Any questions should be addressed to:
George Widding, AFASC-3E
Data Processing Division
Headquarters, USAF, Washington 25, DC

April 1958, Bulletin 57 - 41

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: AF-012-0

PROGRAM NAME: CARD TO TAPE LOAD

PURPOSE: To create, from card input, blocked or unblocked records of any length on tape.

(Continued on next page)

MACHINE: 702 ____ 705 X Model I or II Other ____ (Specify)

#Tapes X #Printer ____ TRC ____ Drum ____

Card Reader X 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder X Symbolic ____ Actual ____

Other ____ (Specify)

PROGRAM TYPE: Complete Program X

Macro-Instruction ____ Label ____

Subroutine ____ Label ____

CONTRIBUTED BY:

A. Lett
Headquarters, USAF
Any questions should be addressed to:
George Widding, AFASC-3E
Data Processing Division
Headquarters, USAF, Washington 25, DC

April 1958, Bulletin 57 - 43

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: AF-013-0

PROGRAM NAME:
Square Table Look-up
Square Table Look-up with Function
Table Look-up
Table Look-up with Function

PURPOSE:
A set of four macro-instructions is provided to be used for table look-up operations. Two macros are merely for argument verification and the other two are for both argument verification and function extraction. Two macros are for use when the number of entries in the table is a perfect square. The other two macros will process tables of fluctuating size since the macro contains a housekeeping portion to calculate the address modification table.

MACHINE: 702 ____ 705 X Model I or II Other ____ (Specify)

#Tapes ____ #Printer ____ TRC ____ Drum ____

Card Reader ____ 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder X Symbolic ____ Actual ____

Other ____ (Specify)

PROGRAM TYPE: Complete Program ____

Macro-Instruction X Label STLU, STLUF, TLU TLUF

Subroutine ____ Label ____

CONTRIBUTED BY:
Headquarters, USAF

Any questions should be addressed to:
George Widding, AFASC-3E-1
Data Processing Division
Headquarters, USAF, Washington 25, D.C.

Distribution No. 4

705 CUSTOMER CONTRIBUTION

Program Write-Up Abstract

INDICATIVE CODE: AL 0001

PROGRAM NAME: 705 Assembly Program for 704/709 Symbolic Programs

PURPOSE: To assemble 704 or 709 symbolic cards on an IBM 705, producing an assembly listing and octal cards.

* This is strictly a tape-to-tape operation.

RESTRICTIONS: 40, 000 character memory capacity
6 tape drives on line

CONTRIBUTED BY:

Robert P. Tapscott
Allison Division, General Motors Corp.

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: AO-001-0

PROGRAM NAME: PRINT I TRACING ROUTINE

PURPOSE: To function as a debugging aid in cases where debugging by memory print fails. The routine lists each PRINT I step executed, along with numerical values of the operands and results, if any.

MACHINE: 702 ____ 705 X Model I Other ____ (Specify)

#Tapes One (or none) #Printer None (or one) TRC ____ Drum ____

Card Reader X 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder ____ Symbolic ____ Actual ____

Other PRINT (Specify)

PROGRAM TYPE: Complete Program ____

Macro-Instruction ____ Label ____

Subroutine X Label (NONE)

CONTRIBUTED BY:

W. R. Brittenham,
A. O. Smith Corporation

(August 1957, Bulletin 50 - 117)

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: AO-002-0

PROGRAM NAME: ABBREVIATED PRINT I TRACING ROUTINE

PURPOSE: To function as a debugging aid in cases where the amount of memory available for a tracing routine is small. BADD and PAC1 are listed for each PRINT I Program step executed.

MACHINE: 702 ____ 705 X Model I Other ____ (Specify)

#Tapes One (or none) #Printer None (or one) TRC ____ Drum ____

Card Reader X 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder ____ Symbolic ____ Actual ____

Other PRINT (Specify)

PROGRAM TYPE: Complete Program ____

Macro-Instruction ____ Label ____

Subroutine X Label (NONE)

CONTRIBUTED BY:

W. R. Brittenham &
George Kuss
A. O. Smith Corporation

(August 1957, Bulletin 50 - 119)

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: AO-003-0

PROGRAM NAME: LEAST SQUARES POLYNOMIAL CURVE-FITTING ROUTINE

PURPOSE: To produce the coefficients of that polynomial which fits given data in the least squares sense, and to plot that polynomial and the given points graphically on the printer. The program makes logarithmic transformations on given data when required.

(Continued on next page)

MACHINE: 702 ________ 705 X One Model I Other ________ (Specify)

#Tapes 2 (or 3) #Printer (or none) TRC ________ Drum ________

Card Reader X 760 ________ Other ________

PROGRAM LANGUAGE: Autocoder ________ Symbolic ________ Actual ________

Other PRINT (Specify)

PROGRAM TYPE: Complete Program X

Macro-Instruction ________ Label ________

Subroutine ________ Label ________

CONTRIBUTED BY:
W. R. Brittenham
A. O. Smith Corporation

(August 1957, Bulletin 50 - 121)

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: AO-004-0

PROGRAM NAME: CURVE-PLOTTING SUBROUTINE

PURPOSE: To convert PRINT I floating point numbers into one or more curves, which are displayed graphically by means of a printer.

MACHINE: 702 ________ 705 X One Model I Other ________ (Specify)

#Tapes 1 (or 2) #Printer (or none) TRC ________ Drum ________

Card Reader ________ 760 ________ Other ________

PROGRAM LANGUAGE: Autocoder ________ Symbolic ________ Actual ________

Other PRINT (Specify)

PROGRAM TYPE: Complete Program ________

Macro-Instruction ________ Label ________

Subroutine X Label (NONE)

CONTRIBUTED BY:
W. R. Brittenham,
A. O. Smith Corporation

(August 1957, Bulletin 50 - 123)

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: AO-005-0

PROGRAM NAME: 705 ADDRESS LISTING

PURPOSE: To produce an actual address listing following a 705 assembly of programs written in either Autocoder, Print I, or Symbolic language. The program reads the listing tape produced by the assembly and prepares a sorted table of address-location references, which is written out on the listing tape following the tape mark.

MACHINE: 702 ________ 705 X Model I or II Other ________ (Specify)

#Tapes 3 #Printer 1-717 TRC ________ Drum ________

Card Reader X 760 ________ Other ________

PROGRAM LANGUAGE: Autocoder X Symbolic ________ Actual ________

Other ________ (Specify)

PROGRAM TYPE: Complete Program X

Macro-Instruction ________ Label ________

Subroutine ________ Label ________

(Continued on next column)

CONTRIBUTED BY:
L. R. Smith - Dept. 0179
A. O. Smith Corporation
EDP Systems
3533 North 27th Street
Milwaukee 1, Wisconsin

April 1958, Bulletin 57 - 47

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: AO-009-0

PROGRAM NAME: 705 Memory Interpreter

PURPOSE:
To provide a memory print of 705 instructions in programs for which no up-to-date listing is available. Operation codes are interpreted as standard 3-character mnemonic symbols, all zoning is decoded and instructions are listed one per line for readability.

MACHINE: 702 ________ 705 X Model I Other ________ (Specify)

#Tapes 1* #Printer 1* TRC ________ Drum ________

Card Reader 1 760 ________ Other ________

PROGRAM LANGUAGE: Autocoder ________ Symbolic ________ Actual ________

Other PRINT (Specify)

PROGRAM TYPE: Complete Program X

Macro-Instruction ________ Label ________

Subroutine ________ Label ________

CONTRIBUTED BY:
W. R. Brittenham and G. W. Kuss
A. O. Smith Corporation

* either tape or printer may be used

Distribution No. 5

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: AO-010-0

PROGRAM NAME: Create Master Program Tape

PURPOSE:
To create or update a master program tape containing all of the PRINT programs in repetitive use in the 705 installation.

MACHINE: 702 ________ 705 X Model I Other ________ (Specify)

#Tapes 3 #Printer ________ TRC ________ Drum ________

Card Reader 1 760 ________ Other ________

PROGRAM LANGUAGE: Autocoder ________ Symbolic ________ Actual ________

Other PRINT (Specify)

PROGRAM TYPE: Complete Program X

Macro-Instruction ________ Label ________

Subroutine ________ Label ________

CONTRIBUTED BY:
W. R. Brittenham and G. W. Kuss
A. O. Smith Corporation

Distribution No. 5

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: AO-011-0

PROGRAM NAME: Search Master Program Tape

PURPOSE:
To search a master program tape on 0201 for a specific PRINT program, re-create any tapes containing portions of the program, bring the program into memory, and transfer control to it.

MACHINE: 702 ____ 705 X Model I Other ____ (Specify)

#Tapes 1 or more #Printer ____ TRC ____ Drum ____

Card Reader 1 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder ____ Symbolic ____ Actual ____

Other PRINT (Specify)

PROGRAM TYPE: Complete Program X

Macro-Instruction ____ Label ____

Subroutine ____ Label ____

CONTRIBUTED BY:
W. R. Brittenham and G. W. Kuss
A. O. Smith Corporation

Distribution No. 5

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: BW - 001 - 1

PROGRAM NAME: Address Modification

PURPOSE:

To provide a common set of address modification macro instructions for 705 Model II and 80K 705 Model III. This version contains revisions to the macro instruction MOVEA of contribution BW - 001 - 0. The macro instructions included are:

Macro Name	Operation Code
Add Address and Move	ADDA
Subtract Address and Move	SUBA
Increment Address	INCRA
Decrement Address	DECRA
Calculate Address	CALCA
Initialize Address	INITA
Move Address	MOVEA
Unconditional Transfer	TO

MACHINE: 702 ____ 705 X Model II & III Other ____ (Specify)

#Tapes ____ #Printer ____ TRC ____ Drum ____

Card Reader ____ 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder III Symbolic ____ Actual ____

Other ____ (Specify)

PROGRAM TYPE: Complete Program ____

Macro-Instruction X Label Address Modification

Subroutine ____ Label ____

CONTRIBUTED BY:

James O'Malley
Boeing Airplane Company
Wichita Division

Distribution No. 8

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: BW - 002 - 0

PROGRAM NAME: Miscellaneous General Purpose Macro Instructions

PURPOSE:	MACRO NAME:
Move Data	MOVE
Digit Selection	DGSEL
Fixed Memory Counter	FMCTR
Linkage to Subroutine	LINK
Option Halt	OPHLT
Sequence Check	SEQCK
Sign a Field	SIGN
Strip Field	STRIP
Variable Memory Counter	VMCTR

MACHINE: 702 ____ 705 X Model II and III Other ____ (Specify)

#Tapes ____ #Printer ____ TRC ____ Drum ____

Card Reader ____ 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder X Symbolic ____ Actual ____

Other ____ (Specify)

PROGRAM TYPE: Complete Program ____

Macro-Instruction X Label ____

Subroutine ____ Label ____

CONTRIBUTED BY:

Boeing Airplane Company
Wichita Division

Distribution No. 8

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: CU-001-1

PROGRAM NAME: Sort 57 - Blocked Variable

PURPOSE:
Corrections to above-mentioned modification to Sort 57. To transmit a group mark before TRA to dump unreadable records.

Phase 2	@ 38554	9H5T5 I7014	Phase 3	@ 38555	9H7T5 IX474

MACHINE: 702 ____ 705 X Model II Other ____ (Specify)

#Tapes ____ #Printer ____ TRC X Drum ____

Card Reader ____ 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder ____ Symbolic ____ Actual X

Other ____ (Specify)

PROGRAM TYPE: Complete Program ____

Macro-Instruction ____ Label ____

Subroutine ____ Label ____

CONTRIBUTED BY:
The Curtis Publishing Company
Independence Square
Philadelphia 5, Pennsylvania

Written by: William Anderson
IBM Corporation

Distribution No. 5

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: CU-002-0

PROGRAM NAME: Save Memory SRT 57 - Ph 3

PURPOSE:

To increase the amount of memory available to the programmer who is integrating a special purpose program into the third phase of the 705 Generalized Sort Program SORT 57.

MACHINE: 702 ______ 705 X Model II Other ______ (Specify)

#Tapes Srt 57 #Printer ______ TRC X Drum ______

Card Reader ______ 760 ______ Other ______

PROGRAM LANGUAGE: Autocoder X Symbolic ______ Actual ______

Other ______ (Specify)

PROGRAM TYPE: Complete Program Patches

Macro-Instruction ______ Label ______

Subroutine ______ Label ______

CONTRIBUTED BY:

The Curtis Publishing Co.
6th and Walnut Streets
Philadelphia 5, Penna

Program patches by
Macon A. Preston
IBM Corporation
James A. McAndrew
The Curtis Publishing Co.

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: DE - 002 - 0

PROGRAM NAME: Title, Halt and Switch Program

PURPOSE:

This program, using program listing tape from an autocoder assembly as input, produces cards which, after EAM processing, may be used to make listings to serve as index and halt logs for console operator's manual and a switch log for programmer's use.

MACHINE: 702 ______ 705 X Model I or II Other ______ (Specify)

#Tapes 3 #Printer ______ TRC ______ Drum ______

Card Reader ______ 760 ______ Other ______

PROGRAM LANGUAGE: Autocoder X Symbolic ______ Actual ______

Other ______ (Specify)

PROGRAM TYPE: Complete Program X

Macro-Instruction ______ Label ______

Subroutine ______ Label ______

CONTRIBUTED BY:

The Detroit Edison Company
2000 Second Avenue
Detroit 26, Michigan

Richard I. Grady

Distribution No. 8

705 CUSTOMER CONTRIBUTION

Program Write-Up Abstract

INDICATIVE CODE: DP 0001

PROGRAM NAME: Calculation of Seasonal Adjustment Factors

(Continued on next column)

MACHINE SPECIFICATIONS:

40, 000 position 705 with 4 tape units

PURPOSE:

To calculate seasonal adjustment factors for series of any length between five and twelve years.

GENERAL DESCRIPTION:

The program is an adaptation of "Census Method II" for calculating seasonal adjustment factors. The steps involved in this method are described in detail in the Census release, "Seasonal Variations in the Labor Force, Employment, and Unemployment" (Series P-50, No. 82, April, 1958), and in Technical Paper No. 12, "Seasonal Adjustments by Electronic Computer Methods" by Julius Shiskin and Harry Eisenpress, published by the National Bureau of Economic Research.

REQUIREMENTS AND RESTRICTIONS:

This program is written for a 12-digit mantissa Print I system for 2 TRC's. However, it may be used by any Model II system after it is pre-edited by that particular 12-digit mantissa system.

CONTRIBUTED BY:

Charles B. Reeder, E. I. duPont de Nemours
Nancy K. Brewer, IBM, Wilmington, Delaware

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: E1-001-0

PROGRAM NAME: LINEAR PROGRAMMING

PURPOSE: Solving Linear Programming problems, and performing associated matrix multiplications; 60th order.

MACHINE: 702 ______ 705 X Model II Other ______ (Specify)

#Tapes 3 #Printer One TRC ______ Drum X

Card Reader X 760 ______ Other ______

PROGRAM LANGUAGE: Autocoder ______ Symbolic X Actual ______

Other ______ (Specify)

PROGRAM TYPE: Complete Program X

Macro-Instruction ______ Label ______

Subroutine ______ Label ______

CONTRIBUTED BY:

David H. Brown
Esso Standard Oil Company
Baton Rouge, La.

January 1958, Bulletin 55 - 67

705 CUSTOMER CONTRIBUTION

Program Write-up Abstract

INDICATIVE CODE	PROGRAM NAME
EK 0001	One card lower load
EK 0002	One card upper load

MACHINE SPECIFICATIONS:

705

PURPOSE:

To provide a loading program in a single card entry to serve the same function as LOD 51.

RESTRICTIONS:

Only 160 memory positions are required.

GENERAL DESCRIPTION:

The program follows:

(Continued on next page)

Columns	EK 0001	EK 0002
1-5	2 0100	2 0100
6-10	Y 0080	Y Z880
11-15	I 0074	I Z874
16-20	B 0002	B 0002
21-25	8 0094	8 Z894
26-30	N 0099	N Z899
31-35	7 0039	7 Z839
36-40	B 0≠00	B 0≠00
41-45	B 0004	B 0004
46-50	8 0092	8 Z892
51-55	7 0059	7 Z859
56-60	U 0000	U 0000
61-65	9 0≠95	9 ZY95
66-70	1 0004	1 Z804
71-75	J 9999	J 9999
76-80	1 0004	1 Z804

CONTRIBUTED BY:

W. L. Myers, Eastman Kodak
Rochester, New York

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: EK-002-0

PROGRAM NAME: EKACTO - 10 DIGIT CONVERSION

PURPOSE: Enable programmer to write in actual as 10 digits (Ex: RAD 02 25519). The routine processes cards punched in 10 digit form, checks instructions for validity, giving listings and condensed cards as output.

MACHINE: 702 ______ 705 X Model I or II Other ______ (Specify)

#Tapes 3 (Optional) #Printer (Optional) TRC ______ Drum ______

Card Reader (Optional) 760 ______ Other Punch (Optional)

PROGRAM LANGUAGE: Autocoder ______ Symbolic ______ Actual X

Other ______ (Specify)

PROGRAM TYPE: Complete Program X

Macro-Instruction ______ Label ______

Subroutine ______ Label ______

CONTRIBUTED BY:

Earl Althoff
Eastman Kodak Company

January 1958, Bulletin 55 - 71

705 CUSTOMER CONTRIBUTION

Program Write-up Abstract

INDICATIVE CODE: EK 0003

PROGRAM NAME: Eastman Kodak, Consolidated Edison Transfer Tracing (EKCETT)

PURPOSE:

To print a record of transfers of control within the main program, ten transfers per printer line. Its function is the same as Trac 51; namely, to provide a means of following the actual path used during the run of a program during debugging. This program is relocable.

RESTRICTIONS:

The program occupies 643 memory positions. It may be placed in any convenient location in memory, except the 1st 240 digits. Only 224 positions of accumulator 00 are available to the main program.

GENERAL DESCRIPTION:

This program is a refinement of a program developed by Mr. Art Brown, Consolidated Edison New York City, customer contribution No. 10.

1. EKCETT may be placed in any convenient location in memory-except the 1st 240 digits. The program occupies 643 memory positions.

(Continued on next column)

2. Tracing may be discontinued at any time during a run by turning off 916. This will cause the machine to stop and the typewriter will print two 5 digit numbers.

   a. The address of the next instruction
   b. The operation just performed

   If the operation was a transfer the two numbers are the same. To continue without Transfer Tracing make a manual transfer from the console to the address of the next instruction as shown on the typewriter.

3. Tracing can be restarted at any point in the main program by the following:

   a. Manually store 5 digit address of instruction at a position in memory that is 500 - higher than the starting point of transfer tracing routine.

CONTRIBUTED BY:

E. Althoff, Eastman Kodak
Rochester, New York

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: EQ-001-0

PROGRAM NAME: CHECKING LOADING ROUTINE

PURPOSE: Program Card loading routine with check for machine errors and proper sequence and identification on cards.

MACHINE: 702 ______ 705 X Model I or II Other ______ (Specify)

#Tapes ______ #Printer ______ TRC ______ Drum ______

Card Reader ______ 760 ______ Other ______

PROGRAM LANGUAGE: Autocoder X Symbolic ______ Actual ______

Other ______ (Specify)

PROGRAM TYPE: Complete Program X

Macro-Instruction ______ Label ______

Subroutine ______ Label ______

CONTRIBUTED BY:

Barry Gordon
Equitable Life Assurance Society of the U.S.
393 Seventh Avenue
New York 1, New York

January 1958, Bulletin 55 - 73

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: EQ-002-0

PROGRAM NAME: SYMBOLIC TO AUTOCODER CONVERSION

PURPOSE: To convert a 705 program written in the symbolic system to a 705 program written in Autocoder language.

MACHINE: 702 ______ 705 X Model I or II Other ______ (Specify)

#Tapes 4 #Printer 1 TRC 1 Drum ______

Card Reader ______ 760 ______ Other ______

PROGRAM LANGUAGE: Autocoder X Symbolic ______ Actual ______

Other ______ (Specify)

PROGRAM TYPE: Complete Program X

Macro-Instruction ______ Label ______

Subroutine ______ Label ______

(Continued on next page)

CONTRIBUTED BY:

Lawrence Shapiro
Equitable Life Assurance Society of the U.S.
393 Seventh Avenue
New York 1, New York

January 1958, Bulletin 55 - 75

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: EQ-005-0
PROGRAM NAME: ALTERED MEMORY PRINT

PURPOSE: To print out, in indexed form, the contents of memory which have been changed since the initial loading of a given program.

MACHINE: 702 ____ 705 X Model I or II Other ____ (Specify)
#Tapes ____ #Printer 1 TRC ____ Drum ____
Card Reader X 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder X Symbolic ____ Actual ____
Other ____ (Specify)

PROGRAM TYPE: Complete Program X
Macro-Instruction ____ Label ____
Subroutine ____ Label ____

CONTRIBUTED BY:

Arthur Rosenzweig
James M. Kappos
Equitable Life Assurance Society of the U.S.
393 Seventh Avenue
New York 1, New York

January 1958, Bulletin 55 - 81

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: EQ-006-0
PROGRAM NAME: SELECTIVE TAPE PRINT

PURPOSE: To print directly, or to write on a tape for subsequent printing, all or selected records of specified tapes.

MACHINE: 702 ____ 705 X Model I or II Other ____ (Specify)
#Tapes Varies #Printer None (or one) TRC 1 Drum ____
Card Reader X 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder X Symbolic ____ Actual ____
Other ____ (Specify)

PROGRAM TYPE: Complete Program X
Macro-Instruction ____ Label ____
Subroutine ____ Label ____

CONTRIBUTED BY:

Robert J. McKenty
Milton P. Persily
Equitable Life Assurance Society of the U.S.
393 Seventh Avenue
New York 1, New York

January 1958, Bulletin 55 - 83

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: EQ-007-0
PROGRAM NAME: SEQUENCE CHECK

PURPOSE:
Sequence-check a file of variable-length tape records and/or delete records which exceed a given length.

MACHINE: 702 ____ 705 X Model II Other ____ (Specify)
#Tapes 4 #Printer ____ TRC 1 Drum ____
Card Reader X 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder X Symbolic ____ Actual ____
Other ____ (Specify)

PROGRAM TYPE: Complete Program X
Macro-Instruction ____ Label ____
Subroutine ____ Label ____

CONTRIBUTED BY:
B. Gordon
The Equitable Life Assurance Society of the United States
393 Seventh Avenue
New York 1, N. Y.

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: EQ-009-0
PROGRAM NAME: Tic-Tac-Toe

PURPOSE:
Demonstration of logical ability and speed of the 705

MACHINE: 702 ____ 705 X Model I or II Other ____ (Specify)
#Tapes ____ #Printer ____ TRC ____ Drum ____
Card Reader X 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder ____ Symbolic ____ Actual X
Other ____ (Specify)

PROGRAM TYPE: Complete Program X
Macro-Instruction ____ Label ____
Subroutine ____ Label ____

CONTRIBUTED BY:
Milton P. Persily
The Equitable Life Assurance Society of the United States
393 Seventh Avenue
New York 1, N. Y.

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: E2-002-0
PROGRAM NAME: Time Series Routine

PURPOSE:
To calculate statistical indices of average, variance, and standard deviation on time series data. A visual interpretation of the data is provided by plotting each point sequentially as a plus or minus deviation from the average. A cell count is shown to indicate the distribution profile.

(Continued on next page)

MACHINE: 702 ______ 705 X Model II Other ______ (Specify)

#Tapes 2 #Printer 1 TRC ______ Drum 1

Card Reader 1 760 ______ Other ______

PROGRAM LANGUAGE: Autocoder ______ Symbolic ______ Actual ______

Other Autocoder A (Specify)

PROGRAM TYPE: Complete Program X

Macro-Instruction ______ Label ______

Subroutine ______ Label ______

CONTRIBUTED BY:

Esso Standard Oil Company
P.O. Box 222
Linden, N.J.

Distribution No. 6

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: E2-003-0

PROGRAM NAME: Stepwise Regression

PURPOSE:

To develop an equation expressing a dependent variable, Y, as a function of as many as 50 independent variables, multiply regression analysis.

MACHINE: 702 ______ 705 X Model II Other ______ (Specify)

#Tapes 5 #Printer 1-717 TRC ______ Drum X

Card Reader X 760 ______ Other ______

PROGRAM LANGUAGE: Autocoder ______ Symbolic ______ Actual ______

Other Autocoder A (Specify)

PROGRAM TYPE: Complete Program X

Macro-Instruction ______ Label ______

Subroutine ______ Label ______

CONTRIBUTED BY:

W.G. Hyde
F.R. Pfaff
R.W. Schrage
D.M. Smith
W.E. Zieman

Esso Standard Oil Company
Linden, New Jersey

Distribution No. 6

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: E2-004-0

PROGRAM NAME: Matrix Inversion

PURPOSE:

To invert a Matrix and/or to solve Simultaneous Linear Equations.

MACHINE: 702 ______ 705 X Model II Other ______ (Specify)

#Tapes 2 #Printer 1-717 TRC ______ Drum ______

Card Reader X 760 ______ Other ______

PROGRAM LANGUAGE: Autocoder ______ Symbolic ______ Actual ______

Other Autocoder A (Specify)

PROGRAM TYPE: Complete Program X

(Continued on next column)

Macro-Instruction ______ Label ______

Subroutine ______ Label ______

CONTRIBUTED BY:

F.R. Pfaff
Esso Standard Oil Company
Linden, N. J.

Distribution No. 6

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: E2-005-0

PROGRAM NAME: Product Inverse Linear Programming

PURPOSE:

To calculate optimum solutions for problems involving up to 99 linear constraints and 120 variables. The program contains a partitioning feature useful in solving block-triangular (for instance, Multi-Grade Blending) problems. Multiple profit functions and/or multiple requirements vectors can be handled.

MACHINE: 702 ______ 705 X Model II Other ______ (Specify)

#Tapes 5 #Printer 1-717 TRC ______ Drum X

Card Reader X 760 ______ Other ______

PROGRAM LANGUAGE: Autocoder ______ Symbolic ______ Actual ______

Other Autocoder A (Specify)

PROGRAM TYPE: Complete Program X

Macro-Instruction ______ Label ______

Subroutine ______ Label ______

CONTRIBUTED BY:

H.E. Clayton
D.M. Smith

Esso Standard Oil Company
Linden, New Jersey

Distribution No. 6

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: E 3-002-0

PROGRAM NAME: GENERAL TRANSFER ANY ROUTINE (Also Generalized Edit Note Routine)

PURPOSE: To avoid need for many specialized TRA routines in a single program. To reduce duplication of programming effort.

MACHINE: 702 ______ 705 X Model I or II Other ______ (Specify)

#Tapes ______ #Printer ______ TRC ______ Drum ______

Card Reader ______ 760 ______ Other ______

PROGRAM LANGUAGE: Autocoder ______ Symbolic X Actual ______

Other ______ (Specify)

PROGRAM TYPE: Complete Program ______

Macro-Instruction ______ Label ______

Subroutine X Label GTRA

CONTRIBUTED BY:

Esso Standard Oil Company - M. H. Grosz
15 West 51 St., N.Y.C.

International Business Machines Corp. - B. P. Dongieux
New York City

(August 1957, Bulletin 50 - 129)

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE	PROGRAM NAME
HB-001-0	LOOPCODER

PURPOSE: To simplify programming of 705 loop operations. The Loopcoder is a precompiler that expands program loops from a simple form to a detailed form, supplying the initialization, address modification, and counter testing operations. Output from the Loopcoder is in Autocoder input form.

MACHINE: 702 ____ 705 X Model I or II Other ____ (Specify)

#Tapes 6 #Printer ____ TRC ____ Drum ____

Card Reader X 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder X Symbolic ____ Actual ____

Other ____ (Specify)

PROGRAM TYPE: Complete Program X

Macro-Instruction ____ Label ____

Subroutine ____ Label ____

CONTRIBUTED BY:

W. M. Harp
Humble Oil and Refining Company
Baytown, Texas

Program written by J. S. Bonner

April 1958, Bulletin 57 - 51

705 CUSTOMER CONTRIBUTION

Program Write-Up Abstract

INDICATIVE CODE	PROGRAM NAME
IB 0002	Card Image

MACHINE SPECIFICATIONS:

20,000 or 40,000 Memory Position 705

FUNCTION:

To establish a card image in memory which may be addressed as CARD, or each column may be addressed as COLXX (i.e., COL 1 or COL 23, etc.).

GENERAL DESCRIPTION:

A card image is established in memory which may be addressed as CARD, or each column may be addressed as COLXX (i.e., COL 1 or COL 23, etc.).

RESTRICTIONS:

The subroutine uses 81 to 85 positions. The programmer must write at least once: INCL CARD.

CONTRIBUTED BY:

W. M. Selden, Program Research
IBM, World Headquarters, New York

705 CUSTOMER CONTRIBUTION

Program Write-Up Abstract

INDICATIVE CODE	PROGRAM NAME
IB 0003	Flow Chart Listing From Assembly Program Print Record Tape

MACHINE SPECIFICATIONS:

40,000 Position 705

PURPOSE:

To produce automatically, a flow chart listing, utilizing the tape which is the listing of the assembled program, as input data. This tape is produced by ASSY 72.

(Continued on next column)

RESTRICTIONS:

The program can handle a total of 1700 transfers.

Of these:

1. 800 may connect one location on a page to a higher location on the same page (forward transfers).
2. 240 may connect one location on a page to a lower location on the same page (backward transfers).
3. 999 may connect one page to another (off page transfers).

If the forward or backward transfer table becomes exhausted, transfers of that type are ignored.

The program can handle a maximum of 99 pages of output listing. The program is written to plot the output at eight lines per inch. Five arrows may be plotted at one time in the forward direction and four in the backward direction. Any location for which an arrow position cannot be found is noted on the typewriter.

CONTRIBUTED BY:

A. E. Scott, Diagnostic Engineering,
IBM, Poughkeepsie, New York

705 CUSTOMER CONTRIBUTION

Program Write-up Abstract

INDICATIVE CODE	PROGRAM NAME
IB 0005	Print I Program for Solution of Simultaneous Equations and Matrix Inversion

MACHINE SPECIFICATIONS:

20,000 or 40,000 Position 705

PURPOSE:

To solve simultaneous equations and matrix inversion.

RESTRICTIONS:

The coding kernel given on page 56 on the PRINT I Intermediate Manual is used with the restriction that only one column vector is allowed.

GENERAL DESCRIPTION

The program is written for PRINT I system and will handle up to thirty equations with thirty unknowns in core storage. The program will operate using the 10-digit mantissa system.

It is necessary to specify on a control card the number of decimal positions in the data words, d($0 \leq d \leq 12$) and the number of equations to be solved, N ($N \leq 30$).

On line print-out of solutions is provided and optional print-out of inverse matrix.

CONTRIBUTED BY:

D. Loposer, IBM, Birmingham

705 CUSTOMER CONTRIBUTION

Program Write-up Abstract

INDICATIVE CODE	PROGRAM NAME
IB 0007	Tape Duplication

MACHINE SPECIFICATIONS:

20,000 or 40,000 Position 705
754 Tape Control Unit

PURPOSE:

To provide exact duplication of one tape from another.

RESTRICTIONS:

1. Record length may not exceed 19,785 characters for a 20,000 position 705, nor may it exceed 39,785 characters for a 40,000 position 705.
2. Records to be duplicated must not contain the following sequence of five characters: E@N%D which is used in determining end of record. If this sequence appears in records, any desired five characters may be substituted for it.

(Continued on next page)

GENERAL DESCRIPTION:

The input tape for this program is mounted on tape unit 0200; output is written on tape 0201. Records to be duplicated may be of fixed or variable length, and may contain group marks. Files separated by tape marks can be reproduced, and the records from several input tapes can be written on the same output tape.

CONTRIBUTED BY:

W. G. Winchester, IBM, Poughkeepsie

705 CUSTOMER CONTRIBUTION

Program Write-up Abstract

INDICATIVE CODE: IB 0009

PROGRAM NAME: Calendar Demonstration

MACHINE SPECIFICATIONS:

20,000 or 40,000 Position 705

PURPOSE:

To demonstrate the speed and versatility of a high-speed computing machine.

GENERAL DESCRIPTION:

The Calendar Demonstration Program will compute the day of the week of any given calendar date between March 1, 0001 and December 31, 9999. This program will also compute the given date for the following holidays, both fixed and variable.

Fixed	Variable
New Years Day	Mothers Day
Lincoln's Birthday	Fathers Day
St. Valentine's Day	Labor Day
Washington's Birthday	Election Day
April Fools Day	Thanksgiving Day
Memorial Day	Easter Sunday
Independence Day	
Columbus Day	
Halloween	
Veterans Day	
Christmas Day	

The participant may, if he likes, try to fool the machine by giving a non-existent date to which the machine will give an appropriate answer.

The program will predict for dates that fall on February 12 or February 22, preceding the year that Lincoln or Washington was born, in how many years hence they will be born. For dates that precede the adoption of the Gregorian Calendar in 1582, the computation proceeds as if it were in effect, but an explanation is printed for the participant's consideration.

CONTRIBUTED BY:

Mr. Elliot Raiffa

705 CUSTOMER CONTRIBUTION

Program Write-Up Abstract

INDICATIVE CODE: IB 0010

PROGRAM NAME: Generalized Matrix Inversion (PRINT I)

MACHINE SPECIFICATIONS:

20,000 or 40,000 Position 705

PURPOSE:

To invert successive matrices printing input and inverse in a convenient format.

RESTRICTIONS:

The largest inversion possible will be found by the following relationship:

$$(n+1)\ (n+b) \leq 1000$$

and

$$(n+b) \leq 99$$

where n=order of matrix
b=number of column vectors.

GENERAL DESCRIPTION:

This program is designed to perform a matrix inversion on data presented to it in a specified form. The routine is accomplished by using the PRINT I Automatic Coding System. Successive matrices of different order may be inverted; each matrix will have its own control card preceding the elements indicating the order and the number of column vectors. The inversion takes place entirely within memory.

CONTRIBUTED BY:

T. Glans and
F. Williams, IBM, WHQ

705 CUSTOMER CONTRIBUTION

Program Write-up Abstract

INDICATIVE CODE: IB 0011

PROGRAM NAME: MUSIC

MACHINE SPECIFICATIONS:

20,000 or 40,000 Position 705
Card Reader
Power Amplifier connected to SPR (Store for Print) instruction.

NOTE: See your Customer Engineer

PURPOSE:

This program is designed to permit the 705, with an attached amplifer, to play music.

GENERAL DESCRIPTION:

The card deck furnished with this program, includes three tunes: "Seems Like Old Times," "Old Piano Roll Blues," and "Entry of the Gladiators." By punching cards according to a specified procedure, other desired tunes may be played on the 705.

CONTRIBUTED BY:

R. W. Bemer, W. M. Selden and
A. S. Petroulakis, IBM, WHQ

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: IO - 001 - 0

PROGRAM NAME: SRTime - Sort 54
Sorting Time Calculation

PURPOSE:

To calculate the time necessary to do a sort on a 705 II using the Sort 54 program. The formulas outlined on pages 39 to 41 of the Sort 54 manual are evaluated. The parameters are inputted by means of the Sort 54 control card and the results are typed out.

MACHINE: 702 ______ 705 __X__ Model __II__ Other ______ (Specify)
#Tapes ______ #Printer ______ TRC ______ Drum ______
Card Reader ______ 760 ______ Other ______

PROGRAM LANGUAGE: Autocoder __X__ Symbolic ______ Actual ______
Other ______ (Specify)

PROGRAM TYPE: Complete Program __X__
Macro-Instruction ______ Label ______
Subroutine ______ Label ______

CONTRIBUTED BY:
Imperial Oil Limited
Toronto, Canada

Distribution No. 8

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: LH-007-0

PROGRAM NAME: End-of-File Search

PURPOSE:

MACHINE: 702 ____ 705 X Model I or II Other ____ (Specify)

#Tapes ____ #Printer ____ TRC ____ Drum ____

Card Reader X 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder X Symbolic ____ Actual ____

Other ____ (Specify)

PROGRAM TYPE: Complete Program X

Macro-Instruction ____ Label ____

Subroutine ____ Label ____

CONTRIBUTED BY:

Lockheed Aircraft Corporation
California Division
Burbank, California

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: NW-001-0, A TRC Modification of AO-005-0

PROGRAM NAME: 705 Address Listing

PURPOSE:

To produce an actual address listing following a 705 assembly of programs written in either Autocoder, Print I, or Symbolic language. The program reads the listing tape produced by the assembly and prepares a sorted table of address-location references - which is written out on the listing tape following the tape mark.

MACHINE: 702 ____ 705 X Model I or II Other ____ (Specify)

#Tapes 3 #Printer ____ TRC X Drum ____

Card Reader X 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder X Symbolic ____ Actual ____

Other ____ (Specify)

PROGRAM TYPE: Complete Program X

Macro-Instruction ____ Label ____

Subroutine ____ Label ____

CONTRIBUTED BY:

The Northwestern Mutual Life Insurance Company
720 East Wisconsin Avenue
Milwaukee 2, Wisconsin

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: NW-003-1

PROGRAM NAME: Tape Compare (TPCMP)

PURPOSE:

Compare any two (2) tape files of fixed or variable length records not greater than 1020 characters or less than 10 characters in length. Records which are not identical are written out. Record comparison may also be aided through preliminary control word comparison at the option of the user. Using this option, all records which are not identical or unmatched are written out.

The Tape Label and Label Routine used in this program is of the same type that is required by IBM's Utility Programs. This program is a revision of Contribution NW-003-0 which contained a specialized Tape Label Routine.

(Continued on next column)

MACHINE: 702 ____ 705 X Model I or II Other ____ (Specify)

#Tapes 3 #Printer ____ TRC 1 or 2 Drum ____

Card Reader X 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder X Symbolic ____ Actual ____

Other ____ (Specify)

PROGRAM TYPE: Complete Program X

Macro-Instruction ____ Label ____

Subroutine ____ Label ____

CONTRIBUTED BY:

Richard Bullis, IBM
Northwestern Mutual Life Insurance Company
720 East Wisconsin Avenue
Milwaukee 2, Wisconsin

Distribution No. 6

705 CUSTOMER CONTRIBUTION

Program Write-up Abstract

INDICATIVE CODE: PG 0001

PROGRAM NAME: Simulation of the IBM 650 on a 40K IBM 705

MACHINE SPECIFICATIONS:

40K IBM 705 with card reader & card punch. (Simple additional modifications permit tape input and output).

PURPOSE:

To modify the program for simulating the IBM 650 on the IBM 705 (reference #1) so as to take advantage of the expanded memory of the 40K version of the 705 and thus gain an increase in speed.

RESTRICTIONS:

Will handle any 650 program written for the basic card 650 with alpha devise. The write-up and program deck for the original simulator (reference #1) are necessary since this write-up and card deck cover only the modifications.

GENERAL DESCRIPTION:

A program already exists (reference #1) which simulates the IBM 650 on the 20K 705. Since the 650 Magnetic Drum storage contains 20K digits, each 10-digit 650 word had to be converted to a packed 7-digit 705 word to allow space for the simulation program itself. This modification was written to simulate the 650 drum in the 20K upper memory of a 40K IBM 705. Elimination of the PAC & UNPAC routines formerly necessary has increased the speed of the simulation of the 650 run at speeds approximately the same as for the 650 itself.

CONTRIBUTED BY:

Procter & Gamble and the
IBM, Cincinnati Office

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: PG-001-0

PROGRAM NAME: GENERALIZED TRANSFER ANY ROUTINE

PURPOSE: To look for, diagnose, and correct where possible 0901, 0902, and 0903 errors. Handles end of file conditions in a specified manner as outlined in the program description. Includes flip-flopping of tapes. Can be used with some or all of the following on line: Any number of 754 tapes, drum, 717 printer, punch, and card reader. Takes care of RD, RD 01, WR, WR 01, WTM, and RWW, but not WRE.

MACHINE: 702 ____ 705 X Model I or II Other ____ (Specify)

#Tapes Any Number #Printer X TRC ____ Drum X

Card Reader X 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder ____ Symbolic X Actual ____

Other ____ (Specify)

(Continued on next page)

PROGRAM TYPE: Complete Program ____

Macro-Instruction ____ Label ____

Subroutine X Label ____

CONTRIBUTED BY: Edward B. Berninger and John B. Hughes - Procter and Gamble

NOTE: If any GUIDE members wish to modify the routine or assemble it at points other than 18525, the appropriate symbolic deck (323 cards) can be obtained from Mr. E.B. Berninger, The Procter and Gamble Company, P.O. Box 599, Cincinnati 1, Ohio.

January 1958, Bulletin 55 - 85

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: PG-004-0

PROGRAM NAME: CHECK TAPE SETTINGS

PURPOSE: To check that one and only one tape unit is dialed to the units position of each designated input and output tape. Types "Check Tape Settings" and halts in case of duplicate settings; stops at I/O No Response if no tape is dialed to one of the designated tape addresses.

MACHINE: 702 ____ 705 X Model I or II Other ____ (Specify)

#Tapes 1 to 10 #Printer ____ TRC ____ Drum ____

Card Reader ____ 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder X Symbolic ____ Actual ____

Other ____ (Specify)

PROGRAM TYPE: Complete Program ____

Macro-Instruction X Label CHKTP

With Linked Subroutine X Label CHKTP

CONTRIBUTED BY:

Edward B. Berninger
Procter & Gamble

January 1958, Bulletin 55 - 91

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: PG-005-0

PROGRAM NAME: IFS (after Setting) XX

PURPOSE: To load an ASU or the accumulator, previously set, compare to a memory field, and make the necessary transfer (E, LO, H, EH, Z, NZ, NE, EL) based on the comparison

MACHINE: 702 ____ 705 X Model I or II Other ____ (Specify)

#Tapes Any Number #Printer ____ TRC ____ Drum ____

Card Reader ____ 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder X Symbolic ____ Actual ____

Other ____ (Specify)

PROGRAM TYPE: Complete Program ____

Macro-Instruction X Label IFSXX

Subroutine ____ Label ____

CONTRIBUTED BY:

Richard B. Thoman, Procter & Gamble

Andrew T. Fogarty, IBM, Cincinnati

April 1958, Bulletin 57 - 53

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: PG-006-0

PROGRAM NAME: Transportation Problem

PURPOSE:

To solve the "Transportation Problem", a special case of linear programming. The program can accommodate matrices with $M + N \leq 700$, where "M" is number of destinations and "N" is number of sources.

The program was written originally by IBM for the 702, and converted by them to 705 language. Procter & Gamble debugged the converted program and added additional features.

The largest problem run has been 26 x 149, which took up 90 iterations and 50 minutes.

MACHINE: 702 ____ 705 X Model I or II Other ____ (Specify)

OFF LINE 717

#Tapes 9 or 10 #Printer or 720 TRC ____ Drum ____

Card Reader 1 760 ____ Other Punch (optional)

PROGRAM LANGUAGE: Autocoder ____ Symbolic ____ Actual X

Other ____ (Specify)

PROGRAM TYPE: Complete Program X

Macro-Instruction ____ Label ____

Subroutine ____ Label ____

CONTRIBUTED BY:

S. Hickenlooper, D. W. Grace, E. B. Berninger
Procter & Gamble

NOTE: Program material includes a "squeeze" deck of approximately 645 cards, complete operating and card punching instructions, a general description of the method used (the original IBM 702 write-up), typical running times, and a one-page block diagram of the overall program system.

Symbolic instruction cards and listing are not available.

Distribution No. 5

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: PG-007-0

PROGRAM NAME: Binary Table Search

PURPOSE:

To search a table in memory, using the "binary search" method. To eliminate multiply instructions and other calculation in the subroutine loop, all increments and decrements are calculated once for each BNSCH macro in a program and stored in an in-line record area. Arguments can be up to 79 characters long and functions up to 255, and can be located anywhere in a table item. The number of items in the table can vary during a program. Table size is limited only by memory availability.

MACHINE: 702 ____ 705 X Model I or II Other ____ (Specify)

#Tapes Any No. #Printer ____ TRC ____ Drum ____

Card Reader ____ 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder X Symbolic ____ Actual ____

Other ____ (Specify)

PROGRAM TYPE: Complete Program ____

Macro-Instruction X Label BNSCH

Subroutine X Label BNSCH

CONTRIBUTED BY:

Richard B. Thoman
Procter and Gamble

Note: Time for one "binary search loop" in the subroutine is 0.578+ .017 N milliseconds, where N is the number of characters in the argument.

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: PG-008-0

PROGRAM NAME: Group Records

PURPOSE:
To group fixed-length records, using serial or high-speed transmission, and transfer to a designated address after a specified number of records have been grouped.

MACHINE: 702 ____ 705 X Model I or II Other (Specify) ____
*Tapes Any No. *Printer ____ TRC ____ Drum ____
Card Reader ____ 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder X Symbolic ____ Actual ____
Other (Specify) ____

PROGRAM TYPE: Complete Program ____
Macro-Instruction X Label GROUP
Subroutine ____ Label ____

CONTRIBUTED BY:
Richard B. Thoman
Procter and Gamble

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: PG-009-0

PROGRAM NAME: Sort Internally

PURPOSE:

To sort fixed-length records which are set up for high-speed transmission on a specified single control field. The sort takes place entirely within memory. The control field can be located anywhere in the record and can be up to 255 characters. Maximum record length is 600 characters, but this can easily be changed to any size. The number of records to be sorted can vary within a program.

MACHINE: 702 ____ 705 X Model I or II Other (Specify) ____
*Tapes Any No. *Printer ____ TRC ____ Drum ____
Card Reader ____ 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder X Symbolic ____ Actual ____
Other (Specify) ____

PROGRAM TYPE: Complete Program ____
Macro-Instruction with linked X Label SORT I
Subroutine X Label SORT I

CONTRIBUTED BY:

William H. Graver
Procter and Gamble

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: PG-010-0

PROGRAM NAME: Move Variable, Grouped Fields

PURPOSE:
To move a group of fields which are set up for high-speed transmission. The number of fields can vary from group to group and the size of each field can be variable. The method used is described on p. 3-4 of 702/705 Bulletin 20, Dec. 1956.

MACHINE: 702 ____ 705 X Model I or II Other (Specify) ____
*Tapes Any No. *Printer ____ TRC ____ Drum ____
Card Reader ____ 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder X Symbolic ____ Actual ____
Other (Specify) ____

PROGRAM TYPE: Complete Program ____
Macro-Instruction with linked X Label MOVRC
Subroutine X Label MOVRC

CONTRIBUTED BY:
William F. Reiland
Procter and Gamble

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: PG-012-0

PROGRAM NAME: New Macro Lookup for 705 Autocoder System

PURPOSE:
The method of searching for macros in Phase I of the 705 autocoder system has been revised to reduce assembly time. A conservative estimate of 705 time saved is one minute per 90 macros assembled. The change requires only three patch cards which overlay part of the present routine.

MACHINE: 702 ____ 705 X Model II Other (Specify) ____
*Tapes ____ *Printer ____ TRC ____ Drum ____
Card Reader ____ 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder ____ Symbolic ____ Actual X
Other (Specify) ____

PROGRAM TYPE:* Complete Program ____
Macro-Instruction ____ Label ____
Subroutine ____ Label ____

CONTRIBUTED BY:
The Procter & Gamble Company

* patches for existing program

Distribution No. 5

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: SB-001-0

PROGRAM NAME: SORT 58

PURPOSE:
To sort fixed or variable length records via TCU.

MACHINE: 702 ____ 705 X Model I or II Other (Specify) ____
*Tapes 7 *Printer ____ TRC ____ Drum ____
Card Reader X 760 ____ Other Punch*
* If labels per SBAMA conventions are used

PROGRAM LANGUAGE: Autocoder X Symbolic ____ Actual X
Other (Specify) ____

PROGRAM TYPE: Complete Program X
Macro-Instruction ____ Label ____
Subroutine ____ Label ____

CONTRIBUTED BY:
Directorate of Ballistic Missiles, EDP
San Bernardino Air Materiel Area
San Bernardino, California
John R. Smith

WRITTEN BY: S/Sgt J. R. Clarke, USAF

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: SB-002-0

PROGRAM NAME: Analyzer

PURPOSE:
To produce an edited listing in several optional sequences, cross referencing the data available in an Autocoder Assembly Listing Tape.

MACHINE: 702 ____ 705 X Model II Other ____ (Specify)
#Tapes 11 #Printer ____ TRC 2 Drum ____
Card Reader ____ 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder X Symbolic ____ Actual ____
Other ____ (Specify)

PROGRAM TYPE: Complete Program X
Macro-Instruction ____ Label ____
Subroutine ____ Label ____

CONTRIBUTED BY:
Directorate of Ballistic Missiles
San Bernardino Air Materiel Area
San Bernardino, California

Written by: Faye Redus

Distribution No. 4

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: SB-005-0

PROGRAM NAME: Tape Input/Output

PURPOSE:
To present a complete set of operations for all functions involving on line 705 tape units controlled by TRC and TCU. Macro Instructions and subroutines are available for tape read, write, read-while-write, control operations, housekeeping, label treatment, blocking/deblocking of grouped records, end of tape, checkpoint, and transfer - any analysis. A utility routine provides for restart if the checkpoint options are used.

MACHINE: 702 ____ 705 X Model II Other ____ (Specify)
#Tapes One TCU tape required #Printer ____ TRC X Drum X
Card Reader ____ 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder X Symbolic ____ Actual ____
Other ____ (Specify)

PROGRAM TYPE: Complete Program ____
Macro-Instruction X Label ____
Subroutine X Label ____
Utility Routine X

CONTRIBUTED BY:
Directorate of Ballistic Missiles
San Bernardino Air Materiel Area
San Bernardino, California

Written by: K. Lantz, L. Cohn, T. Carstens, C. Buss, O. Evans, D. Fisher

Distribution No. 4

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: SB-006-0

PROGRAM NAME: Mem Print Analyzer

PURPOSE:
Rearranges instruction data extracted from the MEM PRINT 75 output tape and produces a listing showing all instruction addresses cross referenced to memory locations.

MACHINE: 702 ____ 705 X Model II Other ____ (Specify)
#Tapes Same as Mem Print 75 #Printer ____ TRC ____ Drum X
Card Reader ____ 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder X Symbolic ____ Actual ____
Other ____ (Specify)

PROGRAM TYPE: Complete Program X
Macro-Instruction ____ Label ____
Subroutine ____ Label ____

CONTRIBUTED BY:
Directorate of Ballistic Missiles
San Bernardino Air Materiel Area
San Bernardino, California

Written by: C. Kubik

Distribution No. 4

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: SI-001-0

PROGRAM NAME: SOCOTT Tape Test System

PURPOSE:
To reduce machine time required for testing, and produce test output shortly after each testing session.

MACHINE: 702 ____ 705 X Model I or II Other ____ (Specify)
#Tapes 10 #Printer Optional TRC ____ Drum ____
Card Reader ____ 760 ____ Other ____

PROGRAM LANGUAGE: Autocoder ____ Symbolic ____ Actual X
Other ____ (Specify)

PROGRAM TYPE: Complete Program X
Macro-Instruction ____ Label ____
Subroutine ____ Label ____

CONTRIBUTED BY:
Standard Oil Company (Indiana)
Chicago, Illinois

Distribution No. 6

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE: SP-001-0

PROGRAM NAME: Tape Characteristics

PURPOSE:
To prepare a listing of tape capacity, and passing speed in minutes, for various record lengths, and for 727, 729-2 and 729-4 tape drives, with both high and low recording density for 729 units.

(Continued on next page)

MACHINE: 702 ______ 705 X Model I or II Other ______ (Specify)

#Tapes 1 #Printer 1-720 TRC ______ Drum ______

Card Reader X 760 ______ Other ______

PROGRAM LANGUAGE: Autocoder X Symbolic ______ Actual ______

Other ______ (Specify)

PROGRAM TYPE: Complete Program X

Macro-Instruction ______ Label ______

Subroutine ______ Label ______

CONTRIBUTED BY:

SPAN Data Processing Center, Inc.

Questions may be addressed to:
Ronald A. Grant
SPAN Data Processing Center, Inc.
99 Woodland Street
Hartford, Conn.

Distribution No. 6

705 CUSTOMER CONTRIBUTION

Program Write-up Abstract

INDICATIVE CODE	PROGRAM NAME
SR 0001	650 Assembly of 705 programs (20, 000 and 40, 000

MACHINE SPECIFICATIONS:

2000 work 650
Alphabetic device on the card reader, no other special devices required.

PURPOSE:

The 705 program assembly as done on the 650 converts symbolic locations and addresses to actual locations and addresses, and converts mnemonic operation codes to actual operation codes.

RESTRICTIONS:

The maximum number of instructions which can be assembled is determined as in Assembly 53 on the 705. Reference should be made to page 7 of Program Brief # 12, "Assembly of Programs by 705" as a key to determining the maximum program size. Generally speaking, if a large number of consecutive symbolic locations and few inserts are used, there should be no difficulty in assembling any size program. Programs have been assembled with 2974 and 3779 entries, all classes.

CONTRIBUTED BY:

H. E. Peabody, IBM, Atlanta, Georgia
Assigned to Southern Railway

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE	PROGRAM NAME
SR-001-0	TAPE LABEL, TRA, CHECKPOINT ROUTINE

PURPOSE: A generalized routine to establish a rigid control on all input and output tapes with TRA and check point included.

Input tapes are checked for valid job identification, unit number, and reel order. Output tapes are checked for valid destroy date with new labels written on tape and typewriter sheet.

Routine is set up for program input on card reader but is easily modified for program input on tape.

MACHINE: 702 ______ 705 X Model II Other ______ (Specify)

#Tapes 10 #Printer ______ TRC ______ Drum ______

Card Reader ______ 760 ______ Other ______

(Continued on next column)

PROGRAM LANGUAGE: Autocoder ______ Symbolic X Actual X

Other ______ (Specify)

PROGRAM TYPE: Complete Program ______

Macro-Instruction ______ Label ______

Subroutine X Label (NONE)

CONTRIBUTED BY:
Southern Railway System
Computer Center
125 Spring St. S.W.
Atlanta, Ga.

(August 1957, Bulletin 50 - 139)

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PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE	PROGRAM NAME
SR-002-0	Generalized TRA Routine Program Tape Operation, Tape Label and Trailer Checking

PURPOSE:

1. To provide for the operation of programs from a program tape.
2. To provide for the detection and correction or disposition of errors resulting from the use of the Tape Record Coordinators.
3. To provide for proper tape usage through the use of tape labels and trailers.

MACHINE: 702 ______ 705 X Model II Other ______ (Specify)

#Tapes * #Printer ______ TRC 2 Drum ______

Card Reader ______ 760 ______ Other ______

PROGRAM LANGUAGE: Autocoder X Symbolic ______ Actual X

Other ______ (Specify)

PROGRAM TYPE: Complete Program ______

Macro-Instruction X Label See write-up

Subroutine X Label SCRAPS, LABTR

CONTRIBUTED BY:
Southern Railway Company - F. P. Ludlow, Jr.
15th and K-Streets, N. W. W. M. Wendt
Washington, D. C.

* The generalized routines use three tapes. All other tape requirements depend upon the running program.

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE ______ PROGRAM NAME

Available prior to January 1962

PURPOSE:	MACRO	
SR-004-0	AGAIN	To perform a specified operation or operation a given number of times; initializing and modifying as indicated.
SR-005-0	INITA	To initialize the address of a macro or hand-coded instruction. (used by AGAIN)
SR-006-0	MODA	To modify the address of a macro-generated or hand-coded instruction. (used by AGAIN)
SR-007-0	MOVEX	To move a defined field to another defined field.
SR-008-0	SPRSP	To provide a class "B" subroutine for use with Store-for Print routines of macros to permit modifications of the Macro's operands. (used with MOVEX)

MACHINE: 702 ______ 705 X Model II Other ______ (Specify)

#Tapes ______ #Printer ______ TRC ______ Drum ______

(Continued on next page)

Card Reader______ 760______ Other______

PROGRAM LANGUAGE: Autocoder III Symbolic______ Actual______

Other______
(Specify)

PROGRAM TYPE:* Complete Program______

Macro-Instruction X Label______

Subroutine X Label______

CONTRIBUTED BY:

Southern Railway System
Office of the Comptoller
Washington 13, D.C.

Robert G. Bizzell

GUIDE

PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE

XE - 001 - 0

PROGRAM NAME

Sort 54 Technique of Modification of Phase III

PURPOSE:

This memorandum provides the information needed to incorporate a tabulation program in Phase III of Sort 54, writing no sort output and utilizing the sort's header and trailer routines for the report. Knowledge of the materials in the Modification Section of the Sort 54 Reference Manual, form C28-6031, is assumed.

MACHINE: 702______ 705 X Model II Other______
(Specify)

#Tapes 10 #Printer______ TRC______ Drum______

Card Reader______ 760______ Other______

PROGRAM LANGUAGE: Autocoder X Symbolic______ Actual______

Other______
(Specify)

PROGRAM TYPE: Complete Program______

Macro-Instruction______ Label______

Subroutine______ Label______

Description of Technique X

CONTRIBUTED BY:

A. F. Rundquist
Department of the Army
TAGO, Data Processing Branch
Washington, D. C.

Distribution No. 8

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PROGRAM WRITE-UP ABSTRACT

INDICATIVE CODE

XE - 002 - 0

PROGRAM NAME

Sort 54 Modification to use file size

PURPOSE:

To change the assignment routine of Sort 54 to use the file size on a control card as a factor in creating the fastest possible sort and to automatically set up over maximum sorts.

MACHINE: 702______ 705 X Model II Other______
(Specify)

#Tapes______ #Printer______ TRC______ Drum______

Card Reader______ 760______ Other______

PROGRAM LANGUAGE: Autocoder______ Symbolic______ Actual X

Other______
(Specify)

PROGRAM TYPE: Complete Program______

(Continued on next column)

Macro-Instruction______ Label______

Subroutine______ Label______

Patches X

CONTRIBUTED BY:

T. Ragland
A. F. Rundquist
Department of the Army
TAGO, Data Processing Branch
Washington, D. C

Distribution No. 8

IBM 0709 PROGRAM LIBRARY ABSTRACT

0709 388GS7I09 AVAILABLE PRIOR TO JANUARY 1962

BASIC 709 I/O CONVERSION SUBROUTINES.
A SET OF BASIC INPUT AND OUTPUT CONVERSION SUBROUTINES FOR USE WITH THE 709. THE TWO GROUPS OF SUBROUTINES ARE INTER-RELATED AMONG THEMSELVES AND USE A COMMON COMMUNICATION REGION. THE ACTUAL CODING HAS NOT BEEN DISTRIBUTED. SPECIF-ICATIONS ARE BY THE 709 SYSTEMS COMMITTEE.

0709 482GASPOT AVAILABLE PRIOR TO JANUARY 1962

709 PROGRAM FOR CHECKING OPERATIONS NEEDING TRANSLATING SPOTS THOSE INSTRUCTIONS IN A 704 ABSOLUTE BINARY DECK WHICH MUST BE CHANGED BEFORE THE DECK MAY BE RUN ON A 709. LISTS THESE INSTRUCTIONS WITH THEIR LOCATIONS.

0709 485MISRT3 AVAILABLE PRIOR TO JANUARY 1962

SQUARE ROOT, FLOATING POINT 709 ONLY
SUBSTANTIALLY THE SAME PROGRAM AS MISRT1 /DISTRIBUTION 399/ MODIFIED TO CONFORM TO THE STANDARDS OF THE SCAT SYSTEM AND TO TAKE ADVANTAGE OF NEW 709 INSTRUCTIONS. FULL SINGLE-PRECISION ACCURACY /26 BITS/. TIMING-1.272M.S. ERROR RETURN FOR NEGATIVE, NON-ZERO ARGUMENTS. AC INDICATOR USUALLY TURNED ON. SPACE REQUIRED. -43 LOCATIONS & 2 COMMON.

0709 502RLTC9 AVAILABLE PRIOR TO JANUARY 1962

TAPE COMPARE FOR THE 709

0709 502RLTD9 AVAILABLE PRIOR TO JANUARY 1962

TAPE DUMP FOR THE 709/OCTAL PRINT/
PRINTS RECORDS OR FILES, ON LINE OR WRITES TAPE A3 FOR OFF LINE PRINT, BINARY CONTROL CARD, WILL READ MORE THAN ONE CONTROL CARD, WILL PRINT A SELECTED SEQUENCE OF WORDS FROM EACH RECORD.

IBM 0709 PROGRAM LIBRARY ABSTRACT

0709 557RL0209 AVAILABLE PRIOR TO JANUARY 1962

704 TO 709 SYMBOLIC TRANSLATOR
THE 704 TO 709 TRANSLATOR IS DESIGNED TO READ A SAP 2 SYMBOLIC PROGRAM, EITHER CARD OR BCD TAPE INPUT, AND TO PREPARE A SYMBOLIC 709 PROGRAM SUITABLE FOR COMPILING BY THE SCAT PROGRAM.

0709 563SE9BLC AVAILABLE PRIOR TO JANUARY 1962

BINARY LOADER AND CHECKSUM CORRECTOR
LOADS ABSOLUTE BINARY CARDS AT OR ABOVE LOCATION 58 OCTAL UNDER SENSE SWITCH CONTROL WHICH CAUSES PUNCHING OF DUPLICATE CARDS WITH CORRECT CHECKSUMS UPON ENCOUNTERING CHECKSUM DISCREPANCIES OF ANY KIND OR PUNCHING OF A COMPLETE NEW DECK.

0709 563SE9LRL AVAILABLE PRIOR TO JANUARY 1962

RELOCATING BINARY LOADER,LOWER
LOADS INTO CORE MEMORY INFORMATION FROM ABSOLUTE AND RELOCATABLE BINARY DATA CARDS,CORRECTION-TRANSFER CARDS, AND ORIGIN TABLE CARDS. ONLY THE DATA CARDS WILL BE CHECK-SUMMED. CORRECTIONS MAY BE UP-DATED AND UP-DATING WILL CONTINUE EVEN THOUGH A PREVIOUS INSTRUCTION HAS BEEN IGNORED. SELF LOADS INTO 0 - 334 OCTAL LOCATIONS.

0709 563SE9RBL AVAILABLE PRIOR TO JANUARY 1962

RELOCATABLE BINARY LOADER
LOADS AND CHECKS STANDARD SHARE ABSOLUTE AND RELOCATABLE CARDS. WILL NOT ACCEPT SHARE CORRECTION OR SHARE CORRECTION-TRANSFER CARDS. SELF LOADS INTO 0 - 170 OCTAL LOCATIONS.

0709 563SE9URL AVAILABLE PRIOR TO JANUARY 1962

RELOCATING BINARY LOADER,UPPER
LOADS INTO CORE MEMORY INFORMATION FROM ABSOLUTE AND RELOCATABLE BINARY DATA CARDS,CORRECTION-TRANSFER CARDS, AND ORIGIN TABLE CARDS, ONLY THE DATA CARDS WILL BE CHECK-SUMMED. CORRECTIONS MAY BE UP-DATED AND UP-DATING WILL CONTINUE EVEN THOUGH A PREVIOUS INSTRUCTION HAS BEEN IGNORED. SELF LOADS INTO LOCATIONS 77452-77777 OCTAL PLUS 0,1,2 USED TO BOOT STRAP IN.

IBM 0709 PROGRAM LIBRARY ABSTRACT

0709 502RLTS9 AVAILABLE PRIOR TO JANUARY 1962

TAPE DUPLICATOR FOR THE 709
READS A6, WRITES B6 WILL SKIP FILES ON EITHER A6 OR B6 BINARY OR DECIMAL TAPES, BINARY CONTROL CARD KEEPS BOTH TAPES MOVING SIMULTANEOUSLY. CORR./646

0709 507IBACS AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT ARCCOSINE SUBROUTINE
MUST BE FOLLOWED BY IB ASN, TIMING 4.0 MS, 9 LOC. CORR./549., ADDENDUM./619

0709 507IBLOG2 AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT NATURAL LOGARITHM
BASED ON 704 PROGRAM LAS 820, TIMING ABOUT 2.0 MS ERROR ... AT MOST 3X10-8, ABSOLUTE FOR LOG SMALLER THAN 1, RELATIVE OTHERWISE.

0709 519CSCAP1 AVAILABLE PRIOR TO JANUARY 1962

COMMENT ATTACHED PROGRAM. /709 PROGRAM/.
PRINTS ONE TO TWELVE BCD WORDS IN ONE LINE. TAKES 61 CELLS PLUS 27 OF COMMON. DELAYS UNTIL PRINTING IS COMPLETED.

0709 534CSENK1 AVAILABLE PRIOR TO JANUARY 1962

TAPE ASSIGNMENT AND CONTROL PROGRAM.
PROVIDES COMMUNICATION BETWEEN THE OPERATOR, THE PROGRAM AND THE MACHINE FOR CONNECTING, DISCONNECTING, ASSIGNING AND DISASSIGNING MAGNETIC TAPES.

0709 536SE09AP AVAILABLE PRIOR TO JANUARY 1962

ASSEMBLY PROGRAM FOR T&E IBM 709
THE TAPE WRITING ROUTINE
THE CONTROL RECORD FOR THE FIRST PASS
THE FIRST PASS
THE CONTROL RECORD FOR T&E SECOND PASS
THE SECOND PASS
THE CALL CARD FOR THE ASSEMBLER

IBM 0709 PROGRAM LIBRARY ABSTRACT

0709 569SE90U2 AVAILABLE PRIOR TO JANUARY 1962

A GENERAL OUTPUT PROGRAM
TO SET UP AND PRINT ONE LINE - 72 OR 120 COLUMNS - OR TO OUTPUT A COMPLETE LINE TO A SPECIFIED TAPE, OR BOTH. ANY DESIRED FORMAT MAY BE USED AND CONVERSIONS FROM FLOATING BINARY TO FIXED DECIMAL, FLOATING BINARY TO FLOATING DECIMAL OR FIXED BINARY TO FIXED DECIMAL ARE MADE AS INDICATED. OUTPUT IN HOLLERITH AND OCTAL CAN ALSO BE DONE. LOCATIONS TO BE OUTPUT MAY BE INDEXED IF DESIRED. THE SHARE 2 BOARD IS USED FOR ON-LINE OUTPUT.

0709 605WDCTS AVAILABLE PRIOR TO JANUARY 1962

CARD TO TAPE SIMULATOR.
714 SIMULATOR. READS HOLLERITH OR COLUMN BINARY FROM CHANNEL A CARD READER AND WRITES BCD OR BINARY RECORDS ON TAPE. TAPE ADDRESS GIVEN IN KEYS AND KEYS CONTROL REWINDING BEFORE AND AFTER. INSERTS PROPER LOOK-AHEAD WORDS. RUNS AT CARD READ SPEED FOR ANY TAPE. CONTROL CARDS TO INSERT END OF FILES AND TO SIMULATE CLEAR LOAD CARDS.

0709 605WDLC2 AVAILABLE PRIOR TO JANUARY 1962

SELECTIVE PROGRAM TRACE.
WHEN ENTERED VIA AN STR, PRINTS ON-LINE THE OCTAL LOCATION OF THE STR

0709 605WDLCC AVAILABLE PRIOR TO JANUARY 1962

SELECTIVE PROGRAM TRACE.
WHEN ENTERED VIA A TSX, PRINTS ON-LINE THE OCTAL LOCATION OF THE TSX

0709 619IBSQRM AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT SQUARE ROOT SUBROUTINE
ADDENDUM TO IB SQR. CORR/ 707, 882

IBM 0709 PROGRAM LIBRARY ABSTRACT
****

0709 633WDCRD AVAILABLE PRIOR TO JANUARY 1962

BUFFERED CARD-INPUT SUBROUTINE
READS HOLLERITH CARDS AND TRANSLATES TO BCD.
CHECKS FOR ILLEGAL PUNCHES.

0709 633WDOMFP AVAILABLE PRIOR TO JANUARY 1962

OCTAL MNEMONIC FLOATING POINT CORE DUMP
DUMPS CORE IN OCTAL WITH OR WITHOUT MNEMONICS, OR IN FLOATING
POINT, USES CONTROL CARDS OR KEYS. LOSES CELLS 0,1,2.
DUMPS PANEL AND THEN DUMPS FROM CONTROL WORDS. PANEL AND
CORE MAY BE RESTORED AND PROGRAM CONTINUED.CORR.795,835,872

0709 651WDTPS AVAILABLE PRIOR TO JANUARY 1962

TAPE TO PRINTER/PUNCH SIMULATOR
SIMULATES 717 PRINTER WITH ECHO CHECKING AND OPTIONAL PROGRAM
CARRIAGE CONTROL. ALSO SIMULATES 722 PUNCH FOR BCD DATA.

0709 665IBLG3M AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT NATURAL LOGARITHM OF NORMALIZED
ARGUMENT, ABSOLUTE ERROR LESS THAN 2X10 TO -8,
MAX. COMP. TIME 1.85 MS, 45 LOC. & 3 ERASABLE
AT COMMON, DOES NOT USE BEGIN AND RETURN MACROS. CORR/ 1036

0709 709RWTML AVAILABLE PRIOR TO JANUARY 1962

TWO MACHINE LOADER.
WILL LOAD RWO-BINARY CARDS AS PRODUCED BY SAP AND 9AP,
LOGICAL OCTAL CARDS, AND BINARY TRANSFER CARDS, ON EITHER
THE 704 OR 709. CORR./741

0709 717NA0988 AVAILABLE PRIOR TO JANUARY 1962

TAPE DUPLICATION AND/-R C-MPAREC
PROGRAM TO PROVIDE A FLEXIBLE BUFFERED TAPE DUPLICATION
AND/OR COMPARING UTILITY DECK.

IBM 0709 PROGRAM LIBRARY ABSTRACT
****

0709 778AEIBCD AVAILABLE PRIOR TO JANUARY 1962

TRANSLATE CARD IMAGE TO BCD IN COMMON.
REQUIRES 132 WORDS PLUS UP TO 12 WORDS OF COMMON. CALLING
SEQUENCE IS TSX PAC,4--PZE A,0,N-- WHERE A IS ORIGIN OF
CARD IMAGE AND N IS NUMBER OF CARD COLUMNS TO BE CONVERTED,
STARTING WITH COLUMN 1. MAX. N IS 72. INCOMPLETE BCD WORD
FILLED WITH BLANKS. NO ERROR CONDITIONS.

0709 792AE650C AVAILABLE PRIOR TO JANUARY 1962

650 TO 704-709 DATA CARD CONVERSION.
CONVERTS DECIMAL DATA CARDS PUNCHED AS 14 WORDS PER CARD
5 POSITIONS PER WORD WITH SIGN O-PUNCHED IN UNITS POSITION.
OUTPUT IS STANDARD SHARE DATA CARD,I.E. 12 WORDS PER CARD.
INPUT TAPE IS UNIT A8 HOWEVER BY CHANGING DECIMAL ADDRESS AT
LOCATION BEGIN&1 ANY CHANNEL A TAPE UNIT MAY BE USED.
SENSE SWITCH ONE UP FOR OUTPUT ON TAPE UNIT B3.SENSE SWITCH
2 DOWN CAUSES ON-LINE OUTPUT ON THE CARD PUNCH ON-LINE.
APPROX. .07 SECONDS PER WORD TIMING COUNTING READING AND
WRITING TIME.

0709 808GDRCC1 AVAILABLE PRIOR TO JANUARY 1962

709 SELF LOADING ROW BINARY TO COLUMN BINARY CONVERTER

0709 819GDBOC1 AVAILABLE PRIOR TO JANUARY 1962

709 FOUR CARD ROW BINARY-OCTAL UPPER CARD LOADER

0709 820RWCSHS AVAILABLE PRIOR TO JANUARY 1962

FORTRAN CARD IMAGE READ ROUTINE /CSH/S FOR FINP5 709
TO READ CARDS IF SSW IS DOWN OR READ INPUT TAPE IF SSW 1 IS
UP.

0709 824LLFLCA AVAILABLE PRIOR TO JANUARY 1962

FLOW CHART ANALYSIS BY BOOLEAN MATRIX MANIPULATION
DETECTS ERRORS IN CONNECTIVITY OF FLOW CHARTS UP TO 500 BOXES
BY TREATING A FLOW CHART AS A BOOLEAN MATRIX. WILL ALSO DE-
TERMINE SUBPROGRAMS IN THE FLOW CHART IF INFORMATION ABOUT
DATA FLOW IS GIVEN. PRINTS COMPLETE LIST OF INPUTS AND OUT-
PUTS OF ANY SPECIFIED BOX. PROGRAM SHOULD ALSO BE USEFUL FOR
NETWORK ANALYSIS AND OTHER PROBLEMS INVOLVING BOOLEAN MATRIX
MANIPULATION.

IBM 0709 PROGRAM LIBRARY ABSTRACT
****

0709 839IBEXD1 AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PREC. FLOATING PT EXPONENTIAL SUBROUTINE
X BETWEEN -88 AND &88, 14.55 MS FOR EXP/X/, 14.93 MS FOR
EXP/-X/, 147 LOCATIONS & 10 ERASABLE.

0709 841RCPEVL AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT POLYNOMIAL EVALUATION ROUTINE FOR 709
EVALUATES A POLYNOMIAL OF DEGREE N WITH REAL COEFFICIENTS.
CALCULATION OF FIRST AND SECOND DERIVATIVES IS OPTIONAL.

0709 860RWCF AVAILABLE PRIOR TO JANUARY 1962

LEAST SQUARES CURVE-FITTING ROUTINE
USING ORTHOGONAL POLYNOMIALS 704-709 FORTRAN FAP
STATISTICAL VALUES INDICATING RELIABILITY
OF THE DERIVATIVES ARE PROVIDED.WEIGHTS OTHER
THAN ONE MAY BE OPTIONALLY PROVIDED.THE MINIMAZATION
MAY BE OPTIONALLY CONSTRAINED TO FORCE UP TO SEVEN
OF THE LOW-ORDER COEFFICIENTS TO VANISH.427 CELLS
PROGRAM PLUS TEMPORATIES. CORR/ 920

0709 875RCFNSQ AVAILABLE PRIOR TO JANUARY 1962

FORTRAN TO SQUOZE CONVERTER
PRODUCES AN SOS PERIPHERAL INPUT OR PUNCH TAPE FROM A FORTRAN
COMPILATION OUTPUT TAPE. IF THE FNSQ OUTPUT TAPE IS USED
DIRECTLY AS SOS COMPILATION INPUT TAPE,A SQ DECK RESULTS.THUS
A FORTRAN PROGRAM MAY BE DEBUGGED USING THE SOS DEBUGGING
TOOLS. ALTERNATELY, AN SOS SYMBOLIC DECK MAY BE PUNCHED FROM
THE FNSQ OUTPUT TAPE.THIS SYMBOLIC DECK IS THEN SUITABLE FOR
INCORPORATION INTO AN EXISTING SQUOZE DECK VIA MOD PACKAGE
ALLOWING FORTRAN SUBROUTINES TO BE USED IN SOS PROGRAMS.

0709 885VGVPRO AVAILABLE PRIOR TO JANUARY 1962

VECTOR TRIPLE CROSS PRODUCT
THIS ROUTINE PRODUCES THE VECTOR Y - W X /U X V/
RESULTING FROM THE VECTOR PRODUCT OF W WITH U X V,
THESE BEING 3-COMPONENT VECTORS. 80 LOCATIONS
ARE REQUIRED. 709 TIMING IS 4.04 MS.

IBM 0709 PROGRAM LIBRARY ABSTRACT
****

0709 887PPTDAC AVAILABLE PRIOR TO JANUARY 1962

TAPE DUPLICATE AND COMPARE
THE PURPOSE OF THIS ROUTINE IS -- /1/ TO MOVE RECORDS AND/OR
FILES OF BINARY AND/OR BCD INFORMATION FROM ANY TAPE OR TAPES
ON CHANNEL A TO ANY TAPE OR TAPES ON CHANNEL B, AND /2/ TO
COMPARE ANY NUMBER OF RECORDS AND/OR FILES OF BINARY AND/OR
BCD INFORMATION FROM ANY TAPE OR TAPES ON CHANNEL A WITH ANY
TAPE OR TAPES ON CHANNEL B.

0709 889GDBCDC AVAILABLE PRIOR TO JANUARY 1962

COPY BCD TAPE ROUTINE
32K 709 2 CARD SELF-LOADING. COPIES N NUMBER OF BCD
RECORDS OR I BCD FILE FROM TAPE A2 TO B1. USES
SWITCHES 1 & 2.

0709 892RWLN3F AVAILABLE PRIOR TO JANUARY 1962

FLOATING-POINT 709 NATURAL LOGARITHM SUBROUTINE
TO COMPUTE THE NATURAL LOGARITHM OF A NORMALIZED
FLOATING-POINT NUMBER CORR/1166

0709 893RWAF3F AVAILABLE PRIOR TO JANUARY 1962

FLOATING-POINT ARCFUNCTION SUBROUTINE
TO COMPUTE THE ARCSIN AND ARCCOS /OR ARCTAN AND
ARCCOT/ OF A NORMALIZED FLOATING-POINT NUMBER CORR.983

0709 921VGKEYS AVAILABLE PRIOR TO JANUARY 1962

KEYS SEARCH BCD LISTING TAPE ROUTINE
KEYS IS A ROUTINE WHICH WILL SEARCH A BCD LISTING TAPE
OF A PROGRAM AND LIST ALL INSTRUCTIONS REFERRING TO A
LOCATION SPECIFIED BY ENTERING IT INTO THE MQ KEYS.

0709 922AXSFD1 AVAILABLE PRIOR TO JANUARY 1962

SELECTIVE FILE DUPLICATOR ROUTINE
A ROUTINE THAT COPY ANY OR ALL OF THE FILES OF 1 INPUT REEL
ONTO 1 OR 2 OUTPUT REELS. THE RECORDS MAY BE OF VARIABLE
LENGTH.

0709 923RWMA4F AVAILABLE PRIOR TO JANUARY 1962

ARDC ATMOSPHERE OF 1959
TO APPROXIMATE THE DENSITY,PRESSURE,TEMPERATURE AND SPEED
OF SOUND OF ANY ALTITUDE IN THE GIVEN RANGE

0709 924RWMA5F AVAILABLE PRIOR TO JANUARY 1962

ARDC MODEL ATMOSPHERE OF 1959
TO APPROXIMATE THE DENSITY,PRESSURE,TEMPERATURE AND SPEED
OF SOUND OF ANY ALTITUDE IN THE GIVEN RANGE. CORR/ 1091

0709 927MAPOLY AVAILABLE PRIOR TO JANUARY 1962

ROOTS OF POLYNOMIAL WITH REAL COEFFICIENTS
SINGLE PRECISION FLOATING POINT COMPUTATION FOR THE REAL
AND COMPLEX ROOTS OF A REAL POLYNOMIAL BY NEWTON-RAPHSON
OR MODIFIED BAIRSTOW METHOD. STORAGE 389&3N&7 PLUS 5 COMMON

0709 933NOANAV AVAILABLE PRIOR TO JANUARY 1962

GENERAL PURPOSE ANALYSIS OF VARIANCE PROGRAM
PROGRAM TO CARRY OUT ANALYSIS OF VARIANCE OF ANY DESIGN OF
NO MORE THAN 8 FACTORS OR 2000 DATA FOR WHICH A VALID
ANALYSIS EXISTS

0709 934NOLSQ AVAILABLE PRIOR TO JANUARY 1962

A LEAST SQUARES ITERATION
SUBROUTINE TO CARRY OUT AN ITERATIVE LEAST SQUARES FIT OR
MINIMIZATION OF A MORE GENERAL FUNCTION OF SEVERAL VARIABLES
WORKING ENTIRELY IN TERMS OF FUNCTION VALUES

0709 935NGBSF AVAILABLE PRIOR TO JANUARY 1962

BINARY SEARCH, FORTRAN
PERFORMS RAPID SEARCHING OF AN ORDERED TABLE.
WRITTEN IN FAP FOR USE AS A FORTRAN SUBPROGRAM.
REPORTS THE INDEX OF THE TABLE ENTRY EQUAL TO
/OR NEXT HIGHER THAN/ THE ARGUMENT
AS A FORTRAN INTEGER VARIABLE.
A FLAG INTEGER VARIABLE IS SET EQUAL
TO ZERO IF THE ENTRY WAS FOUND IN THE TABLE,
AND SET TO ONE IF NOT FOUND.

0709 936LLMMIP AVAILABLE PRIOR TO JANUARY 1962

MATRIX MANIPULATING INTERPRETIVE PROGRAM FOR THE 709
THIS ABSTRACTION IS A GENERAL PURPOSE INTERPRETIVE PROGRAM
FOR SOLVING MATRIX EQUATIONS AND FOR PERFORMING OPERATIONS
ON MATRICES AND VECTORS. INSTRUCTIONS ARE READ IN LL MMIP
LANGUAGE AND THE INDICATED OPERATIONS ARE PERFORMED ON
MATRICES AND VECTORS READ FROM DATA CARDS. CORR. 987
CORR 1139

0709 938 VGRECC AVAILABLE PRIOR TO JANUARY 1962

ERROR CORRECTION CODE READER
THIS PROGRAM REMOVES HAMMING CHECKSUMS FROM A RECORD
AND CORRECTS IT IF NECESSARO AND POSSIBLE
ITS CALLING SEQUENCE IS AS FOLLOWS
TSX RECC,4
A,,N
ERROR RETURN
NORMAL RETURN WITC AC - TO ORIGINAL RECORD COUNT
WHERE A IS THE RECORD ORIGIN
AND N IS THE RECORD COUNT

0709 938VGWECC AVAILABLE PRIOR TO JANUARY 1962

ERROR CORRECTION CODE WRITER
THIS PROGRAM EXPANDS A RECORD TO INCLUDE HAMM9N7 CHECKSUMS
FOR THE PURPOSE OF ERROR CORRECTION
ITS CALLING SEQUENCE IS AS FOLLOWS
TSX WECC,4
A,,N
NORMAL RETURN WITH AC - HAMMING RECORD COUNT
WHERE A IS THE RECORD ORIGIN
AND N IS THE RECORD COUNT

0709 941RWHY3F AVAILABLE PRIOR TO JANUARY 1962

FLOATING-POINT 709 HYPERBOLIC SINE AND HYPERBOLIC
COSINE SUBROUTINE TO COMPUTE THE HYPERBOLIC SINE
AND HYPERBOLIC COSINE OF A NORMALIZED FLOATING-POINT
ARGUMENT. REQUIRES 95 & 5 COMMON.

0709 942MLPUNB AVAILABLE PRIOR TO JANUARY 1962

BINARY PUNCHING SUBROUTINE
WRITES A CHECKED B/5 TAPE WITH RECORDS TO PUNCH
EITHER ROW OR COLUMN BINARY CARDS ON THE TYPE 722
PERIPHERAL PUNCH. SEQUENCES CARDS BY ONES IN COLUMNS'
75, 76 AND 77. REQUIRES 178 CELLS OF CORE. PUNCHES 36
BIT CHECK-SUM WHICH DOES NOT INCLUDE 7-9 CONTROL
PUNCHES IN THE CASE OF A COLUMN BINARY CARD.

0709 945RWREQX AVAILABLE PRIOR TO JANUARY 1962

TO ROTATE A GIVEN VECTOR X FROM THE EQUINOX OF
1950.0 TO OTHER EQUINOYES, AND VICE VERSA.
REQUIRES111 CELLS, PROGRAM AND CONSTANTS
3CELLS COMMON, THROUGH & 2. TIME .98MS. TO ROTATE
VECTOR PLUS 1.47MS.TO COMPUTE MATRIX.
PROGRAM CAN RUN ON 7090-709-704 WITHOUT MODIFICATIONS

0709 946RWFEQX AVAILABLE PRIOR TO JANUARY 1962

FORTRAN WRITE-UP OF RW REQX.SPACE REQUIRED-122 CELLS
TIMING-1.05MS. TO ROTATE VECTOR PLUS 1.47MS. TO
COMPUTE MATRIX. CAN RUN ON 7090-709-704 WITHOUT
MODIFICATIONS

0709 947MLAS63 AVAILABLE PRIOR TO JANUARY 1962

GENERAL PURPOSE OUTPUT PROGRAM.
BUFFERED VERSION OF AS63 FOR THE 709/90. OPERATES ON CHANNEL
A. PROVIDES FOR SAMPLING OF LINES GOING TO TAPE UNDER SENSE
SWITCH CONTROL. FLOATING FORMAT HAS TRAILING EXPONENT AND
MANTISSA IS HEADED BY A DECIMAL POINT. ON LINE PRINTING DOES
NOT SIMULATE PROGRAM CONTROL OF PERIPHERAL PRINTER.

0709 948MLRBCD AVAILABLE PRIOR TO JANUARY 1962

ON-LINE BCD CARD READ ROUTINE
READS A BCD CARD THRU ON LINE CHANNEL A CARD READER.
ERROR RETURN FOR NON HOLLERITH CHARACTER. REQUIRES 92
CELLS OF CORE.

0709 949WDFAP AVAILABLE PRIOR TO JANUARY 1962

FAP ASSEMBLY PROGRAM
THIS DISTRIBUTION CONSISTS OF THE PROGRAM LISTING AND
EXTENDED PROGRAM WRITE-UP FOR THE FAP ASSEMBLY PROGRAM
THIS PROGRAM WRITE-UP IS INTENDED AS A GUIDE TO SYSTEM
PROGRAMMERS WHO WISH TO MODIFY FAP, OR WISH TO BORROW
PORTIONS OF THE CODING FOR USE IN OTHER PROGRAMMING SYSTEMS.
THE FAP PROGRAM, TOGETHER WITH ALL INFORMATION PERTAINING TO
ITS USE, IS AVAILABLE FROM IBM AS PART OF THE 709 FORTRAN
SYSTEM. ORDINARY FAP USERS WILL NOT REQUIRE THE MATERIAL
IN THIS DISTRIBUTION.

0709 951NA0839 AVAILABLE PRIOR TO JANUARY 1962

BINARY SEARCH ROUTINE NA 839
RAPID SEARCHING OF A TABLEC TABLE MUST CONSIST O6 FULL WORDS
IN LOGICALLY INCREASING ORDER. LAS COMPARE IS USED. THE
ROUTINE STORES IN INDEX REGISTER 1 THE LOCATION IN THE TABLE
OF THE ENTRY CORRESPONDING TO /E-UAL TO OR NEXT LARGER THAN/
THE ARGUMENT. INDICATORS ARE DESTROYED. INDX RGSTR 2 IS SAVED

0709 951NA0925 AVAILABLE PRIOR TO JANUARY 1962

BINARY AND OCTAL LOADER
709 LOADER TO LOAD STANDARD 704 BINARY CARDS INTERMIXED WITH
OCTAL PATCHES. OCTAL CARDS ARE TO HAVE LOCATION IN COLUMNS
2-6 AND WORD IN COLUMNS 7-18

0709 951NA9011 AVAILABLE PRIOR TO JANUARY 1962

704 ROW BINARY TO COLUMN BINARY CONVERSION.
READS 704 ROW BINARY CARDS AND PUNCHES OUT 704 COLUMN BINARY
CARDS WITH 9-7 PUNCH IN COLUMN 1

0709 951NA9012 AVAILABLE PRIOR TO JANUARY 1962

704 ROW BINARY TO 709 COLUMN BINARY CONVERSION.
READS 704 ROW BINARY CARDS AND PUNCHES OUT 709 COLUMN BINARY
CARDS WITH 9-7 PUNCH IN COLUMN 1 AND WITH FOLDED CHECKSUM

IBM 0709 PROGRAM LIBRARY ABSTRACT
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0709 953RWROBL AVAILABLE PRIOR TO JANUARY 1962

EQUATOR-ECLIPTIC ROTATION-ROTATE A GIVEN VECTOR
ABOUT THE X-AXIS THROUGH THE OBLIQUITY OF THE
ECLIPTIC.86 CELLS,PROGRAM AND CONSTANTS
2CELLS OF COMMON,THROUGH COMMON T 1.TIMING-.33MS.
TC PERFORM THE ROTATION-.48MS. TO COMPUTE THE MATRIX

0709 954RWFOBL AVAILABLE PRIOR TO JANUARY 1962

EQUATOR-ECLIPTIC ROTATION
FORTRAN WRITE-UP OF RW ROBL.ROTATE A GIVEN VECTOR ABOUT
THE X-AXIS THROUGH THE OBLICUITY OF THE ECLIPTIC. 94 CELLS
REQUIRED.35MS.TO PERFORM THE ROTATION-48MS.TO COMPUTE
THE MATRIX.

0709 955VGGASP AVAILABLE PRIOR TO JANUARY 1962

GENERAL AMORTIZATION SCHEDULE PROGRAM
THIS PROGRAM PRODUCES A SCHEDULE GIVEN AT LEAST THREE
OF THE FOLLOWING-- LOAN AMOUNT,RATE OF INTEREST, NUMBER
OF PAYMENTS, MONTHLY PAYMENT. OUTPUT IS ON TAPE, PRINTER,
OR CARDS. FOR MISSING PARAMETER , THERE IS AN OPTION
WHICH SUPPLIES MISSING VALUE IN LIEU OF SCHEDULE. DATA
MAY BE READ FROM READER OR TAPE. MAXIMUM PERIOD-- 50
YEARS. MAXIMUM NUMBER OF CASES -- 99.

0709 956LCPSN AVAILABLE PRIOR TO JANUARY 1962

POISON
THIS CODE COMPUTES THE PROBABILITY DISTRIBUTION OF AN
ELECTRON MULTIPLIER FOR ONE INCIDENT ELECTRON, USING
THE POISSON DISTRIBUTION.

0709 961PPPEST AVAILABLE PRIOR TO JANUARY 1962

PERIPHERAL EQUIPMENT SYMBOLIC TRANSLATOR
PEST IS AN ASSEMBLY ROUTINE FOR USE ON THE IBM 709
FOR TRANSLATING IBM 1401 PROGRAMS WRITTEN IN THE
PEST LANGUAGE INTO 1401 MACHINE LANGUAGE. CORR/ 972,1083

IBM 0709 PROGRAM LIBRARY ABSTRACT
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0709 963IB9FES AVAILABLE PRIOR TO JANUARY 1962

FORECASTING BY ECONOMETRIC SYSTEMS
ESTIMATES THE COEFFICIENTS OF A SYS. OF LINEAR STOCHASTIC
EQUATIONS BY LIMITED-INFORMATION,TWO-STAGE LEAST-SQUARES,
AND FULL-INFO. COVARIANCES OF ESTIMATES ARE COMPUTED.
ALSO REDUCED-FORM EQUATIONS FOR COMPLETE SYS. CAN HANDLE
UP TO 70 ECUATS. IN 70 DEPENDENT VARIABLES AND 70 INDEPEN-
DENT VARIABLES FOR 5000 OBSERVATIONS. CORR/ 1015,1106

0709 978WDIOF AVAILABLE PRIOR TO JANUARY 1962

WDPC BUFFERED I/O PACKAGE FOR 709 FORTRAN.
/SEPTEMBER 1960 FIELD-TEST VERSION/
A COMPLETE SET OF ROUT. TO REPLACE THE I/O ROUTINES IN THE
709 FORT. LIBRARY. THIS SET PROVIDES TAPE BUFFERING FOR ALL
FORTRAN PROGRAMS. NO CHANGE IS REQUIRED IN FORTRAN SOURCE
DECKS OR IN PREVIOUSLY COMPILED OBJ. DECKS. OTHER FEATURES
PROVIDE FILE SKIPPING, RECORD PREVIEWING, AND DIAGNOSTIC
ERROR COMMENTS. FAP LANG. PROGRAMS CAN USE NON-CONVERTING-
TRANSMISSION FEATURES. THERE ARE SOME RESTRICTIONS.CORR/ 1044

0709 982RWSI2F AVAILABLE PRIOR TO JANUARY 1962

SIMPSONS RULE FLOATING-POINT INTEGRATION
TO GENERATE A SEQUENCE OF EQUALLY SPACED ARGUMENTS IN
THE INTERVAL A TO B AND TO EVALUATE THE DEFINITE
INTEGRAL OF A FUNCTION F/X/ OVER THE INTERVAL.
REQUIRES 78 CELLS & 1 COMMON. COMMON NEED NOT BE
PRESERVED BETWEEN ENTRANCES. TIMING IS 0.562 &
0.250 /N&1/ MS.

0709 984RWBF7F AVAILABLE PRIOR TO JANUARY 1962

ALL ORDERS OF BESSEL FUNCTION J SUB K TIMES Z OR I
SUB K TIMES Z FOR COMPLEX Z. GIVEN AN INTEGER N GREATER THAN
OR EQUAL TO 0 AND A COMPLEX ARGUMENT Z - X & THE PRODUCT
OF LOWER CASE I AND Y, THIS SUBROUTINE COMPUTES THE
BESSEL FUNCTIONS J SUB K TIMES Z OR, OPTIONALLY, I SUB
K TIMES Z FOR K - 0,1,...,N. REQUIRES PROGRAM 468 CELLS
COMMON 15 CELLS. TIMING IS APPROX .7L & 2 MS., WHERE
L - K OVER 2. /7090/ CORR/1161

IBM 0709 PROGRAM LIBRARY ABSTRACT
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0709 985RWBF8F AVAILABLE PRIOR TO JANUARY 1962

ALL ORDERS OF THE BESSEL FUNCTIONS Y SUB K TIMES Z AND
J SUB K TIMES Z FOR COMPLEX Z. GIVEN AN INTEGER N GREATER
THAN OR EQUAL TO 0 AND A COMPLEX ARGUMENT Z - X & THE
PRODUCT OF LOWER CASE I AND Y, THIS SUBROUTINE COMPUTES
THE BESSEL FUNCTIONS Y SUB K TIMES Z AND J SUB K TIMES Z
FOR K - 0,1,....,N. REQUIRES PROGRAM 790 CELLS-COMMON
18 CELLS. TIME TO COMPUTE Y SUB 0 IS ABOUT 5 & .7L MS.
MAXIMUM TIME TO COMPUTE Y SUB 1,...., Y. CORR/1162

0709 990RWLE4F AVAILABLE PRIOR TO JANUARY 1962

LINEAR EQUATION SOLVER OF BAND MATRICES
GIVEN A LINEAR MATRIX EQUATION AX-B, THIS ROUTINE FINDS
THE SOLUTION WHERE A IS A BAND MATRIX OF DIMENSION N X
/KL&K2&1/ AND B IS OF DIMENSION N X M. REQUIRES 802 CELLS
OF PROGRAM AND CONSTANTS. 5 CELLS OF COMMON THROUGH
COMMON & 4. CORR/ 1049

0709 991MACEQ2 AVAILABLE PRIOR TO JANUARY 1962

DETERMINANT EXPANSION
THIS IS A 709 ROUTINE THAT CALCULATES THE CHARACTERISTIC
EQUATION OF M OF THE DETERMINANT M & I LAMDA. REQUIRES
330 WORDS & COMMON THRU COMMON & 2N & 5. WHERE N -ORDER
OF MATRIX

0709 995FDEDIT AVAILABLE PRIOR TO JANUARY 1962

709 SYMBOLIC TAPE EDITING PROGRAM
EDITS A SYMBOLIC MASTER TAPE BY INSERTING, DELETING,
OR CHANGING SPECIFIED RECORDSC

0709 997MLCVRT AVAILABLE PRIOR TO JANUARY 1962

BINARY TO BCS INTERGER CONVERSION
CONVERTS A SIGNED BINARY INTEGER TO A 6-CHARACTER BCD WORD
MAXIMUM ABSOLUTE VALUE FOR ARGUMENT IS 999999
ARGUMENT IN MC RESULT IN MQ
PRODUCES NEGATIVE RESULTS FOR NEGATIVE ARGUMENT
CALLING SEQUENCE TSX CNVRT,4
ERROR RETURN, ARGUMENT EXCEEDS 999999 IN ABSOLUTE VALUE
NORMAL RETURN

IBM 0709 PROGRAM LIBRARY ABSTRACT
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0709 998RL0393 AVAILABLE PRIOR TO JANUARY 1962

TAPE COPY AND COMPARE
THIS IS A SELF-CONTAINED PROGRAM TO COPY AND COMPARE TAPE
FILES OR RECORDS IN BINARY, BCD OR MIXED MODE.

0709 999RL0390 AVAILABLE PRIOR TO JANUARY 1962

SELF-LOADING BINARY-OCTAL LOWER LOADER
LOADS ROW BINARY ABSOLUTE DECKS AND OCTAL CHANGE CARDS.
CARDSO AND 2 OF THE OUTPUT DECK CONTAIN IN 9R THE WORDS TO
BE PUNCHED MANUALLY INTO 9L OF CARDS 1 AND 3, AFTER
-REMOVING- THE CONTROL INFO FROM THE 9L OF CARDS 1 AND 3.
CARDS 0 AND 2 SHOULD THEN BE DISCARDED.

0709 1000RSEDT1 AVAILABLE PRIOR TO JANUARY 1962

SQUOZE TAPE EDITOR
THIS PROGRAM MAINTAINS A MASTER TAPE CONTAINING
SCUOZE DECKS IN MOCK-DONALD BUFFERED FORMAT. IT WILL
ALSO SELECT DECKS FROM THE MASTER AND/OR TAPES
CONTAINING SQUOZE DECKS IN CARD IMAGE FORM AND MERGE
THEM WITH MODIFICATION PACKAGES IN ORDER TO PRODUCE
A SYSPIT SUITABLE FOR RUNNING BY SOS. MUST BE RUN
UNDER CONTROL OF THE MOCK-DONALD MONITOR. CORR/ 1047

0709 1001NA8600 AVAILABLE PRIOR TO JANUARY 1962

NORMAL PROBABILITY - ORDINATE AND AREA M. SINGLETON
A FORT. SUBROUTINE WHICH COMPUTES THE ORDINATE AND/OR AREA
OF EITHER OF 2 CLOSELY RELATED FORMS OF THE NORMAL PROBA-
BILITY FUNCTION. WHEN AREA OF EITHER FUNCTION IS TO BE
DETERMINED, IT MAY BE OBTAINED IN ANY ONE FIVE DIFFERENT
FORMS OF AREAL SEGMENT - CENTRAL, SEMICENTRAL, TWO TAIL,
SINGLE TAIL, OR CUMULATIVE FROM MINUS INFINITY. THE CALL
STATEMENT REQUIRES AN ABSCISSA ARGUMENT, FUNCTION TYPE AND
FORM SPECIFICATION. ERROR INDICATION IS PROVIDED AND THE
ANSWER/S/ ARE SINGLE PERCISION.

0709 1002NA8610 AVAILABLE PRIOR TO JANUARY 1962

INVERSE NORMAL PROBABILITY FUNCTIONS M. SINGLETON
A FORTRAN SUBROUTINE WHICH COMPUTES THE ABCSISSA X WHEN
EITHER THE AREA OR DERIVATIVE VALU FOR EITHER OF 2 CLOSELY
RELATED FORMS OF NORMAL PROBABILITY FUNCTION IS SPECIFIED
IF THE ABSCISSA VALUE IS TO BE DETERMINED AS A FUNCTION OF
AREA, ANY ONE OF FIVE DIFFERENT AREAL FORMS MAY BE USED AS
INPUT - CENTRAL, SEMICENTRAL, 2-TAIL, SINGLE-TAIL, OR CUM-
ULATIVE FROM MINUS INFINITY. THE CALL STATEMENT REQ. TWO
PIECES OF INPUT - AN AREAL OR ORDINATE VALUE AND FUNCTION

0709 1007RL0395 AVAILABLE PRIOR TO JANUARY 1962

STUDENT INPUT-OUTPUT
INTERPRETIVE INPUT-OUTPUT COMPATIBLE WITH SMASHT IN SOS.
FIXED POINT EXTERNAL TO MACHINE, FLOATING POINT INTERNALLY.

0709 1009WDSERI AVAILABLE PRIOR TO JANUARY 1962

UPCATE SYMBOLIC PROGRAM TAPE USING SERIAL NUMBERS.
UPDATES SYMBOLIC PROGRAM DECK ON TAPE BY INSERTING, DELETING, AND RE-ORDERING RECORDS, USING LABELS IN COLUMNS 73-80 FOR CONTROL. WILL RELABEL ITS OUTPUT OR COPY OLD LABELS. REQUIRES 709 FORTRAN MONITOR AND WD IOF. CORR/ 1053

0709 1016RWAT3F AVAILABLE PRIOR TO JANUARY 1962

FLOATING-POINT 7090 ARCTANGENT SUBROUTINE COMPUTES THE ARCTANGENT IN RADIANS OF A NORMALIZED FLOATING-POINT NUMBER.SPACE REQUIRED 75&6 COMMON. VOIDS DIST.860

0709 1025WPK006 AVAILABLE PRIOR TO JANUARY 1962

INPUT PROGRAM UNDER SENSE LIGCT CONTROL
READS DECIMAL, OCTAL OR BCD INFORMATION FROM A BCD TAPE OR PUNCHED CARDS, CONVERTS TO BINARY AND STORES THE RESULTS IN CORE STORAGE. THE PROGRAM USES TWO BUFFERS /COMMON STORAGE/ TO MAKE USE OF THE SIMULTANEOUS READ-WRITE/COMPUTE FEATURE OF THE COMPUTER. T&IS IS A MODIFIED VERSION OF THE 704 PROGRAM, NY INP2. PROGRAM USES 585 LOCATIONS PLUS 81 COMMON.

0709 1026WPK007 AVAILABLE PRIOR TO JANUARY 1962

DECIMAL OUTPUT PROGRAM UNDER SENSE LIGHT CONTROL
CONVERTS BINARY NUMBERS TO DECIMAL NUMBERS IN BINARY CODED DECIMAL FORM AND WRITES T&ESE ON TAPE OR PRINTS THEM ON THE ON-LINE PRINTER. THE PROGRAM USES TWO BUFFERS /COMMON STORAGE/ TO MAKE USE OF T&E SIMULT1N5OUS R514-WR9TE/COMPUTE FEATURE OF THE COMPUTER. THIS IS A MODIFIED VERSION OF THE 704 PROGRAM, NY OUT2. PROGRAM USES 597 LOCATIONS PLUS 118 COMMON. CORRC/1174

0709 1027RSIPLV AVAILABLE PRIOR TO JANUARY 1962

709/7090 IPL-V INTERPRETIVE SYSTEM
INTERPRETS AND EXECUTES PROGRAMS WRITTEN IN THE IPL-V LANGUAGE. WRITTEN IN THE FORM OF A SUBROUTINE, IT MAY USED INDEPENDENTLY OF, WITH, OR AS PART OF SOS.

IBM 0709 PROGRAM LIBRARY ABSTRACT
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0709 1031RL0400 AVAILABLE PRIOR TO JANUARY 1962

BI EDITOR FOR PROGRAMMED 704/709/90 COMPATIBILITY
PROVIDES THE NECESSARY SIMULATION, MONITORING AND UTILITY ROUTINES TO ALLOW THE EXECUTION OF 704 ABSOLUTE BINARY PROGRAMS ON THE 709 OR 7090. OPERATES EITHER IN CONJUNCTION WITH OR INDEPENDENT OF THE SHARE OPERATING SYSTEM /SOS/. DRUMS CAN BE SIMULATED.
THIS PROGRAM REQUIRES CELLS 0-27/8 AND A PORTION OF UPPER MEMORY EQUAL IN LENGTH TO THE LONGEST RECORD TO BE PROCESSED PLUS APPROXIMATELY 900 CELLS. VOIDS RL-L349 SDA 687

0709 1032RL0412 AVAILABLE PRIOR TO JANUARY 1962

RESTART PROGRAM FOR THE BINARY EDITOR /RL 0400/
LOADS THE BINARY EDITOR FROM A TAPE.

0709 1033BEFAP AVAILABLE PRIOR TO JANUARY 1962

FAP ASSEMBLY PROGRAM
THIS DISTRIBUTION INCLUDES A LISTING TAPE, A SYMBOLIC TAPE, A BE FAP MANUAL, AND A SHORT WRITE-UP OF THE ASSEMBLER AND ITS MONITOR. A SYSTEM PROGRAMMERS WRITE-UP SHOULD BE AVAILABLE EARLY IN 1961.
THE SYMBOLIC TAPE HAS PROPER CONTROL CARDS FOR ASSEMBLY BY WD FAP, HOWEVER INDIVIDUAL INSTALLATIONS WILL WANT TO REPLACE THE MONITOR SUPPLIED BY ONE MEETING THEIR OWN REQUIREMENTS. SEE WRITE-UP. CORR/ 1093,1216

0709 1034SCCSB1 AVAILABLE PRIOR TO JANUARY 1962

ROW BINARY CARD LOADER
MODELED AFTER UA CSB1 FOR THE 704

0709 1037SCM002 AVAILABLE PRIOR TO JANUARY 1962

MATHEMATICAL PROGRAMMING SYSTEM TWO
A REVISION OF RS MIC A SINGLE PRECISION 7090 CODE USING THE REVISED SIMPLEX METHOD WITH PRODUCT FORM INVERSE. CAN HANDLE PROBLEMS HAVING UP TO 200 ROWS, 599 COLUMNS, AND 3488 NON-ZERO MATRIX ENTRIES. INCLUDES COMPOSITE, MULTIPLE OBJECTIVES, INTERRUPT AND PUNCH-OUT ABILITY, USE OF SYSTEM TAPE, AND BATCH RUNNING. CORR/ 0 7

IBM 0709 PROGRAM LIBRARY ABSTRACT
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0709 1038RWPCRG AVAILABLE PRIOR TO JANUARY 1962

PRINT CONTROL FOR REPORT GENERATION
THIS SUBROUTINE SETS UP AND CONTROLS THE PRINTING OF THE OUTPUT FOR A REPORT GENERATING PROGRAM. IT FACILITATES THE SETTING UP OF PRINT FIELDS,LINES OR PARAGRAPHS FOR SPECIFIC REPORTS AND,IF DESIRED, PROVIDES FOR AUTOMATIC PAGING AND TITLING. THE SUBROUTINE MUST BE USED IN CONJUNCTION WITH STL SYSTEM B.

0709 1039RWPRT9 AVAILABLE PRIOR TO JANUARY 1962

GENERAL OUTPUT ROUTINE FOR THE 709.
RW PRT9 IS A MODIFICATION OF RW PRT2 DIST. NO. 652. REQUIRES 533 CELLS PLUS 10 COMMON.

0709 1045 WDLOAD AVAILABLE PRIOR TO JANUARY 1962

709-7090 LOADER PACKAGE 1
PROVIDES A FULL SET OF LOADERS FOR USE IN CONJUNCTION WITH THE -LOAD CARDS- OR -LOAD TAPE- KEY ON THE 709-7090 CONSOLES. THIS PACKAGE VOIDS DISTRIBUTIONS NUMBERED 527 AND 535.

0709 1055DIBTC AVAILABLE PRIOR TO JANUARY 1962

BINARY TAPE CORRECTOR. NON-SYSTEM VERSION
BTC IS A BINARY TAPE CORRECTOR WITH SUBROUTINES WHICH PERMIT TAPE MANIPULATION AND RECORD SEARCHING. CONTROL INFORMATION IS PREPARED IN OCTAL AND MAY BE ENTERED IN THE MQ KEYS OR READ FROM CARDS. NON-SYSTEM VERSION.

0709 1063GEQUDE AVAILABLE PRIOR TO JANUARY 1962

QD SURGE /709-90 CONVERSION OF 704 SURGE/
PROVIDES FOR THE DIRECT USE OF 704 SURGE SOURCE PROGRAM DECKS TO PRODUCE 709 OR 7090 PROGRAMS. REQUIRES A 32K 709 OR 7090 CORRECTION DIST.1200

0709 1084RSOKF1 AVAILABLE PRIOR TO JANUARY 1962

OUT OF KILTER NETWORK FLOW ROUTINE ONE
AN INDEPENDENT ROUTINE TO SOLVE CAPACITATED NETWORK FLOW PROBLEMS USING A METHOD IN WHICH A MEASURE OF OPTIMALITY IS NOT WORSENED ON ANY ITERATION. FLOWS HAVE UPPER AND LOWER BOUNDS WHICH MAY BE POSITIVE OR NEGATIVE. NO INITIAL FEASIBLE SOLUTION IS NEEDED. HAS PROVISION FOR SOLVING PROBLEMS WHICH VARY SLIGHTLY FROM PREVIOUSLY SOLVED PROBLEMS IN MINIMAL MACHINE TIME. SOURCE LANGUAGE IS FORTRAN AND FAP.

IBM 0709 PROGRAM LIBRARY ABSTRACT
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0709 1086IBAPF AVAILABLE PRIOR TO JANUARY 1962

SCHEDULING WITH ARBITRARY PROFIT FUNCTIONS
WE CONSIDER A SET OF JOBS TO BE EXECUTED SUCCESSIVELY ON A SINGLE FACILITY. ANY GIVEN JOB REQUIRES THE SERVICES OF THE FACILITY FOR A KNOWN LENGTH OF TIME. WITH EACH JOB IS GIVEN THE PROFIT ASSOCIATED WITH COMPLETING THE JOB AT TIME T. WE ASSUME THAT THE FACILITY IS TO BE CONSTANTLY IN USE. ANY GIVEN ORDER OF EXECUTION OF THE JOBS /A SCHEDULE/ IMPLICITL ASSIGNS TO EACH JOB A TERMINATION TIME, AND HENCE A PROFIT. THE PROGRAM SEEKS TO FIND A SCHEDULE WHICH YIELDS THE MAXIMUM ACHIEVABLE TOTAL PROFIT.

0709 1090NOTIA9 AVAILABLE PRIOR TO JANUARY 1962

TRACE INSTRUCTION ALTERATION FOR 709
THIS TRACING PROGRAM IS A POWERFUL TOOL FOR IDENTIFYING SOURCE OF TRANSFER TO AN UNINTENDED LOCATION OR OF UNDESIRED ALTERATION OF MEMORY. BY MEANS OF IT THE MACHINE IS DIVERTED TO A MEMORY DUMP AT FIRST TRAPPED TRANSFER OCCURRING IMMEDIATELY BEFORE TRANSFERRING TO A SPECIFIED EFFECTIVE ADDRESS OR AFTER ONE OF SEVERAL DESIGNATED LOCATIONS BECOMES ALTERED FROM SPECIFIED CONTENTS.

0709 1102SE9DUL AVAILABLE PRIOR TO JANUARY 1962

ABSOLUTE BINARY UPPER LOADER ONE CARD
LOADS A FILE OF ABSOLUTE ROW BINARY CARDS INTO CORE FROM ON LINE CARD READER.HALTS ON BAD CHECKSUM EXCEPT WHEN THERE IS A 9 ROW PUNCH IN COLUMN 3 OR A CHECKSUM IS ZERO. RECOGIZES TRANSFER CAR. USES LOCATIONS 77751 THROUGH 77777 /OCTAL/

0709 1118URPLOT AVAILABLE PRIOR TO JANUARY 1962

PRINTER PLOT BCD TEXT GENERATOR FOR FORTRAN OUTPUT
CONSTRUCTS A 120 CHAR LINE OF TEXT SUITABLE FOR OUTPUT WITH AN -A- TYPE FORMAT DESCRIPTION. THE CALLING SEQUENCE INCLUDES A LIST OF CHARACTERS TO BE PLOTTED, A VECTOR OF POSITIONS FOR EACH CHARACTER, AND THE LOCATION OF A 20 WORD BLOCK INTO WHICH THE LINE IS TO BE STORED FOR SUBSEQUENT OUTPUTTING.

IBM 0709 PROGRAM LIBRARY ABSTRACT
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0709 1120ATLOC AVAILABLE PRIOR TO JANUARY 1962

ADDRESS LOCATION SUBROUTINE.
FINDS THE LOCATION OF ANY CONSTANT OR VARIABLE IN THE PROGRAM
VARIABLES MAY BE FIXED OR FLOATING, SUBSCRIPTED OR NOT.
SUBSCRIPTS MAY BE EXPRESSIONS OF STANDARD FORTRAN FORM.

0709 1121NRNRMC AVAILABLE PRIOR TO JANUARY 1962

FORTRAN MULTIPLE CORRELATION ANALYSIS PROGRAM
THIS PROGRAM IS FOR THE STATISTICAL ANALYSIS OF A SET OF
POINTS /P1, P2....PM/ WHERE P1 - /X0,X1, X2....XN/.
THE PROGRAM WILL PERFORM MULTIPLE CORRELATIONS OF THE FORM
X/1/-B/1/&B/2/&B/3/*X/3/&...&B/N/*X/N/ WHERE X/1/ IS THE
DEPENDENT VARIABLE, X/2/, X/3/....X/N/ ARE INDEPENDENT
VARIABLE FUNCTIONS, AND THE B VALUES ARE TO BE STATISTICALLY
ESTIMATED FROM THE DATA.

0709 1133EL9LUP AVAILABLE PRIOR TO JANUARY 1962

709 FORTRAN LOAD/UNLOAD PACKAGE
PROVIDES GREATER INPUT AND OUTPUT FLEXIBILITY WITH 709/7090
FORTRAN. IT ALLOWS FOR VARIABLE LENGTH BCD TAPE RECORDS UP TO
31500 WORDS. END OF FILE, AND PHYSICAL END OF TAPE INDICATION
WHICH MAY BE USED FOR BRANCHING. IT MAKES USE OF MULTIPLE
FORMAT STATEMENTS TO DESCRIBE TAPE RECORDS. 1500 WORDS OF
UPPER STG. ARE REQUIRED

0709 1135BWVIPP AVAILABLE PRIOR TO JANUARY 1962

709 VARIABLE INFORMATION PROCESSING PACKAGE
709-7090 VIPP, LIKE 704VIPP, IS A COLLECTION OF SUBROUTINES
DESIGNED TO SERVE AS AN EFFICIENT GENERAL PURPOSE
DATA PROCESSING PACKAGE CORR./1178

0709 1136BWVIPM AVAILABLE PRIOR TO JANUARY 1962

VIPP MERGER.
SECOND PHASE OF A GENERAL PURPOSE SORTER. FIRST PHASE IS M1
BW VIPS. WILL MERGE VARIABLE LENGTH ITEMS ON ANY PORTIONS OF
THE ITEMS. OPTIONAL CHECKSUM CONTROL AND RECOVERY PROCEDURE.
TAPE COUNTS FOR TAPE ERROR DIAGNOSIS. 2,3 OR 4-WAY TAPE MERGE
LOGIC. FAVORABLE TIMING. MAY BE RUN AS A SINGLE PHASE MERGER
TO MERGE 2,3 OR 4 SORTED FILES.

IBM 0709 PROGRAM LIBRARY ABSTRACT
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0709 1136BWVIPS AVAILABLE PRIOR TO JANUARY 1962

709 VIPP SORTER.
FIRST PHASE OF A GENERAL PURPOSE TAPE SORTER. SECOND PHASE IS
M3 BW VIPM. WILL SORT VARIABLE LENGTH ITEMS OR NON-VIPP BCD
MODE TAPES ON ANY PORTIONS OF THE ITEMS. OPTIONAL CHECKSUM
CONTROL TO GUARANTEE THE SORT. RECOVERY PROCEDURE. TAPE
COUNTS FOR TAPE ERROR DIAGNOSIS. FAVORABLE TIMING.

0709 1137BW9BUG AVAILABLE PRIOR TO JANUARY 1962

709 VIPP BUG TRAP.
DESIGNED TO ASSIST IN CHECKOUT OF PROGRAMS USING SUBROUTINES
FROM MO BW VIPP. AN ILLEGAL CALL WILL CAUSE ON-LINE INDICA-
TION OF THE CALL AND BUG LOCATIONS.

0709 1137BW9SYN AVAILABLE PRIOR TO JANUARY 1962

709 VIPP SYNONYM DECK
SCAT EQUIVALENCE DECK TO BE ASSEMBLED WITH SCAT ROUTINES
USING BW VIPP.

0709 1148NODPAT AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION FLOATING POINT ARCTANGENT SUBROUTINE
RATIONAL APPROXIMATION METHOD,INPUT IN AC-MQ OR FROM CORE,
OUTPUT IN RADIANS, EITHER PRINCIPAL VALUE OR CORRECTED FOR
QUADRANT, DEPENDING ON OPTION CHOSEN. 256 LOCATIONS & 14 COM-
MON & NECESSARY DP ABSTRACTION, SUCH AS NO DPAB

0709 1159MDSORT AVAILABLE PRIOR TO JANUARY 1962

709/7090 GENERALIZED VARIABLE LENGTH RECORD SORT
THIS GENERALIZED SORT PROGRAM PROVIDES A 2-5 WAY MERGE,BCD OR
BINARY INPUT OF N REELS, VARIABLE OR FIXED LENGTH BLOCKED
RECORDS, 1-6 SCATTERED CONTROL FIELDS, INTERRUPT FEATURES,
OPTIONAL INPUT AND OUTPUT LABELING. MINIMUM MACHINE REQUIRE-
MENTS- 1 CHANNEL, 6 TAPES & CD. READER OR 7 TAPES, PRINTER.
CONTROL CARDS ARE USED TO SPECIFY ALL SORT PARAMETERS.
SPECIFIED LEVELS MAY BE DELETED FROM THE FILE. DUPLICATE
RECORDS ARE SUMMARIZED OUT.

0709 1160MDSRST AVAILABLE PRIOR TO JANUARY 1962

RESTART PROGRAM FOR MD SORT
USED TO RESTART A SORT AT THE BEGINNING OF ANY PHASE OR MERGE
PASS. RELOADS CHECKPOINT TAPE INTO CORE AND CHECKS THE TAPE
TRANSMISSION.

0709 1163MWRCTC AVAILABLE PRIOR TO JANUARY 1962

FORTRAN CARD OR TAPE /ROW AND/OR COLUMN BINARY/ LOADER.
LOADS FORTRAN PROGRAMS FROM TAPE, FROM CARDS, OR FROM FIRST
CARDS THEN TAPE.BASICALLY AN EXTENSION OF THE F2 BSS LOADER,
THE PROGRAM ALLOWS OCTAL CORRECTION AND COMMENT CARDS AT
OBJECT TIME, AND OPTIONALLY LISTS THESE ON- OR OFF-LINE. A
MAP OF MEMORY ALLOCATION IS ALSO OPTIONALLY LISTED. CARD
DECKS MAY BE IN ROW OR COLUMN BINARY FORM OR A MIXTURE OF
BOTH.

0709 1164MWFOTO AVAILABLE PRIOR TO JANUARY 1962

INTERRUPT FORTRAN-LOADING TO COPY MEMORY ON TO TAPE.
WRITES COPY OF MEMORY, AS IT IS WHEN FOTO IS ENCOUNTERED
DURING LOADING BY FRCTC, PRECEDED BY A SELF-LOADING TAPE
READING PROGRAM, SO THAT THE TAPE MAY BE LATER SIMPLY
RELOADED AND FRCTC LOADING CONTINUED. FRCTC LOADING RESUMES
AFTER TAPE IS COPIED./FRCTC LOADER PREVIOUSLY DISTRIBUTED./

0709 1170ATRKSJ AVAILABLE PRIOR TO JANUARY 1962

FLOATING POINT OPTIMIZED RUNGE-KUTTA INTEGRATION.
FIXED INTERVAL OR VARIABLE INTERVAL OPTIMIZED BY A SIMPSONS
RULE CHECK USING DERIVATIVES ALREADY FORMED IN THE 4TH ORDER
RUNGE-KUTTA PROCESS. INTEGRATES A SYSTEM OF N FIRST ORDER
DIFFERENTIAL EQUATIONS WITH ACCURACY CONTROLLABLE BY RELATIVE
AND/OR ABSOLUTE CRITERIA FOR EACH EQUATION. COMMUNICATES WITH
USER-SUPPLIED DERIVATIVE AND CONTROL SUBROUTINES. USES DOUBLE
PRECISION INTERNALLY TO INCREMENT THE VARIABLES. SPACE
REQUIRED- 277 WORDS AND 13N&9 CELLS OF WORKING STORAGE.

0709 1171ATRKS3 AVAILABLE PRIOR TO JANUARY 1962

FORTRAN FLOATING POINT RUNGE-KUTTA INTEGRATION.
FIXED INTERVAL OR VARIABLE INTERVAL OPTIMIZED BY A SIMPSONS
RULE CHECK USING DERIVATIVES ALREADY FORMED IN THE 4TH ORDER
RUNGE-KUTTA PROCESS. INTEGRATES A SYSTEM OF N FIRST ORDER
DIFFERENTIAL EQUATIONS WITH ACCURACY CONTROLLABLE BY RELATIVE
AND/OR ABSOLUTE CRITERIA FOR EACH EQUATION. COMMUNICATES WITH
USER-SUPPLIED DERIVATIVE AND CONTROL SUBROUTINES. USES DOUBLE
PRECISION INTERNALLY TO INCREMENT THE VARIABLES. SPACE
REQUIRED- 318 WORDS AND 9N&6 CELLS OF WORKING STORAGE.

IBM 0709 PROGRAM LIBRARY ABSTRACT
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0709 1198MICOMT AVAILABLE PRIOR TO JANUARY 1962

COMIT - GENERAL PURPOSE LANGUAGE FOR SYMBOL MANIPULATION
USEFUL FOR PRIMARILY NON-NUMERICAL PROGRAMS - TRANSLATION,
INFORMATION RETRIEVAL, DICTIONARY WORK, FILE MAINTENANCE AND
SEARCH, FORMAL ALGEBRA, THEOREM PROVING, SIMULATION, GAME
PLAYING, TEXT PROCESSING, DATA REDUCTION, ARTIFICIAL INTELLI-
GENCE, ETC. A CONVENIENT, HIGH-LEVEL LANGUAGE - EASY TO USE
AND QUICK TO CHECK OUT. FEATURES DIRECTNESS OF EXPRESSION,
EASY USE OF MNEMONICS, BUILT-IN PUSH DOWN LISTS AND ADDRESS-
ABLE STORAGE, FREEDOM FROM FIXED FORMAT AND WORD-LENGTH RE-
STRICTIONS, AUTO. INTERNAL STGE. ALLOCATION 1222

0709 1201NRDICV AVAILABLE PRIOR TO JANUARY 1962

SINGLE PRECISION TO DOUBLE PRECISION FORTRAN INPUT
ALLOWS A FORTRAN PROGRAMMER TO READ IN SINGLE PRECISION
NUMBERS - WITH K DECIMAL DIGITS /WHERE K IS EQUAL TO OR LESS
THAN 25/ WITH EXPONENT E /WHERE E IS EQUAL OR LESS THAN 11/
ACCORDING TO A SPECIFIED CARD FORMAT - AND TO CONVERT THESE
DECIMAL NUMBERS TO DOUBLE PRECISION NUMBERS.
SHOULD BE USED ONLY WITH THE ROCKETDYNE /SHARE CODE NR/
DOUBLE PRECISION PACKAGE NPRE.

0709 1202NRDOCV AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION OUTPUT FOR FORTRAN
ALLOWS A FORTRAN PROGRAMMER TO CONVERT A DOUBLE PRECISION
NUMBER TO K /K EQUAL TO OR LESS THAN 22/ DECIMAL DIGITS WITH
EXPONENT AND PRINT OUT ACCORDING TO A SPECIFIED FORMAT.
SHOULD BE USED ONLY WITH THE ROCKETDYNE /SHARE CODE NR/
DOUBLE PRECISION PACKAGE NPRE.

0709 1215AQE073 AVAILABLE PRIOR TO JANUARY 1962

DOUBLE PRECISION POLONOMIAL ROOT EXTRACTION PROGRAM
EXTRACTS THE ROOTS OF AN NT& DEGREE POLONOMIAL WITH REAL
COEFICIENTS. N CANNOT EOCEED FIFTOC ALL 6LO1T9NG POINT
ARITHMETIC IS PERFORMED IN T&E DOUBLE PRECISION MODE.

0709 1219WDHOLR AVAILABLE PRIOR TO JANUARY 1962

HOLLERITH WORD GENERATOR
SUBROUTINE HOLRTH FACILITATES THE HANDLING OF HOLLERITH
CHARACTERS IN A FORTRAN PROGRAM. IT PLACES A STRING OF
HOLLERITH CHARACTERS INTO A ONE-DIMENSIONAL ARRAY SO THAT
THE USER CAN REFER TO THE STRING BY REFERRING TO THE NAME
OF THE ARRAY. OCCUPIES 16 LOCATIONS IN CORE-STORAGE.
LISTING INCLUDED IN SHORT WRITE-UP

APWRC-SYNFAR

709 Nuclear Code

(1) Code Originated by:
The Martin Co. (Baltimore)

(2) Computer:
709 (FORTRAN II and FAP)

(3) Description of Code:
This code does a synthesis computation of the static flux and reactivity, or of the stable period and corresponding flux shape, in XY or RZ geometry. A direct computation of the same quantities is made in one-dimensional spherical geometry. It is assumed, in two-dimensional problems, that the flux is separable in the two perpendicular directions. One-dimensional calculations are carried out alternately in each direction, and are coupled through lithargy dependent bucklings.

(4) Restrictions or Limitations:
A 32K memory with ten tape units. For transport calculations, two or three groups may be used, and P_1, S_2, S_6, S_8, and S_{16} calculations may be made. The S_{16} calculation may not be done in cylindrical geometry. Up to 199 space intervals in each direction.

(5) Approximate Performance:
12 minutes on the 709 for 3 passes on a right-circular cylinder with homogeneous core and reflector.

(6) References:
1. C. Eicheldinger, "APWRC-SYNFAR", Computer Code Abstract No. 15, Nuclear Sciences and Engineering, 10, p. 296, 1961.
2. D. H. Frederick, "APWRC-SYNFAR, A FORTRAN II Program for Two-Dimensional Static or Dynamic Synthesis Using P1 or SN DSN Flux or Adjoint in Slab, Cylinder, or Spherical Geometry", MND-C-2460, 1961.

(7) Material Available:
1. SYNFAR-01 Binary Deck.
2. SYNFAR-01 Tape (2 files).
   File 1 Nuclear Data Tape (Binary).
   File 2 Source Listing (BCD).
3. Sample Problem Input Decks.
   Sample Problem Output Listings.
4. MND-C-2460.

Notes: 1. The above information was taken from Reference 1.
2. This code was contributed through the Argonne Code Center.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.1.001

MASCOT (Modified Assembly System COnverted to Tape)

Aaron C. Williams
IBM
340 Market Street
San Francisco 11, California

Purpose: This program is a variation of the 1401 SPS - 1 system that uses magnetic tape to store intermediate results rather than punched cards.

Method: Source Language 1401 Symbolic Programming System.

Restrictions, Range: Reiteration is possible with MASCOT, and is necessary if the program to be assembled has over 260 labels.

Storage Requirements: Not Given.

Equipment Specifications: 4K Model C 1401 with High - Low - Equal Compare, six sense switches and advanced programming.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.1.003

CARAT I
Aaron C. Williams & Jackson McElmell

Direct Inquiries to: Mr. Aaron C. Williams
IBM Corporation
340 Market Street
San Francisco 11, California

Purpose/Description: CARAT I automates the 1401 SPS Assembly process. It allows the user to assemble a number of source programs sequentially as they are "stacked" in the 1402 Card Reader, without subsequent card handling or operator intervention. The output "object program" can be prepared in the form of punched cards, magnetic tape or both.

Method: N/A

Restrictions/Range:

1. A maximum of 260 labels per program assembled.
2. Each program to be assembled must have a CTL and END card.
3. The CTL card should not specify a 1.4K processor.

Storage Requirements: N/A

Equipment Specifications: 4K Model C Tape System with Store B-Address Register feature, and High-Low-Equal compare, 3 Model 729 or 7330 Tape Drives.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.1.004

CARAT II
Aaron C. Williams & Margery C. Rendahl

Direct Inquiries to: Aaron C. Williams & Margery C. Rendahl
IBM Corporation
340 Market Street
San Francisco 11, California

Purpose/Description: CARAT II automates the 1401 SPS assembly process. It allows the user to assemble a number of source programs sequentially as. they are stacked in the 1402 card reader, without subsequent card handling or operator intervention. The output, object programs, can be prepared in the form of punched cards, magnetic tape, or both.

Method: N/A

Restrictions/Range: Assembly time is reduced by at least 40%. An even greater savings accrues when assembling small decks. Post Listing from tape allows the printer to run at maximum speed during the listing operation.

Storage Requirements: A Clear Storage and Post List-Punch routine have been added to the systems tape.

Equipment Specifications: 4K model C tape system, with Store B Address Register feature, and High-Low-Equal compare. Three model 729 or 7330 tape drives.

(Continued on next column)

Additional Remarks: A companion program, CALL (Carat Assembled Logical Loader), is available for use with CARAT II. This program allows the user to load assembled programs directly from the CARAT output tape (TU#5). This makes it unnecessary to punch the object program until it is completely debugged. The CALL program also provides for patching.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.1.005

MAST (Minneapolis Assembly of SPS Two)
Richard T. Firtko

Direct Inquiries to: Mr. Richard T. Firtko
Test Center Coordinator
IBM 1401 Test Center
200 Foshay Tower
Minneapolis 12, Minnesota

Purpose/Description: This program is a variation of the 1401 SPS II Assembly Program to use magnetic tape to store the partly assembled output of PASS I rather than on punched cards. Punching will occur at the end of each iteration.

Method: Source language 1401 SPS

Restrictions/Range: Reiteration is possible with MAST, and necessary if program to be assembled has over 254 labels.

Storage Requirements: 4K minimum

Equipment Specifications: 4K Model C 1401 with no special devices, one tape unit. Additional core will allow faster assembly due to more labels processed per iteration.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.1.006

FULL MAST (Full Minneapolis Assembly of SPS Two)
Richard T. Firtko

Direct Inquiries to: Mr. Richard T. Firtko
Test Center Coordinator
IBM 1401 Test Center
200 Foshay Tower
Minneapolis 12, Minnesota

Purpose/Description: This program is a variation of the 1401 SPS II Assembly program. It is completely automatic from input, through post list, and punching. Any reiterations will be performed automatically.

Method: Source language 1401 SPS

Restrictions/Range:

1. Will handle multiple programs stacked in reader for assembly.
2. Allows reassembly of previously assembled programs.
3. Sense switch selection of one per card or condensed output.

Storage Requirements: 4K minimum.

Equipment Specifications: 4K or larger Model C 1401 with sense switches, read release, and 3 tape units. Writeup includes indication of minor changes that can be made to run without sense switches and read release.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.1.007

704 ASSEMBLY OF 1401 SPS PROGRAMS
R. Nelson

Direct Inquiries to: R. Nelson
IBM Applied Science
Albuquerque, New Mexico

Purpose/Description: To use the 704 to assemble 1401 SPS programs which include special features and revised mnemonic operating codes. Also, to be able to assemble 1401 programs before 1401 delivery.

Method: N/A

Restrictions/Range: No limit to the number of cards per program. There is a maximum of 200 symbols per program.

Storage Requirements: 8K or 32K

(Continued on next page)

Equipment Specifications: 704, 3 tapes and a card reader, and off-line card to tape, tape to card, tape to printer, or appropriate on-line simulators for the 704.

Additional Remarks: Timing - process approximately 750 cards per minute. Load and process program occupies approximately 0-30638. Input-Output to 704 is via tape only.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.2.001

SORT 1401

Mr. Hal Durette
IBM
340 Market Street
San Francisco 11, California

Purpose: To perform a two- or three-way sort on 4K to 16K 1401 utilizing the advantages of the advanced programming feature.

Method: Source Language 1401 SPS.

Restrictions, Range:

a) counts the number of blocks written in Phase 1 and checks this during all merge passes.

b) a given number of records may be sorted in 25-50% less time than if sorted by Sort 1.

c) analyst must scale blocking to equal blocking by considering number of character/record. No variable output blocking. A minimum of two records is required, however, there is room in Phase 1 to modify so that single records may be read and blocked for the internal sort.

d) padding the last block with records with blanks or nines in the control field has to be done before the sort.

e) maximum block length

	3-way	2-way
4K	560	685
8K	1500	1625
12K	2500	2625
16K	2500	3625

f) there is a provision in Phase 2 to collate a sorted reel with same specifications (record length, blocking length, control field) with the records that are presently being sorted.

g) a fixed control field of any number of characters is possible.

Storage Requirements: There are approximately 1291 positions of memory used for the Phase 1 program.

Equipment Specifications: Minimum 4K 1401 with H-L-E Compare Feature Advanced Programming Feature and 4 or 6 729 II or IV.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.2.002

1401 Generalized Merge Program for Unblocked Records
J. E. Czerkies & P. MacGregor

Direct Inquiries to: J. E. Czerkies & P. MacGregor
IBM Corporation
590 Madison Avenue
New York 22, New York

Purpose/Description: This merge program is specifically designed to merge files of any type of unblocked record on a 1401 tape system.

Method: The merge consists of two phases: the assignment phase, and the merge program.

The assignment phase initializes and optimizes the merge program on the basis of information supplied by the user on a control card.

The merge program tests, by means of a comparison loop, for the low record of those currently contained in storage. When the low record is found, it is written on the output tape, the file from which it came is read up, and the program returns to the comparison loop. Records are checked for sequence, redundancies, correct length, etc.

Restrictions/Range:	Maximum	Minimum
Number of files	5	2
Number of reels per file	9	1
Record length (Number characters)	997	10
Number of control fields	5	1
Total length of all control fields	99	1

(Continued on next column)

Storage Requirements: A minimum of 4000 positions of storage is required.

Equipment Specifications: The minimum 1401 system required is:

a) 1401 Model C
b) High-Low-Equal Compare Feature
c) Advanced Programming Features
d) Multiply-Divide Feature
e) Three (3) Tape Drives (729 II, 729 IV, 7330)

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.3.001

CARD REPORT PROGRAM GENERATOR AND AUTOCODER ASSEMBLY
J. L. Dorsey

Direct Inquiries to: Mr. J. L. Dorsey
IBM Corporation
Time-Life Building
1271 Avenue of the Americas
New York, New York

Purpose/Description: The purpose of this program is to lessen machine time required for generation and assembly of a program generated by the standard CRPG deck. Autocoder is automatically read in and assembly takes place with no card handling by the operator, (the generated symbolics are written on tape and not punched.

Mathematical Method: Does not apply

Restrictions/Range: Does not apply

Storage Requirements: Does not apply

Equipment Specifications: For generation and assembly, same requirements as for Autocoder. For execution of the generated program, any 1401 card system whose storage capacity will accomodate the program.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.3.002

1401 TAPE REPORT PROGRAM GENERATOR AND AUTOCODER ASSEMBLY
J. L. Dorsey

Direct Inquiries to: Mr. J. L. Dorsey
IBM Corporation
Time-Life Building
1271 Avenue of the Americas
New York, New York

Purpose/Description: The purpose of this program is to lessen machine time required for generation and assembly of a program generated by the standard TRPG deck. Autocoder is automatically read in and assembly takes place with no card handling by the operator, (the generated symbolics are written on tape and not punched).

Mathematical Method: Does not apply

Restrictions/Range: Does not apply

Storage Requirements: Does not apply

Equipment Specifications: For generation and assembly, same requirements as for Autocoder. For execution of the generated program, at least a 4K 1401 with one tape unit.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.3.003

GENERAL PURPOSE TAB-BACK PROGRAM
Bernard T. Smith

Direct Inquiries to: Bernard T. Smith
The Warner Brothers Company
325 Lafayette Street
Bridgeport 1, Connecticut

Purpose/Description: To provide tabulations or listings of summary cards or initial data cards for control and verification purposes.

Method: This method of instructing the machine as to the various card formats was chosen because of its simplicity and flexibility.

Restrictions/Range: This program may have the following:

(Continued on next page)

1 card A: Up to ten, eight column add field descriptions

2 card B: a) Up to ten positive, ten column add fields, or up to ten negative, eight column add fields,
b) Up to three classes of comparing of not more than ten columns for each class of comparing,
c) Up to four classes of totals.

Storage Requirements: 3479 core positions are required for this program.

Equipment Specifications: 4K, 1401 card system, with the advanced programming package, and 1403 printer.

Additional Remarks: We have found that this program is helpful in debugging sessions because it proves our summary output immediately.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.4.001

CORRECTION CARD LOADER

F. E. Johnston
IBM
2500 Central Avenue, S. E.
Albuquerque, New Mexico

Purpose: To alter a 1401 program after it is loaded. Corrections will be punched with one instrument or up to 31 characters of data per card. The instruction cards will contain the length of the instruction, location to be loaded and the instruction. The location as well as the A and B address of the instruction may be actual machine language or 4 digit addresses.

Method: Source Language SPS.

Restrictions, Range: This program is located in positions 100 through 317. This area is cleared upon reading an end card. The correction loader may be used with condensed, condensed with checking feature or one instruction per card such as SPS type cards.

Storage Requirements: Not given.

Equipment Specifications: Standard 1401 with 1400 positions of core storage. No special features needed.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.4.002

CALL (Carat Assembled Logical Loader)

Robert W. Heald
IBM
340 Market Street
San Francisco 11, California

Purpose: The CALL program loads the CARAT (1.1.002) assembled programs directly from tape into the 1401. Thus object program decks need not be punched until the programs are completely "debugged".

Method: Source Language 1401 Symbolic Programming System.

Restrictions, Range:

a) When used with CARAT, as much as 75% of the machine time required to assemble and test a program can be saved.

b) The CALL program provides for patching.

Storage Requirements: Not given.

Equipment Specifications: 4K Model C 1401 with High - Low - Equal Compare and six sense switches.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.4.003

CARD REPRODUCING AND/OR LISTING PROGRAM FOR THE IBM 1401

(Continued on next column)

F. E. Johnston
IBM
2500 Central Avenue, S. E.
Albuquerque, New Mexico

Purpose: This program may be used to reproduce cards in any manner as well as gang punching, interspersed gang punching, sequence numbering, listing or combinations of these operations.

Method: Source Language SPS.

Restrictions, Range: Not given.

Storage Requirements: Not given.

Equipment Specifications: Basic 1401 - No special features needed. 1400 positions of core storage.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.4.004

FAST - (Fourteen 0 one Automated System of Testing)

Margaret Pentaleri
IBM Eastern Region Datacenter
1271 Avenue of the Americas
New York 20, New York

Purpose: A testing procedure which permits the preparation of magnetic tape files immediately preceding the test of the program which will use them and a storage print and tape print following the test of the program. It allows for the testing of programs on a continuous basis.

Method: Through the use of simple control cards, the tape file generator, storage print and tape print can be accomplished.

Restrictions, Range: Not given.

Storage Requirements: Minimum 4000 positions.

Equipment Specifications: 132 position printer.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.4.005

TRICOM II

Dick Nichols
North American Aviation, Inc.
Dept. 92, Building 6
4300 East 5th Avenue
Columbus 16, Ohio

Purpose: This program simulates peripheral equipment as tape-to-printer and/or card-to-tape, or tape-to-card.

It allows for running tape-to-printer or card-to-tape or tape-to-card at maximum speeds allowed by the hardware.
A synchronous operation is permitted when running tape-to-printer. Card-to-tape or tape-to-card can be run with tape-to-printer but they cannot be run at the same time (reading and punching cards).

Through use of external sense switches, program recognizes which tape operation is to be executed and also the input-output mode.

Method: Tape-to-Printer Simulator - Program scans records for record marks and prints each record defined by an ending record mark or physical end record as a separate line. An indefinte number of records may occur in a block.

Card-to-Tape Simulator - With Sense Switch D and G UP all cards are assumed to be BCD and a validity check occurs if an illegal BCD character is loaded. An 80 column image is written on tape. With Sense Switch D UP and G DOWN, all cards are read in the binary mode. Column 1 is interrogated and if both a "9" punch and a "7" punch are found, a 168 character binary record is written on tape. If not, the BCD image of 84 columns is written on tape with even redundancy; although the validity of BCD characters on the card is not checked by the reader when reading in the binary mode, the 1401 checks its own reading as completely as it does in the BCD mode.

Tape-to-Punch - TRICOM II will accept either binary and/or BCD records in any mixture and punch corresponding binary or BCD images.

(Continued on next page)

Special Techniques - By using redundant instructions we can arrive at the address of a record's terminating location, e.g., "Page 4, lines 070 and 170 MCM 0742", etc.

Restrictions, Ranges: Not given.

Storage Requirements: Memory 4K. Written in SPS

TRICOM II

Equipment Specifications: Equipment: Model C3 with two tape units, advanced programming package, print storage RPQ read 8-5, 6, 7 characters (or can be loaded from console), high-low equal compare, space supression, optional column binary. Tape units 1, 2, 3; card reader; card punch; printer.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.4.006

1401 TCS (Tape Control System)

Catherine Selleck
IBM
3424 Wilshire Blvd.
Los Angeles, California

Purpose: To eliminate the necessity for coding of tape reading, writing, error, end of file and label instructions.

Method: Does not apply.

Restrictions, Range: TCS-1 provides header and trailer labels which are compatible with 7070 and 1410 IOCS. Multiple reel file operations and tape drive alternation are included.

TCS-2 Same as TCS-1 except that no header or trailer label routines are included.

The program is distributed in SPS form to be assembled with the user's program.

Any desired combination of tape drives may be used for input or output.

Storage Requirements: TCS-1 1848 memory positions
TCS-2 720 memory positions

Equipment Specifications: 1401 Model C, D, E, F 13-16, or F 23-26 Advanced Programming Package
High-Low-Equal Compare.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.4.007

FACTOR 1 Fourteen -O-One Automatically Controlled Test Optimizing Routine

Mr. T. E. Robertson
IBM Corporation
525 South Flower Street
Los Angeles 17, California

Mr. R. N. Barnes
IBM Western Region
3424 Wilshire Boulevard
Los Angeles, 5, California

Purpose: FACTOR 1 is a program testing routine, which makes possible continuous testing of any number of assembled card system 1401 Object Programs.

Method: All test output is identified by test program title on the printer and in the punch stackers. Stacker identification cards also indicate the number of the stacker selected (NP, 4, 8/2). At the end of each program test an automatic storage print out with word marks, in 100 position increments is provided.

Restrictions, Range: Card programs only, with total memory not exceeding 3700 positions.

Storage Requirements: Factor is stored in the upper 300 positions of 4K 1401.

Equipment Specifications: 1401 4K, 1402, 1403

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.4.008

BINARY TAPE DUMP

F. J. X. Berckman
Westinghouse Electric Corporation
Steam Division, B. Plant, Room 410
Lester, Pennsylvania

Purpose: This program provides the ability to dump a binary tape in octal equivalent. The printed result is in word blocks with eight blocks to a line.

Method: Does not apply.

Restrictions, Range:

a) Variable length records acceptable. Maximum length decoded is 2200 characters or 366 words.
b) Single or double spacing available (SSB).
c) Record count and character count per record message is available with each record (SSC).

Storage Requirements: Not given.

Equipment Specifications: 1401 Standard Model C3, Two Tapes, column binary, advanced programming package, High-Low-Equal Compare. Sense Switches (optional).

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.4.009

ZIP (Instant Printing)
Keith Swan

Direct Inquiries to: Keith Swan
Southern Permanente Services
143 South Alvarado Street
Los Angeles 57, California

Purpose/Description: A utility load and go program for listing cards at a rate of 600 lines per minute.

Method: Source language SPS

Restrictions/Range: 10 fields of any size can be listed. Field 10 can be accumulated up to 12 positions and edited. Without control cards, an 80-80 list is obtained. Card count, limited page headings, and page numbering are included.

Storage Requirements: N/A

Equipment Specifications: Read release and print buffer required for any 2K or larger 1401.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.4.010

ESCAPE (Effortless System of Calculating and Printing Everything)
W. J. Teagarden

Direct Inquiries to: W. J. Teagarden
Southern Permanente Services
143 South Alvarado Street
Los Angeles 57, California

Purpose/Description: A utility program which provides rapid conversion of 604, 602, and 528 jobs to the 1401. This load and go program also may be used to reproduce cards as well as gang punching, selective reproducing, sequence numbering, listing or combinations of these operations. Combines the functions of the previously published Card Reproducing and/or Listing Program (1.4.003) and BANG I and II (10.2.002) without the restrictions of BANG I and II.

Method: Source language SPS

Restrictions/Range: Three separate routines (or two card routines and end-of-file routine) may be developed. The effective working storage of the object program is comprised of 20 counters and 20 storage units of ten positions each. Multiplication and division can be executed only from counters.

Storage Requirements: Approximately 1800 positions of core are available to build the three routines of 1,000 positions, 500 positions and 300 positions.

Equipment Specifications: 4K 1401. Punch feed read, multiply-divide and High-low-equal compare features are required if program is completely used.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.4.011

FITS (Fourteen-O-one Input-output Tape-control System)
R. J. Macartney

Direct Inquiries to: R. J. Macartney
IBM Corporation
6252 East Telegraph Road
Los Angeles 22, California

Purpose/Description: This program supplies Open, Close, Get, and Put closed subroutines to users awaiting the full IOCS package for 1401 Autocoder. In addition, it supplies the advantages of an IOCS compatable package to users who are unable to assemble Autocoder due to their system's configuration (less than 4 tape drives).

Method: FITS has been written in two source languages, aimed at the two groups mentioned in the "Purpose" paragraph. FITS I is written in 1401 Autocoder. FITS II is written in SPS II.

Restrictions/Range:

1. Since the header labels are processed in the punch area, the use of Punch Feed Read requires patching.
2. Writing is in the Move Mode only.
3. Header and trailer labels are always written on the output files.
4. Input files are acceptable with or without header labels.
5. The FITS subroutines provide the following:

   A. Open:

      1. Input File: Checks file ID name and reel number.
      2. Output File: Checks creation date and retention cycle.
      3. Writes Output header label.

   B. Get

      Places the next record in a work area for use by the program. All tape reading, deblocking, error routines and end of reel conditions are taken care of by the subroutine.

   C. Put:

      Moves each record sequentially from a work area to a blocking area, automatically writing to tape when the blocking area is full. All error routines are taken care of by the subroutine. A trailer label is written, a status card is punched, and a new reel is opened when an end of reel condition occurs.

   D. Close:

      Processes the end of file trailer label and removes the tape from use.

Storage Requirements: Approximately 1370 positions.

Equipment Specifications: 1401 Model C, D, E, F 13-16, or F 23-26.
Advanced Programming Package
High-Low-Equal Compare

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.4.012

SCOOP I and II
Robert E. Engelson & Louis P. Poulin

Direct Inquiries to:

Mr. Robert E. Engelson	Mr. Louis P. Poulin
IBM Corporation	California-Western States
1215 - 15th Street	Life Insurance Company
Sacramento, California	2020 L Street
	Sacramento 4, California

Purpose/Description: To provide a simple method of converting 90 column (or other) cards in descending sequence to 80 column cards (or magnetic tape) in ascending sequence.

Method: The user of SCOOP specifies in Column Control Cards each column to be translated FROM and TO. A Translation Table control card permits complete control over character translation. The user must program his own output routine and assemble it with SCOOP. Program Exit and Entry points have been provided for this purpose.

Restrictions/Range: Field tests and actual customer conversion usage have proven that unverified 90 column round hole cards can be accurately read in a 1402 read feed when it is properly adjusted for normal 80 column card reading. Verified 90 column cards have an elongated hole. To prove accuracy of conversion, control totals should be taken prior to translation and a control total routine should be included as part of the output routine.

Storage Requirements: 4,000 positions of storage

(Continued on next column)

Equipment Specifications: 1401 with 4,000 positions of storage and Column Binary Device. SCOOP II requires the Advanced Programming Package.

Additional Remarks: The Interchangeable Brush Block (RPQ #899287) is not required when using SCOOP.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.4.013

STRIDE - Subroutine for Translation from Remington to IBM Data Equivalent
L. E. Ohman & L. K. Pounds

Direct Inquiries to: L. E. Ohman & L. K. Pounds
1011 San Jacinto Street
Austin 1, Texas

Purpose/Description: STRIDE provides a method for converting 90-col. cards to 80 - col. cards or may be used as a sub-routine so that the 1401 can use 90-col. cards as input for a report writing program.

Mathematical Method: N/A

Restrictions/Range: N/A

Storage Requirements: 4K

Equipment Specifications: 4K 1401 with column binary feature.

Additional Remarks: STRIDE presently puts first 80 of 90 col. input into first card and last 10 into second card.

No format rearrangement is attempted but provision is made for the user to insert his own format control.

90 col. cards are read directly into the 1401 if the 45 col. brush block is available; otherwise 90 col. cards are first reproduced into 80 col. cards.

1772 locations are available for format control.

Speed is approximately 200 cpm input, dependent on output and alphabetic content.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.4.014

AUTOPIC 1401 - Automatic Personal Identification Code for the IBM 1401
Jack Melnick

Direct Inquiries to: Mr. Jack Melnick
IBM Corporation
215 West State Street
Trenton 8, New Jersey

Purpose/Description: The program will code alphabetic names of individuals and assign unique identifying data to each individual in order to simplify Alphabetic sorting, provide alphabetic characteristics to a numeric code, and identify an individual in an alphabetic list by specific individual characteristics.

Method: SPS II Language

Restrictions/Range: The running time is 98 to 148 cards per minute depending on sequence of input cards.

Storage Requirements: 8K Core

Equipment Specifications: IBM 1401, 8K Core, 2 Tapes, Hi-Low-Equal Compare

Additional Remarks: Compatible with previously announced AUTOPIC 650 for the IBM 650. General information Manual, "Unique Compatible Name Code for Alphabetic Account Numbering," form number F20-8052 and 650 Library Program 1.6.041 contain details of program. Expected alphabetic sequence of 85 - 95% perfect; no duplicates encountered thus far.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.4.015

1401 TAPE EXECUTIVE PROGRAM
H. Lee Baker

Direct Inquiries to: Mr. H. Lee Baker
The Detroit Edison Company
2000 Second Avenue
Detroit 26, Michigan

Purpose/Description: To place 1401 programs on an Executive System Tape. To select and load these programs, based on sense switch settings, to update the Executive System Tape.

(Continued on next page)

Method: Symbolic language

Restrictions/Range: See writeup

Storage Requirements: 4000 memory positions hi-lo-eq compare

Equipment Specifications: 1401 Model C-3, Two 729 Model II or IV Tape Units, 1402 Read/Punch, 1403 Printer

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.4.016

UC TPOP, TAPE TO PRINTER OR PUNCH
Paul Tani

Direct Inquiries to: Paul Tani
Union Carbide Corporation
270 Park Avenue
New York, New York

Purpose/Description: To obtain printed or punched output from a file of tape records.

Method: N/A

Restrictions/Range: Requires Advanced Programming, Column Binary, (if column binary cards are to be punched), High-Low-Equal-Compare, and Space Suppress (if this feature is to be used).

Storage Requirements: 8000 character memory

Equipment Specifications: 1401 - 8000 character memory - Autocoder

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.4.017

IBM 1401 CORE PRINTOUT ROUTINE - VARIABLE
F. F. Matthews

Direct Inquiries to: F. F. Matthews
Cleveland Datacenter
2925 Euclid Avenue
Cleveland 15, Ohio

Purpose/Description: To print the contents of core storage in a format useful for debugging. This program performs the following operations:

1. Prints the contents of the print band.
2. Prints the contents of the index registers.
3. Prints a message identifying those Sense Switches which are on.
4. Prints the contents of core storage beginning with location 300. The printout is in bands of 100 with an indication (in both machine language addressing and numerical addressing) of the address of the low order position of the band. The program substitutes an * for a groupmark. Any bands which are totally blank are not printed.
5. The program halts after printing 38, 78, 118, or 158 bands. The amount of printout obtained depends on the positioning of the control card (the last card in the deck).

Method: N/A

Restrictions/Range: By rotating the control card you designate the amount of core to be printed. Any bands which are blanks without wordmarks are automatically skipped. On the printed form a groupmark will print as an *. No distinction is possible between the two.

Storage Requirements: N/A

Equipment Specifications: IBM 1401 Model D, E, or F; Advanced Programming Package.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.4.018

STER (SIMPLE TAPE ERROR ROUTINE)
Art Christopher

Direct Inquiries to: Art Christopher
IBM Corporation
401 Grand Avenue
Oakland 10, California

Purpose/Description: To re-read or re-write tape records when errors occur using a minimum amount of storage (276 positions).

Method: Source language 1401 SPS

(Continued on next column)

Restrictions/Range: Noise records are not tested. The only alternatives are re-writing and re-reading.

Storage Requirements: 276 positions

Equipment Specifications: 1401 Tape System with Advanced Programming.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.4.019

TRAP (Tape Record Analyzer Print)
W. J. Wilson & C. L. Craig

Direct Inquiries to: W. J. Wilson & C. L. Craig
Computation Division
Huntsville Computer Center
Marshall Space Flight Center
Huntsville, Alabama

Purpose/Description: To automatically analyze and print at 600 lpm in optimum readable form the contents of a magnetic tape written in BCD mode.

Method: This program reads, analyzes and prints tape records maintaining vertical alignment of equivalent fields from record to record and block to block which avoids the staggered print pattern associated with most tape print programs. This program handles both variable and constant length, single and blocked records which may be intermixed on tape. No parameters are required as the program is completely generative. A count representing the actual position of the last character of each line printed is maintained on the right margin - print positions 129-132. To indicate the last portion of each tape record printed the notation RAPREC is appended to the left of the count. The following options are included: The ability to interrupt, to print multifile reels, and to simulate end-of-file at any time.

Restrictions/Range: Tape records of length greater than 2500 characters will have only the first 2500 characters printed.

Storage Requirements: 4K

Equipment Specifications: Advanced programming features, High, Low Equal Compare.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 1.4.020

SD 1402 (Search Program-Card Version)
Fred G. Stockton

Direct Inquiries to: Fred G. Stockton
Shell Development Company
4560 Horton Street
Emeryville, California

Purpose/Description: This program searches a deck of IBM cards (library deck), for cards which meet any (or optionally all) of a number of criteria. The criteria are specified in a simple code on set-up cards prefixed to the library deck. Matched cards are counted for the criterion which they satisfy. Optionally they may be printed, a replica may be punched, or the machine may be stopped for examination of the original card. At the end of the run a summary of the card count for each criterion is printed.

The program is used for information retrieval, especially in impromptu situations, and for descriptive statistical purposes. It can effectively simulate the searching and counting functions of the IBM 101.

Method: A "finder" card identifies those punches (of the 960 possible punches on an IBM card) which are referred to by any of the criteria. "Name" cards carry the codes for the criteria. Each coded criterion refers to all the punches on the "finder" card and may demand that a punch be present or absent, or ignore its presence or absence, or demand the presence or absence of some one of a group of punches. The program constructs a coded "signature" for each library card, and compares it with the "names" to see if there is a match. Output and other options are controlled by input indicators, or by sense switches.

Restrictions/Range: No more than 100 punches on the "finder" card, and therefore no more than 100 characters in any "name". No more than 1000 characters for all "names" together. Cards are counted separately for the first 40 criteria; card counts for higher numbered criteria are lumped together.

Storage Requirements: 3995 positions.

Equipment Specifications: 4000 core-storage positions
1403 Printer
1402 Card Read-Punch
Advanced Programming Features
High-Low-Equal Compare
Column Binary Feature
Sense Switches

Additional Remarks: The speed is 400 cards per minute for unmatched cards, for the simplest cases. At least 120 cards per minute for the slowest cases.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 2.0.001

1401 TAPE LIBRARY CONTROL SYSTEM
Robert W. Heald

Direct Inquiries to: Mr. Robert W. Heald
IBM Corporation
1215 15th Street
Sacramento 14, California

Purpose/Description: To insure the proper mounting of magnetic tapes for each machine run and to facilitate the maintenance of the tape library. To eliminate the necessity for coding tape error routines. To provide end of reel and end of file logic in a routine manner.

Method: N/A

Restrictions/Range: N/A

Storage Requirements: Approximately 2000 storage positions.

Equipment Specifications: 1401 Model C, D, E, F 13-16 or F 23-26. Advanced Programming Package, High-low-equal Compare

Additional Remarks: The program is distributed in SPS II or Autocoder forms.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 2.0.002

ASC SYSTEM (Aeronutronic Simplified Coding System)
S. Schlesinger & L. Sashkin

Direct Inquiries to: S. Schlesinger & L. Sashkin
Aeronutronic, A Division of Ford Motor Company
Ford Road
Newport Beach, California

Purpose/Description: To eliminate the requirement for hand computation using a desk calculator and sets of tables by a method which is more reliable and less costly.

Method: Does not apply

Restrictions/Range: Does not apply

Storage Requirements: 4000 positions of storage. Model C3 or E3 equipped with multiply and divide, Advanced Programming Feature, and two magnetic tape units.

Equipment Specifications: Model C3 or E3

Additional Remarks: If a program is less than 350 ASC instructions and no instruction blocks are stored on magnetic tape, then only one tape unit is needed.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 3.0.001

9 x 9 TEN MILLISECOND MULTIPLY SUBROUTINE

Mr. Richard B. Feaster & Mr. William H. Post
IBM
340 Market Street
San Francisco 11, California

Purpose: This program will multiply two nine position fields together, with sign control, in significantly less time than previous programs.

Method: Source Language SPS.

Restrictions, Range: Timing 10 ms. per multiplication.

Storage Requirements: 334 Positions.

Equipment Specifications: 1401 - any model, no special features required.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 3.0.002

SCION (Scientific 1401 Programming with Floating Point)

John Discola
IBM
9250 Wilshire Blvd.
Beverly Hills, California

(Continued on next column)

Purpose: Scion provides the programmer with closed floating point subroutines. The subroutines include the normal arithmetic operations in addition to mode-conversion type operations. The programmer is also afforded the option of utilizing one of three sizes of floating point mantissa - namely, 4, 8, and 12 digits. This gives what normally would be termed 6, 10, and 14 digit floating point. The subroutines are mapped so that modular utilization is possible in those cases where some additional memory space is needed.

Method: Source Language SPS-1
For those who prefer to code with pseudo hardware instructions, a pre-assembly program is provided that edits a source program at the SPS level and creates the required linkage for the floating point operations written in macro foam.

Restrictions, Range:
Two digit characteristic (excess-50) gives the following ranges for floating point operations.

6 digit:	$.1000 \times 10^{-50}$ to $.999 \times 10^{49}$
10 digit:	$.1000000000 \times 10^{-50}$ to $.99999999 \times 10^{49}$
14 digit:	$.1000000000000 \times 10^{-50}$ to $.999999999999 \times 10^{49}$

Accuracy: Subroutines truncate significant digits of result after normalizing.

Storage Requirements:
Total package
6 digit: positions 0333 thru 1140
10 digit: positions 0333 thru 1172
14 digit: positions 0333 thru 1204.

Scion packages are not restricted to memories larger than 4K since the Modify-Address (MA) instruction peculiar to the larger memory configurations is not used in any of the subject routines.

Index registers 2 and 3 are used by the subroutines. This should not concern the programmer because they are restored to the entry conditions at exit time. One proviso is made however, namely - that word marks are not left in their tens and units positions at entry time.

Equipment Specifications: IBM 1401 B. C. D. or E with the following special features:
1) Multiply-Divide
2) Advanced Programming Package
3) Hi-Lo-Equal Compare.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 3.0.003

SQUARE ROOT SUBROUTINE
Kenneth Johnson

Direct Inquiries to: Kenneth Johnson
Bureau of Public Roads
Department of Commerce
Washington 25, D. C.

Purpose/Description: Computes the Square Root of a single-precision fixed point 10 digit number.

Mathematical Method: Accuracy - $\pm$ 1 in units postition

Restrictions/Range: .999999999 to 999999999.

Storage Requirements: 314 positions of core storage

Equipment Specifications: Minimum 1401 with automatic multiply-divide and high, low, equal compare features.

Additional Remarks: This routine was converted directly from a modification of the routine in the original 650 manual. It can be incorporated with other programs without modification.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 3.0.004

1401 FLOATING POINT SUBROUTINES (Normalized)
H. P. Nucci

Direct Inquiries to: Hubert P. Nucci
U. S. Department of Commerce
Bureau of Public Roads
Washington 25, D. C.

Purpose/Description: Computes floating point add, add absolute, subtract, subtract absolute, multiply, and divide.

Mathematical Method: N/A

Restrictions/Range: 00 00 00 00 00 to 99 99 99 99 99

Storage Requirements: 806 cores of memory

Equipment Specifications: Any size 1401 with index registers, multiply-divide, High-Low-Equal Compare

(Continued on next page)

Additional Remarks: This package can be assembled anywhere in memory independently or as part of a program. The contents of index register number 1 are stored temporarily, and restored after operation is completed. Coding is in symbolic and can be assembled by SPS or Autocoder.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 3.0.005

1401 SIN-COS SUBROUTINE

Kenneth Johnson

Direct Inquiries to: Kenneth Johnson
U. S. Department of Commerce
Bureau of Public Roads
Washington 25, D. C.

Purpose/Description: Computes SIN and/or COS converting degrees to radians producing a nine decimal place result.

Method: Hastings Approx.: Result in location KOSIN with sign in units position.

Restrictions/Range: 000.1 to 359.9 degrees

Storage Requirements: Approximately 700 positions of core storage.

Equipment Specifications: Minimum 1401 with automatic multiply-divide and high, low, equal compare features.

Additional Remarks: This routine was converted directly from a modification of the routine in IBM Technical Newsletter No. 9 by G. R. Trimble. It can be incorporated in other programs with only modification of sample exit instructions.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 9.4.001

DIVERSITY STUDY

Henry L. Schmitz, Jr.

Direct Inquiries to: Mr. Henry L. Schmitz, Jr.
Systems Engineer-Scientific
IBM Corporation
273 State Street
Springfield, Massachusetts

Purpose/Description: Analysis of customer demand to determine the following:

1. Maximum demand for each customer
2. Maximum Coincident Demand for 1, 2, 3, --- N customers where N is the number of customers in the sample.
3. Coincidence Factors for 1, 2, 3, --- N customers

Mathematical Method: Not pertinent

Restrictions/Range: N/A

Storage Requirements: 4000 positions of storage

Equipment Specifications:
1. 3 tapes
2. Advanced programming
3. Multiply-Divide
4. High-Low-Equal Compare
5. Card input-output
6. Expanded print storage

Additional Remarks: Program handles 3 digit demand for up to 39 customers. Coincident Demand cannot exceed 4 digits.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 10.1.001

1401 LINEAR PROGRAM

Harm K. Schreur
IBM
2911 Cedar Springs Road
Dallas 19, Texas

Purpose: This program attempts to obtain a maximum functional of A unknowns in B equations.

Method: The Simplex method, such as described by Charnes, Cooper and Henderson (Wiley and Sons - An Introduction to Linear Programming) is used to obtain the Maximal.

Restrictions, Range: A 1401 Model B3 or C3 system with 4000 core storage positions. Direct multiply, divide and the high-low-equal compare features

(Continued on next column)

will accommodate a matrix, subject to the following restrictions:

$2B+B(WL)+(A+1)(B+2)WL \leq 2250$, where
B is the number of rows in the matrix,
A is the number of columns in the matrix, and
WL is the number of digits in the elements.

Storage Requirements: Not given.

Equipment Specifications: A 1401 Model B3 or C3 system with 4000 core storage positions.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 10.2.001

717/720 SIMULATION ON 1401

W. Stokes
IBM
425 Park Avenue
New York, New York

Purpose: To achieve maximum 1403 print speed while printing tapes originally prepared for "off line" use on IBM Tape 717 and 720 printers.

Method: Not given.

Restrictions, Range: Tape records must be 1000 characters or less in length. Blocked data records must be separated by a record mark. (Last data record may or may not end in a record mark).

1.) Accepts single fixed or variable length records with or without a record mark in terminal position.

2.) Accepts blocked fixed or variable length records, each data record must be separated by a record mark, however last data record may or may not have a record mark in terminal position.

3.) Number of data records per block is unlimited, however total length may not exceed 1000 characters.

4.) Files may be:
unlabeled.
labeled followed by tape records.
labeled followed by T/M followed by tape records.

5.) Multifile reels may be printed.

6.) No control cards required.

Storage Requirements: 4000 positions of memory - approximately 700 positions available for patching.

717/720 SIMULATION ON 1401

Equipment Specifications:

IBM 1401 Model C3 or D3
IBM 1402 (required only for program loading, can be tape loaded on D3)
IBM 1403 Printer Model 2
IBM 729 Tape Drive
Advanced Programming Feature #27
Print Storage (required to achieve maximum print speed) Feature #617.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 10.2.002

BANG 4 : Basic Arithmetic Notation Generator

Revision #4 with optional nondimensional Multiplication and Division subroutines.

Mr. L. Wagoner
Bendix Corporation
South Bend, Indiana

Purpose:

1.) Multiplication and/or Division - For 1401 Data Processing Systems not equipped with the Multiply - Divide optional feature, subroutines will be incorporated in the subject program by BANG to enable the user to perform multiplication and/or division.

2.) Problem Oriented Specifications: To broaden the scope of BANG without devisating from the concept of simple problem oriented

(Continued on next page)

specifications for solution of unit card algebraic equations. The object program generated by BANG requires no manual insertions, modifications or patching. This new package includes all the functions of BANG 1, 2, 3 plus the subroutine option.

Method ; An optional code has been added to the specifications cards of BANG. This code is the means of requesting BANG to include, within the generated object program, closed multiplication and division subroutines with all required entry and return linkage. If the users 1401 is equipped with the Multiply - Divide feature, he can so specify and BANG will not generate the subroutines.

Restrictions, Range: The subroutines incorporated by BANG in the object program are nondimensional in that there is no limit to the size of the product or quitient develloped. Each subroutine is completely self-initializing based on the parameters of the factors involved. At the completion of multiplication and/or division, the B-field contains the product, or quotient and remainder positioned with assocated signs exactly as though the Multiply-Divide feature had been used.

Storage Requirements: 4, 000 positions of core are required to generate object program with BANG. The generated and then assembled program will require core capacity directly related to the complexity of the problem.

Equipment Specifications: Card 1401 with 4K core; Hi-Low- Equal compare; read/punch feed; are required for BANG operations.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 10. 3. 001

1401 LESS (Least-cost EStimating and Scheduling) 4K

Lou Granato, Jim Borden, and Joe Rose

Direct Inquiries to: Lou Granato
IBM Corporation
631 Cooper Street
Camden 2, New Jersey

Purpose/Description: This program is a high speed method of determining critical path and related information. (float time etc.) for problems where scheduling is important.

Method: Not available

Ristrictions/Range: This program will handle 575 events (node points), any number of arrows (jobs). The length of the critical path cannot exceed 6 digits (999999).

Storage Requirements: 4, 000 positions of core required. Will handle 575 events in approximately ten minutes including card handling time. This is a three (3) Phase, three (3) pass program.

Equipment Specifications: Basic 1401 Card System
4, 000 positions of storage
No special features required

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 10. 3. 002

1401 LESS (Least-cost EStimating and Scheduling) 8K, 12K, & 16K

Lou Granato, Jim Borden, and Joe Rose

Direct Inquiries to: Lou Granato
IBM Corporation
631 Cooper Street
Camden 2, New Jersey

Purpose/Description: This program is a high speed method of determinining critical path and related information (float time etc.) for problems where scheduling is important.

Method: Not available

Restrictions/Range: The program will handle:

8K Memory - 985 Events*
12K Memory - 1555 Events*
16K Memory - 2125 Events*

*Any number of jobs (arrows) can be handled. Length of the critical path cannot exceed 7 digits (9999999).

Storage Requirements: 8, 12, or 16 thousand positions of core required. Will handle 1000 arrows in approximately 12 minutes including card handling time. This is/a three (3) Phase, two (2) Pass program.

Equipment Specifications:

1401 Card System with 8, 12 or 16 K memory
Multiply Divide Feature
Hi-Lo-Equal Compare

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 11. 0. 001

Solution of an Equation with Newton-Raphson's Method on the IBM 1401

Hans Johansson

Direct Inquiries to: Hans Johansson
IBM Sweden
Fack
Stockholm 30, Sweden

Purpose/Description: A demonstration program which solves the non-linear equation, $\frac{1}{\sqrt{x}} + 2 \cdot \log \left(\frac{2.51}{A\sqrt{x}} + \frac{B}{3.71} \right) = 0$ with regard to X by use of floating point arithmetic.

Mathematical Method: The Newton-Raphson's iterative method is used. All arithmetic calculations are executed in floating point arithmetic with six significant digits. The logarithm function is approximated with a formula taken from Hastings "Approximations for Digital Computers."

Restrictions/Range: N/A

Storage Requirements: 4000 Storage Positions

Equipment Specifications: IBM 1401 Model A3, B3, C3 or E3
equipped with the Expanded Print Edit feature
IBM 1402 Card Read Punch
IBM 1403 Printer Model 1

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 11. 0. 002

NUMERICAL SOLUTION OF LEGENDRE'S DIFFERENTIAL EQUATION ON THE IBM 1401

Curt Kamlin

Direct Inquiries to: Curt Kamlin
IBM Sweden
Fack
Stockholm 30, Sweden

Purpose/Description: A demonstration program which computes and tabulates the Legendre functions PI-P9

Mathematical Method: Numerical integration of Legendre's differential equation

$$(x^2 - 1)\ P_n'' + 2x\ P_n' - n\ (n+1)\ P_n = 0$$

in the interval

$$0 \leq x \leq 1$$

and for

$$1 \leq n \leq 9$$

by the Runge-Kutta 2:nd order method according to the scheme in figure 1. Intergration step: 0. 01.

Restrictions/Range: N/A

Storage Requirements: 2, 800 positions

Equipment Specifications: IBM 1401 with 4000 positions of core storage, sense switches and expanded print edit features, IBM 1402 Card Read Punch and IBM 1403 Printer, Model 1.

Additional Remarks: This program using 2, 800 storage positions computes and tabulates the Legendre functions P1-P9 in 6. 8 minutes by numerical solution of Legendre's differential equation.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 11. 0. 003

A PROGRAM FOR SOLVING SYSTEMS OF LINEAR EQUATIONS ON THE IBM 1401

Sören Nordin

Direct Inquiries to: Sören Nordin
IBM Sweden
Fack
Stockholm 30, Sweden

Purpose/Description: A program for solving linear equation systems. It is also well suited as a demonstration program.

Mathematical Method: The system of equation is solved using the elimination method. All arithmetic operations are performed in floating point numbers.

(Continued on next page)

The program includes special subroutines for floating point addition, subtraction, multiplication, and division.

Restrictions/Range: The number of digits (D) in the mantissa can be varied up to a maximum of 36. The maximum size (N) of Systems that can be handled can be calculated from the formula, (N+1 (D+2) = 999

Storage Requirements: 4,000 positions

Equipment Specifications: 1401 Model C3
1402 Card Read Punch
1403 Printer
2 tape units

IBM 1401 PROGRAM LIBRARY ABSTRACT — File Number 11.0.004

PRINTING THE CONSTANT π TO 10,000 DECIMALS AND TESTING THE RANDOMNESS OF THE DECIMALS

Knut Angstrom

Direct Inquiries to: Knut Angstrom
IBM Sweden
Fack
Stockholm 30, Sweden

Purpose/Description: A demonstration program which using the results from the famous calculation of π on the IBM 704 in Paris prints all decimals, thereby showing the high speed printing. As an optional feature the randomness of the decimals can be tested.

Mathematical Method: The randomness is tested by using a common X^2 - test.

Restrictions/Range: N/A

Storage Requirements: 1100 positions

Equipment Specifications: IBM 1401 Model C1
IBM 1402 Card Read Punch
IBM 1403 Printer
One IBM 729 Tape Unit

IBM 1401 PROGRAM LIBRARY ABSTRACT — File Number 13.1.001

1401 Tape Duplication or Compare

Dick Nichols
North American Aviation, Inc.
Dept. 92, Building 6
4300 East 5th Avenue
Columbus 16, Ohio

Purpose: This program permits multi-file duplication or Compare of Binary and BCD information. The information may be in mixed or single mode.

Method: The Tape Duplication reads in a physical record BCD and/or Binary and writes it our on another tape. With the settings of sense switches and/or control cards it will duplicate single or multifiles.

The Tape Compare reads in a physical record BCD and/or Binary from two (2) tapes and compares them character for character. When comparing these characters, a halt will occur when an unequal condition exists. A successful compare terminates with both tape units rewinding and unloading.

Restrictions: The following restrictions are applicable for this Duplicate and Compare Program.

1. When duplicating, input tape cannot exceed 3200 characters.
2. When comparing, block size input tape cannot exceed 1600 characters.
3. With a Control Card up to 999 files may be duplicated.
4. Tape drive 1 must be used for input.
5. Tape drive 2 must be used for output.
6. Control Card must follow last card of program deck.
7. If one file is to be duped or compared and sense switch "E" is used instead of control card, user cannot select file. Only the first file will dupe or compare.

Storage Requirements: Program occupies 800 positions in core. Storage requirements are any size system with the larger the system available the larger blocks can be duplicated (with little modification to program). in SPS

Equipment Specifications: Model C 3, 2 tape drives, optional column binary.

IBM 1401 PROGRAM LIBRARY ABSTRACT — File Number 13.1.002

1401 Card-to-Tape Program

C. R. Mayo, T. S. Schurman (IBM), R. F. Vorwald
McDonnell Automation Center
P. O. Box 516
St. Louis 66, Missouri

Purpose: The program was written specifically to replace the SHARE 80 x 84 board of the IBM 704 card reader. It will read cards (column binary or BCD) at full speed (800 cpm) and place them on tape with "look ahead" bits as described in the SHARE 709 Reference Manual. An "END OF FILE" Card is provided.

Method: Each card is read as a column binary card. If it has a 7-9 punch in column 1, it is treated as such; otherwise it is a Hollerith card and the normal read area is used. So that "look ahead" may be added, two cards are kept in core.

Restrictions, Range: This program has been written for a 4K machine with the read release feature, column binary read, and high-low-equal compare. One tape is required. Because each card is read as a binary card, validity checking is not in effect.

Storage Requirements: Not given.

Equipment Specifications: 1401 4K with read release feature, column binary read, and high-low-equal compare.

IBM 1401 PROGRAM LIBRARY ABSTRACT — File Number 13.1.003

1401 Tape-to-Card Program

R. F. Vorwald
McDonnell Automation Center
P. O. Box 516
St. Louis 66, Missouri

Purpose: The program was written to punch, in the first 80 columns of a card, the corresponding positions of any tape (binary or BCD).

Stops are provided at an end of file and at persistent tape read errors.

In either mode, cards are punched at 250 cpm.

Method: Each record is read and tested for error. If in error, the mode is switched. This process is repeated until either a correct read or 10 errors occur in both modes. If the read is correct, reading continues in the same mode until another error occurs.

Restrictions: The program has been written for a 4K machine with advanced programming and the punch column binary feature. It will read a record of any length and punch only the first 80 columns. One tape drive is required.

Storage Requirements: Not given.

Equipment Specifications: 1401 4K with advanced programming and the punch column binary feature.

IBM 1401 PROGRAM LIBRARY ABSTRACT — File Number 13.1.004

ACT - Automatic Checkout Technique

Robert Kanemaru

Direct Inquiries to: Lloyd W. Green
North American Aviation, Inc.
Programming Dept. 092
Los Angeles 45, California
SPring 6-3011, Ext. 3034

Purpose/Description: This is a system where a minimum amount of operator intervention is required, which also obviates the need for the programmer to be present at the computer for his run. Input data or master tapes will be created from cards as specified by the programmer thus eliminating the need to reserve or mount special input tapes for each run. The system will notify the user where the input tapes were created, give him a core dump of the object program, tape prints on whichever tapes he desires along with any printing his object program

(Continued on next page)

has produced. There are a maximum of four programs that make up this package.

Mathematical Method: N/A

Restrictions/Range: N/A

Storage Requirements: N/A

Equipment Specifications: 1401 Model C; Advanced Programming Package; One tape drive; 1402 reader; 1403 printer.

Additional Remarks: The machine language is SPS.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 13.1.005

PROGRAM AND DATA FILE SYSTEM FOR THE IBM 1401
Fred Kory

Direct Inquiries to: Fred Kory
Space Technology Laboratories Inc.
P. O. Box 95001
Los Angeles 45, California
OSborne 5-4677

Purpose/Description: This system provides a means for the generation of input tapes for an IBM 7090 using master tape files on the 1401. It also provides for the generation and updating of these files and for the maintenance of usage statistics.

Method: N/A

Restrictions/Range: N/A

Storage Requirements: N/A

Equipment Specifications: Configuration:
a. 1402 reader-punch
b. 1403 printer
c. High-low-equal compare
d. 3 tape units
e. Column binary

Additional Remarks: The alternate program on page 12 of the writeup is not included. Machine language is PEST.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 13.1.006

PUNCH A SCAT DECK
Chuck Holmes

Direct Inquiries to: June J. Watson
McDonnell Automation Center
P. O. Box 516
St. Louis 66, Missouri

Purpose/Description: To punch a SCAT symbolic deck from a magnetic tape containing an SOS assembly listing.

Method: The input tape is read initially ignoring all records until "Page 1" occurs in the proper locations. To avoid confusion of an assembly listing with another type "Job" which might have "Page 1" in the same print positions, a search is then made for alter number 1, 2 or 3 occurring in the first nonblank record. Punching of the symbolic deck then commences with the first alter number encountered. At any time that the present alter number is not exactly one more than the immediately previous alter number, a "SPACE" card is punched. Usually, the punching of a card corresponding to the previous record occurs shortly after reading the present record. This is done so that a symbol attached to the first generated instruction of a MACRO may be correctly punched in the symbolic macro-generating card. The only special considerations for a given record are whether it was generated from a Remarks ("*") card or has a "BCI" operation code. Punching of a deck will cease upon encountering an "END" card.

Restrictions/Range: The variable field of a source card must not have exceeded 57 characters; e.g., it must have originally fitted into columns 16 to 72 of the symbolic source card.

Storage Requirements: 1-99, 101-180, 401-1445

Equipment Specifications: The following special features are needed:

1. Indexing
2. Core storage greater than 1.4K
3. Punch release
4. High-Low-Equal Compare

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 13.1.007

DUMP 01
Dick Nichols

Direct Inquiries to: Dick Nichols
North American Aviation, Inc.
Dept. 92, Building 6
4300 East 5th Avenue
Columbus 16, Ohio

Purpose/Description: The purpose of this 1401 Utility is to have the facility of "Dumping" the contents of magnetic tapes; whether in BCD, or Octal equivalent if in Binary. Output listing includes file count, block count, number of characters in each block, mode of the block and contents of the block.

Method:
When initiating "DUMP 01" the tape may be moved forward or backward from its original position before printing begins. The first record read from a file is read in Binary Mode.

Restrictions/Range: The following restrictions are applicable to this program.

1. Maximum block size is: BCD-2534 characters in Binary 422+Words. Records longer than the maximum will be truncated and treated as though they were exactly 2534 characters. No indication of the truncation will be given.
2. When sense switches D through G are down switches B and C are not active.
3. Equipment - Model "C3", advanced programming package, high-low equal, Column Binary and One (1) tape drive.

Storage Requirements: Memory 4K. All programs are written in SPS.

Equipment Specifications: 1401 Model C-3

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 13.1.008

1401 PROGRAM TAPE WRITER
C. A. Irvine

Direct Inquiries to: C. A. Irvine
Space Technology Laboratories
P. O. Box 95001
Los Angeles 45, California
OS 5-4677

Purpose/Description: To write either an SPS or PEST produced 1401 absolute program on tape in a self-loading, self-starting format.

Method: The program to be written on tape is permitted to load in the normal fashion except that the transfer is not executed, but is simply read into the read area. A group-mark is inserted into 198 and memory from 001 to the first group-mark word-mark is written with word-marks on logical tape 1. If sense switch B is on, the tape is not rewound before writing, and if sense switch C is on, it is not rewound after writing.

Restrictions/Range: This program will operate on any model C 1401 which has sufficient storage for the object program. The object program may contain at most one group-mark word-mark which must be in the highest addressed cell of the program. However, this group-mark word-mark is lost when the program is loaded from tape and is replaced by a group-mark without word-mark. Thus if group-mark word-marks are required they should be constructed during execution. The program may not occupy cells 101-153 inclusive. Any word separator characters (11-7-8 punches, B-8-4-2-1 bits) will be lost during the process.

Storage Requirements: 4KC

Equipment Specifications: 1401 machine

Additional Remarks: The RW-PTWT deck is placed between the program deck and the transfer card. The "load card" button initiates the process. The resultant tape may be loaded by depressing the "load tape" button on the console, and execution is initiated automatically at the transfer card address.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 13.1.009

RGCP - REPRODUCE, GANG-PUNCH, COUNT & PRINT
B. J. Manring

Direct Inquiries to: B. J. Manring
8621 Georgia Avenue
Silver Spring, Maryland

Purpose/Description: To reproduce cards, performing operations which would otherwise entail wiring a separate reproducer board, to list cards where a reformating of the card image is desired, and to serially number cards and/or lines on a page.

(Continued on next page)

Method: The program reads a series of control cards, which set up the operations to take place. If there are errors in the control card set up, or sense switch settings, a message will print and the machine will stop at this point.

Restrictions/Range: A Punch-release instruction may be deleted by the user.

Storage Requirements: N/A

Equipment Specifications: 4K 1401, 1402, 1403 Model 2, Sense Switches B-D, Advanced programming feature, high-low-equal compare.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 13.1.010

1401 SIMULTANEOUS CARD-TO-TAPE AND/OR TAPE-TO-PRINTER
J. Oldenburg

Direct Inquiries to: J. Oldenburg
Republic Aviation Corporation
Farmingdale
Long Island, New York

Purpose/Description: RFX006 was written to take advantage of the overlap in Read Release and Print Storage.to print BCD output tapes and load mixed mode input decks onto tape as does other peripheral equipment. (Cards containing a 7-9 punch in Column 1 are considered to be binary cards.

Method:

Card-To-Tape

Each record is written and tested for tape error. If an error is detected, the tape is backspaced and rewritten five times. If the error persists, the tape is erased forward and the above sequence repeated. After three erasures, the machine Halts at location 1382. The program will not continue. (See "USAGE")

Tape-To-Printer

Each record on tape is tested for error when reading. If an error is detected, the tape is backspaced and reread. This process is repeated ten times after which a Halt occurs at Location 1586. The program will continue after printing the record if the start button is pressed. (See "USAGE")

Restrictions/Range: The program has been written for a 4K machine with Read Release and Print Storage. It will read a record of any length (only 132 characters are stored) and print 131 characters with print control and 132 characters on single space control. At the same time it will read 80 Columns from cards and put their contents plus four blanks on tape.

Storage Requirements: Read Release and Print Storage. Only 132 characters are stored.

Equipment Specifications: 4K machine

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 13.2.001

704 ASSEMBLY OF 1401 SPS PROGRAMS

R. Nelson
IBM
2500 Central Avenue S. E.
Albuquerque, New Mexico

Purpose: To use the 704 to assemble 1401 SPS programs which include special features and revised mnemonic operating codes.

Method: Source Language. SAP.

Restrictions, Range:

a) Timing - processes approximately 750 cards per minute.

b) Load and process program occupies approximately 0-30638.

c) No limit to the number of cards per program. There is a maximum of 200 symbols per program.

d) Input-Output to 704 is via tape only.

Storage Requirements: Not given.

Equipment Specifications:

a) 704, either 8K or 32K.

(Continued on next column)

b) 3 Tapes and a card reader.

c) Off-line card to tape, tape to card, tape to printer, or appropriate on-line simulators for the 704.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 13.3.001

1401 "SCRAMBLE" Peripheral Equipment Simulator

D. S. Latimore
General Electric Company
Aircraft Nuclear Propulsion Department
Cincinnati, Ohio

Purpose: To efficiently simulate all phases of peripheral equipment operation on the IBM 1401 at maximum I/O speeds with a complete, self-contained program that required a minimum of operator handling.

Method: Under normal operating conditions, SCRAMBLE performs I/O functions at maximum 1401 operating speeds, e.g.:

card-to-tape (column binary and/or Hollerith) - 800 CPM
tape-to-card (binary and/or decimal) - 250 CPM
tape-to-printer (single space or program control with buffered output option) - 600 LPM.

Each I/O subroutine is interruptible and may be restarted with minimum operator action.

Restrictions, Range: To be used primarily for supplying input to and developing output from 709/7090 computers. Requires a MOD C 1401 with advanced programming package, two tape units, high-low-equal compare, print storage, and columm binary feature. Should not be used for making 704 input tapes without minor modifications to card-to-tape subroutine. Requires 1401 memory to be cleared prior to loading (IBM two-card clear memory routine is attached to front of object deck).

Storage Requirements: Requires approximately 3900 memory locations of 4K 1401.

Equipment Specifications: Requires approximately 3900 memory locations of a 4K 1401. Error conditions are handled by the program. As far as practical, IBM Applied Programming tape error philosophy is employed.

IBM 1401 PROGRAM LIBRARY ABSTRACT File Number 14.0.001

1401 PLOT I

G. S. Ingersoll
IBM
9250 Wilshire Blvd.
Beverly Hills, California

Purpose: This is a program to simultaneously plot several curves twenty points to the inch both horizontally and vertically on the 1403 printer. This accuracy would satisfy the requirements of a large number of graphing problems at a relatively low cost.

Method: Source Language; 1401 SPS.

Restrictions, Range: Timing - three curves of 400 points each were plotted in less than 40 seconds.

Scaling - minimum ordinate and ordinate increment are fed to the 1401, which does the necessary scaling to the data.

Abscissa lie on the axis parallel to the forms movement and are unlimited.

Size - program and working areas lie below location 2800.

Storage Requirements: Not given.

Equipment Specifications: 1401 CPU with 4K memory, hi-low-equal compare*, multiply-divide*; 1403 Printer with ten lines per inch**, space supression, six non-standard characters.

*May be programmed.
**Desirable for output format, but not necessary to the program.

(Continued on next page)

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1.1.001

LAMP (Less Arithmetic More Programming) (CARD)
E. Matthys

Direct Inquiries to: E. Matthys
IBM Corporation
Green Bay, Wisconsin

Purpose: LAMP is a revised version of SPS II for card I/O. It was designed specifically for commercial applications requiring more than the 312 symbols allowed by SPS II for assemblies on a 20K 1620. LAMP allows 670 symbols and will reduce assembly time by up to 35%.

Mathematical Method: Does not apply

Restrictions, Range: LAMP will accept any SPS II statement with the following exceptions:

1. DAS, DSB, DNB, DN, DNTY, and DNCD
2. RN and RA (User must specify RNCD, RNTY, RACD, RATY)
3. BP, BN, BZ, BNP, BNN, and BNZ (User must use instead BH, BL, BE, BNH, BNL, BNE)
4. BV, BNV, BC1, BC2, BC3, BC4 and BNC1, BNC2, BNC3, BNC4 (User must use BI and BNI)
5. The TDM instruction will be assembled with a flag in position 7.
6. The input for both pass 1 and pass 2 must be from card.
7. All references to subroutines have been eliminated.
8. Error 1 and Error 7 have been eliminated.
9. Checking for record marks in label and op. code fields has been eliminated.

Storage Requirements: Processor occupies all of memory.

Equipment Specifications: 20K; 1620 and 1622.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1.2.001

PROGRAM LOADERS (Card)
R. E. Boss & W. W. Marks

Direct Inquiries to: R. E. Boss
W. W. Marks
Systems Engineering
3424 Wilshire Boulevard
Los Angeles 5, California

Purpose/Description: Program Loader for the IBM 1620 with card input.

Mathematical Method: N/A

Restrictions/Range: N/A

Storage Requirements: Not given

Equipment Specifications: 20K 1620 with I/A for one of the two loaders listed.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1.2.002

RELOCATING LOADER (Tape)
W. J. Richards

Direct Inquiries to: W. J. Richards
Pettijohn Engineering Co. Inc.
4145 N.E. Cully Boulevard
Portland, Oregon

Purpose/Description: To load SPS programs of a specified type into arbitrary locations in memory.

Method: N/A

Restrictions/Range: Programs must not include SPS subroutines, have flags in the middle of P or Q fields, nor have constants exactly 12 digits in length. One change is required in the SPS processor.

Storage Requirements: Locations 19980 - 00399

Equipment Specifications: Paper tape, Memory 20K, and no other special features required.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1.4.001

SELECTIVE TRACE (CARD)
W. H. Jefferys

Direct Inquiries to: W. H. Jefferys
Van Vleck Observatory
Wesleyan University
Middletown, Conn.
DI 7-4421 ext. 303

Purpose/Description: This program provides a detailed listing of the operations executed during the running of a program which is being debugged. Indirect addresses are completely traced. The mnemonics for the commands are printed. The programmer specifies, by two numbers input to the routine, which instructions he wants traced. Outside of the specified range the instructions are executed, but not printed. In this manner already debugged portions of the program and routines such as the floating point subroutines can be run through at high speed. Several options as to the mode of tracing are provided.

Mathematical Method: Not Applicable.

Restrictions, Range: Console Switch #4 cannot be interrogated by the traced program without special (but trivial) modification of the program.

Storage Requirements: 2366 locations.

Equipment Specifications: Any 1620 with indirect addressing.

Additional Remarks: Of the 2366 locations, all but one are completely relocatable. The digit with label DIGIT must be at the end of a memory module. The routine is written in SPS except for the symbol table, which cannot be compiled with the SPS processor. Provision is provided for relocation in the form of a program which will punch standard SPS constant cards for the symbol table. These cards may be inserted in the object deck as produced by SPS, which may be compressed, if desired. It is possible to include optional instructions such as 71-MF, etc., without difficulty. The program has been written for card I/O only.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1.4.002

TRACE PROGRAM FOR THE IBM 1620 WITH CARD INPUT/OUTPUT (Card)
Ralph L. Miller

Direct Inquiries to: Ralph L. Miller
IBM Corporation
618 S. Michigan Avenue
Chicago 5, Illinois

Purpose/Description: Output of one card per instruction executed showing instruction, its address, and P, Q, and general products field (where applicable).

Method: Not available

Restrictions/Range: Not available

Storage Requirements: 1139 core locations -- relocatable SPS

Equipment Specifications: Memory 20K, and no other special features required.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1.4.003

1620 MULTI-TRACE (Card)
Jim Moore

Direct Inquiries to: Jim Moore
IBM
2145 Highland
Birmingham, Alabama

Purpose/Description: Virtually eliminates tedious debugging. A mere scan of MULTI-TRACE output will turn up a majority of user errors. Complete tracing versatility in one program. Card or typed output yields before and after snapshots of data as well as effective addresses if indirect. Sense switch control of address stop, full or branch trace, elimination of BT subroutines, and typed or card output.

Mathematical Method: Each traced instruction selects its own output format.

(Continued on next page)

Restrictions, Range: Will not properly handle more than 5 digits in an immediate command. Record mark encountered in instruction or data will result in short line if typed. No such restriction in card mode.

Storage Requirements: 3720 positions.

Equipment Specifications: 20K card 1620 with IDA

Additional Remarks: Program largely made up of subroutines. Easily expanded to any size memory. One digit change for adaptation to paper tape. The speed is full punch with output, otherwise about 7 instructions per second. The source language--SPS - completely relocatable. Also included are 4 table cards.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1.4.004

STROBIC - Skelly Trace Routine with Option on Branch and transmit and Indirect address Conversion (Card)
O. R. Boyer & K. R. Tieman

Direct Inquiries to: O. R. Boyer
K. R. Tieman
Skelly Oil Company
Accounting Department - Computer Programming Unit
P. O. Box 1650
Tulsa, Oklahoma
LUther 4-2311, Extension 634

Purpose/Description: STROBIC is a full trace routine for the 1620 computer equipped with a 1620 card read/punch unit and the indirect addressing special feature. STROBIC will trace the automatic divide, the indirect address feature, and the transfer numeric strip/move flag/transfer numeric fill instruction package.

Mathematical Method: N/A

Restrictions/Range: N/A

Storage Requirements: 2,434 positions

Equipment Specifications: Computer: IBM 1620, card input/output. Special features: Must have indirect addressing special feature.

Additional Remarks: Language: 1620 S.P.S.. Entry: Console. Output: Punched cards, one card for each traced instruction.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1.4.005

TRACE AND IA SIMULATOR (Tape)
Charles E. Berry

Direct Inquiries to: Charles E. Berry
IBM Corporation
1212 S.W. 6th Avenue
Portland, Oregon
CA 8-6623

Purpose/Description: To simulate a 1620 program written with or without indirect addressing and type out instructions and data fields at user's option. Traces all instructions. Types address chains. Output format selected by operation code - may be digit, field, or record. User may execute portions of program at full speed with return to trace at a predetermined instruction.

Method: Not applicable

Restrictions/Range: Cannot re-enter trace made from automatic mode internal to a BT-BB pair.

Storage Requirements: 2613 plus 20 at the end of memory

Equipment Specifications: Memory 20K, 40K, 60K, Automatic Divide and Paper Tape. No other special features required.

Additional Remarks: Relocatable.. Immediate fields may be 12 digits long. Record marks internal to fields or to instructions are acceptable. Typewriter control commands are not executed while in type mode. In non-type mode all typewriter commands are executed normally.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1.4.006

1620 MULTI-TRACE (Tape)
Jim Moore

Direct Inquiries to: Jim Moore
IBM Corporation
2145 Highland
Birmingham, Alabama

Purpose/Description: Virtually eliminates tedious debugging. A mere scan of MULTI-TRACE output will turn up a majority of user errors. Complete tracing versatility in one program. Card or typed output yields before and after snapshots of data as well as effective addresses if indirect. Sense switch control of address stop, full or branch trace, elimination of BT subroutines, and typed or card output.

Mathematical Method: Each traced instruction selects its own output format.

Restrictions, Range: Will not properly handle more than 5 digits in an immediate command. Record mark encountered in instruction or data will result in short line if typed. No such restriction in card mode.

Storage Requirements: 3720 positions.

Equipment Specifications: 20K tape 1620 with IDA

Additional Remarks: Program largely made up of subroutines. Easily expanded to any size memory. One digit change for adaptation to paper tape. The speed is full punch with output, otherwise about 7 instructions per second. The source language--SPS - completely relocatable.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1.5.001

FORTRAN SOURCE TAPE CORRECTOR (Tape)
D. S. Gardner

Direct Inquiries to: D. S. Gardner
General Foods Research Center
Tarrytown, New York

Purpose/Description: To correct a FORTRAN source tape; to produce a new FORTRAN source tape.

Mathematical Method: N/A

Restrictions/Range: The maximum number of changes is 105.

Storage Requirements: 1980 + I/O area

Equipment Specifications: Minimum 1620

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1.5.002

FORTRAN BUTLER (Tape)
Jack Burgeson

Direct Inquiries to: Jack Burgeson - IBM
340 S. Broadway
Akron 8, Ohio

Purpose/Description: Under sense switch control, this program accepts either typewriter or tape input and prepares either typewriter or tape output (or both). Input is 1620 Fortran statements, unaligned with respect to "card columns". Output is a tidied up statement, C (if present) in position 1, statement number (if present) in positions 2-5, statement itself in positions 7 - 72. Excessively long statements are edited by elimination of blanks to fit in positions 7 - 72 when this is possible.

The program is most useful when preparing to convert a 1620 Fortran program to some other machine by going tape to card through an 047.

Method: N/A

Restrictions/Range: N/A

Storage Requirements: N/A

Equipment Specifications: Basic paper tape 1620

Additional Remarks: The language is SPS.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1. 5. 003

TAPE EDIT (Tape)

Jack Burgeson

Direct Inquiries to: Jack Burgeson
IBM Corporation
340 S. Broadway
Akron 8, Ohio

Purpose/Description: Provision is made in this program to edit source tapes such as Fortran or SPS tapes. The operator can make changes in part or in whole, insert before or after, delete or skip over sections of the tape by choosing among several edit codes. Maximum record length checking is also done.

Method: N/A

Restrictions/Range: N/A

Storage Requirements: Uses most of storage

Equipment Specifications: Basic paper tape 1620

Additional Remarks: The language is SPS.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1.5.004

POST MORTEM DUMP FOR CARD 1620 (Card)

W. T. Gault

Direct Inquiries to: W. T. Gault
IBM Corporation
609 S. State Street
Salt Lake City, Utah

Purpose/Description: To dump portions of memory in data or instruction format for debugging at either a programmed or error halt.

Method: Does not apply

Restrictions/Range: The program destroys the multiply tables, loads its own add tables, and loads into either 402-1422 (lower memory) or 18798-19998 (upper memory). It requires either a 403 or 407 for listing the output with a 80 by 80 board.

Storage Requirements: 1020 locations

Equipment Specifications: Memory 20 K and 1622 Card Reader. No other special features required.

Additional Remarks: It operates at punch speed and is loaded after the running of a main program.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1. 6. 001

Regression Analysis Data Preparation Program for the 1620 (Tape)

T. H. Korelitz

Direct Inquiries to: T. H. Korelitz
Badger Manufacturing Company
363 Third Street
Cambridge 42, Massachusetts

Purpose/Description: This program prepares data in a form required by the RAP program written by D. N. Leeson

Method: N/A

Restrictions/Range: N/A

Storage Requirements: N/A

Equipment Specifications: Memory 20K. No other special features required.

Additional Remarks:

1. SPS language used
2. Fixed point notation
3. Running time depends on amount of data to be prepared.
4. Has been run successfully about 25 times.
5. The program occupies positions 2178-07853. Symbols and data input area are in locations 07854-12231

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1. 6. 002

1620 I D A Edit Subroutine (Tape)

Neil Lewis

Direct Inquires to: Neil Lewis
Systems Engineer-Scientific (756641)
IBM Corporation
Honolulu, Hawaii

Purpose/Description: This routine is an indirect addressing version of the 1620 Edit Subroutine 1. 6. 010.

Restrictions, Range: There are no restrictions as to the length of a record to be edited. Floating dollar signs are not handled.

Storage Requirements: 306 positions

Equipment Specifications: Tape 1620, memory 20K, 40K, 60K with Indirect Addressing, no other features required.

Additional Remarks: Language-Relocatable (Relativised) Symbolic
Running time- 30% faster than 1. 6. 010
Number of times run successfully- 100
Programming hours-two

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1.6.003

1620 AUTOPLOTTER (tape)

Bob Louden
IBM Detroit North
7700 Second Boulevard
Detroit 2, Michigan

Purpose: To provide two-color graph plotting for a tape 1620 system. The graphs are plotted off-line on an 870 system. See preliminary Autoplotter manual.

Restrictions, Range: Graph paper sizes up to 20 inches high and 100 inches wide. Accuracy plus or minus .010 inches on all points plotted. Graphs include automatic generation of all scales and labels.

Speed: Main Frame time 5 to 6 minutes; off line typing time 5 to 10 minutes.

Method: An original scanning and curve-fitting technique is used.

Storage Requirements: All 20,000 digits.

Remarks: This is an independent program and is not relocatable. The Language used is SPS.

Equipment Specifications: 20K tape, no special features. Modified 870 system used as plotter. See preliminary manual.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1. 6. 004

1620 AUTOPLOTTER (card)

Bob Louden
IBM Detroit North
7700 Second Boulevard
Detroit 2, Michigan

Purpose: To provide two-color graph plotting for a card 1620 system. The graphs are plotted off-line on an 870 system. See preliminary Autoplotter manual.

Restrictions, Range: Graph paper sizes up to 20 inches high and 100 inches wide. Accuracy plus or minus .010 inches on all points plotted. Graphs include automatic generation of all scales and labels.

Speed: Main Frame time 30 seconds to one minute; plotting time 5 to 10 minutes.

Method: An original scanning and curve-fitting technique is used.

Storage Requirements: All 20,000 digits.

Remarks: This is an independent program and is not relocatable. The Language used is SPS.

Equipment Specifications: 20K card, no special features. Modified 870 system used as plotter. See premiminary manual.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1.6.005

1620 I D A Edit Subroutine (Card)
Neil Lewis

Direct Inquiries to: Neil Lewis
Systems Engineer-Scientific (756641)
IBM Corporation
Honolulu, Hawaii

Purpose/Description: This routine is an indirect addressing version of the 1620 Edit Subroutine 1.6.010.

Restrictions, Range: There are no restrictions as to the length of a record to be edited. Floating dollar signs are not handled.

Storage Requirements: 306 postions.

Equipment Specifications: Card 1620, memory 20K, 40K, 60K with Indirect Addressing, no other features required.

Additional Remarks: Language-Relocatable (Relativised) Symbolic Running time- 30% faster than 1.6.010. Number of times run successfully - 100. Programming hours-two.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1.6.006

1620 FORCOM (Card)

Bob Louden
IBM Detroit North
7700 Second Boulevard
Detroit 2, Michigan

Purpose: To provide alphameric comments and column headings for 1620 FORTRAN, and to control tabs and carriage returns.

Restrictions, Range: A maximum of nine 40-character records may be stored in core at one time.

Speed: Essentially that of I/O instructions.

Method: None.

Storage Requirements: 990 digits.

Equipment Specifications: IBM 1620 card, any core size. No special features required.

Additional Remarks: 1620 SAY is a FORTRAN Subroutine or Independent. It is relocatable. Machine Language (24 instructions).

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1.6.007

SPS - To - FORTRAN SUBROUTINE EDIT (Tape)

C. I. Johnson
IBM Corporation
1730 Cambridge Street
Cambridge 38, Mass.

Purpose: To convert an SPS object program to the format required to include it in the subroutine library tape for FORTRAN.

It allows distribution of a program in SPS source language for use as an SPS program or as a FORTRAN subroutine.

Restrictions, Range: Does not apply.

Speed: Approximately limited by tape read and punch speed.

Method: Does not apply.

Storage Requirements: Program is always loaded between 00402 and 03569.

Equipment Specifications: Basic Tape 1620.

Additional Remarks: Programs to be edited must be written in SPS and must follow a few additional rules itemized in the write-up of the edit program.

The edit routine converts the SPS object program automatically. An optional feature is the ability to list the tape in FORTRAN subroutine form. Also optional is the ability to insert up to 1000 digits of remarks on the listing in addition to a heading including the name, date and number of the subroutine.

This program is non-relocatable.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1.6.008

1620 Fortran Input-Output Routine Using Format Control (Card)
Donald C. Willan

Direct Inquiries to: Donald C. Willan
c/o Sundstrand Aviation
2421 11th Street
Rockford, Illinois
WO 8-6811 Ext. 642

Purpose/Description: To give greater flexibility and control to Fortran Output on cards and typewriter. It is now possible to leave off unsignificant digits, have control of the decimal point, and have control of the number of words per line with no sacrifice of storage area.

Mathematical Method: Does not apply.

Restrictions/Range: The output numbers are limited to 10^8 and 10^{-8}. Four formats are available and up to 11 numbers per line can be specified in each format. Up to 25 words per line can be specified if the next format is not used. (See miscellaneous notes in writeup.)

Storage Requirements: The program occupies location 4364 to 7498.

Equipment Specifications: Card 1620, memory 20K, Indirect Addressing, and other special features required TNS, TNF, MF.

Additional Remarks: To use this program a modified subroutine deck must be used when processing a Fortran program. No changes need be made to the processor, so that the unmodified subroutine deck can be used if desired. The language used is SPS and is not relocatable. It will handle both fixed and floating point numbers on input and output.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1.6.009

SPS - To - FORTRAN Subroutine Edit (Revision) (Tape)
C. I. Johnson

Direct Inquiries to: C. I. Johnson
IBM Corporation
1730 Cambridge Street
Cambridge, Massachusetts

Purpose/Description: To convert an SPS object program to the format required to include it in the subroutine library tape for FORTRAN. It allows distribution of a program in SPS source language for use as an SPS program or as a FORTRAN subroutine.

Mathematical Method: Does not apply.

Restrictions/Range: Does not apply.

Storage Requirements: Program is always loaded between 00402 and 04429.

Equipment Specifications: Memory 20K, Paper Tape Machine. No other special features required.

Additional Remarks: Edit Routine Written In: SPS Language (1) Programs to be edited must be written in SPS and must follow a few additional rules itemized in the write-up of the edit program. (2) The edit routine produces the SPS object program automatically. An optional feature is the ability to list the tape in FORTRAN subroutine form. Also optional is the ability to insert up to 1,000 digits of remarks on the listing in addition to a heading including the name, date, and number of the subroutine. This version replaces the original #1.6.007.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1.6.010

1620 EDIT SUBROUTINE (Tape)
Neil Lewis

Direct Inquiries to: Neil Lewis
Systems Engineer - Scientific (756641)
IBM Corporation
Honolulu, Hawaii

Purpose/Description: This routine inserts a continuous series of numeric data fields into an alphameric record as specified by the programmer, leaving it ready for printing or punching. Automatic zero suppression and the ability to handle all alphameric characters are standard features. All data following a decimal point is printed. When room is provided ahead of a decimal point, the routine insures that at least one figure or zero precedes the decimal point.

(Continued on next page)

Mathematical Method: None

Restrictions, Range: There are no restrictions as to the length of a record to be edited. Floating dollar signs are not handled.

Storage Requirements: 390 positions

Equipment Specifications: Tape 1620, memory 20K, 40K, 60K. No other special features required.

Additional Remarks: Language-Relocatable (Relativised) Symbolic
Running time-extremely variable
Number of times run successfully-200
Programming Hours-5

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1.6.011

1620 EDIT SUBROUTINE (Card)
Neil Lewis

Direct Inquiries to: Neil Lewis
Systems Engineer- Scientific (756641)
IBM Corporation
Honolulu, Hawaii

Purpose/Description: This routine inserts a continuous series of numeric data fields into an alphameric record as specified by the programmer, leaving it ready for printing or punching. Automatic zero suppression and the ability to handle all alphamaeric characters are standard features. All data following a decimal point is printed. When room is provided ahead of a decimal point, the routine insures that at least one figure or zero precedes the the decimal point.

Mathematical Method: None

Restrictions, Range: There are no restrictions as to the length of a record to be edited. Floating dollar signs are not handled.

Storage Requirements: 390 positions

Equipment Specifications: Card 1620, memory 20K, 40K, 60K. No other special features required.

Additional Remarks: Language-Relocatable (Relativised) Symbolic. Running time is extremely variable. Number of times run successfully-200. Programming Hours are 5.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1.6.012

FLOAT Subroutine (Tape)
Henry L. Schmitz, Jr.

Direct Inquiries to: Henry L. Schmitz, Jr.
Systems Engineer - Scientific
IBM Corporation
Springfield, Massachusetts

Purpose/Description: To translate data from fixed point form to the internal floating point form required by the floating point subroutines of the Symbolic Programming System.

Mathematical Method: N/A

Restrictions/Range: Numbers from or - .00000000001 to or - 99,999,999,999, can be handled. The user cannot specify a power of ten to be added to the computed characteristic.

Storage Requirements: 848 positions

Equipment Specifications: Base 1620

Additional Remarks: Subroutine is applicable to either a tape or card oriented 1620.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1.6.013

FIX Subroutine (Tape)
Henry L. Schmitz, Jr.

Direct Inquiries to: Henry L. Schmitz, Jr.
Systems Engineer - Scientific
IBM Corporation
Springfield, Massachusetts

Purpose/Description: To translate data from the internal floating point form required by the floating point arithmetic and functional subroutines to a fixed point form more readily understood.

(Continued on next column)

Mathematical Method: N/A

Restrictions/Range: Handles all valid floating point numbers. No format control may be exercised by the user as to the number of positions to the left or right of the decimal to be printed. Floating point zero will be typed as O.O E51.

Storage Requirements: 820 positions

Equipment Specifications: Base 1620

Additional Remarks: Subroutine is applicable to tape or card oriented 1620.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1.6.014

1620 5-CHANNEL TAPE TRANSLATION PROGRAM (Card)
Charles R. Alancraig

Direct Inquiries to: Charles R. Alancraig, Systems Engineer
340 Market Street
San Francisco 11, California

Purpose/Description: This program will convert 5-channel tape read on the 1621 Paper Tape Reader into legitimate 1620 characters. The translation is punched on the 961 Paper Tape Punch.

Mathematical Method: N/A

Storage Requirements: N/A

Equipment Specifications: The program requires an 063 Card Controlled Tape Punch equipped with the special character device and RPQ W-97695, which actuates the eighth channel punch on the 063.

A standard 20,000 digit core 1620 is used for translation.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1.6.015

DYNAMIC DUMP (CARD)
W. T. Gault

Direct Inquiries to: W. T. Gault - IBM
609 S. State St.
Salt Lake City, Utah

Purpose/Description: To dump portions of memory during the running of a program and to return to the main program.

Mathematical Method: Does not apply.

Restrictions, Range: Labels in the main program beginning with the letters, "DUMP", must not be used when the Dynamic Dump is used as a SPS subroutine. It also requires a three instruction linkage (Macro form) to the dump routine.

Storage Requirements: 333 locations including the output area.

Equipment Specifications: Memory 20K; 1620 Card Reader.

Additional Remarks: Speed: It punches out 60 digits per card at punch speed.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1.6.016

FORTRAN MAPPER ROUTINE (Tape)
Jack Burgeson

Direct Inquiries to: Jack Burgeson - IBM
340 S. Broadway
Akron 8, Ohio

Purpose/Description: Aid in debugging and patching Fortran object program.

Method: N/A

Restrictions/Range: N/A

Storage Requirements: Uses most of storage-relocatible

Equipment Specifications: Basic paper tape 1620

Additional Remarks: The language is SPS

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1.6.017

Format Control Subroutines for 1620 Card Fortran (Fat & Cle) (Card)
William M. Fleischman

Direct Inquiries to: William M. Fleischman
Worthington Corporation
410 Worthington Avenue
Harrison, New Jersey

Purpose/Description: These subroutines permit the Fortran programmer the use of both fixed length, variable point format, the standard Fortran print routine, and variable length, fixed point format - FAT & CLE subroutine provides full interchangeability of both these modes within a single program.

Method: N/A

Restrictions/Range: FAT subroutine allows the programmer to specify the number of places to be printed before the point, the number to be printed after the point, and the number of trailing spaces to be allowed. He is limited to a maximum of nine of each. He must specify at least one place before the point. There are no other restrictions placed on the use of this subroutine.

Storage Requirements: FAT and CLE are relocatable subroutines for 1620 card Fortran and occupy 816 and 50 digits of core storage respectively.

Equipment Specifications: Memory 20K, Indirect Addressing.

Additional Remarks: These subroutines were written for 1620 card Fortran but may be easily accommodated to 1620 Fortran for tape I/O. Example Fortran Statements: FORM = FAT (421) Notes (1) "Form" could be any unused symbol
(2) 4 of (421.) specifies digits before decimal
(3) 2 of (421.) specifies digits after decimal
(4) 1 of (421.) specifies spaces between words
(5) Decimal in (421.) is essential to make a floating point number.
(6) Sign is in addition to spaces
(7) If number to be printed is too large or too small the exponent of ten is specified

CLEAR = CLE (000.)
Notes (1) This statement restores normal Fortran format
(2) Any float point number in parenthesis will achieve same result.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1.6.018

GOHOT (Generator Of Hermaphroditic Object Tapes) (Tape)
Dick Conner

Direct Inquiries to: Frank Mozina
IBM Corporation
421 Seventh Avenue
Pittsburgh 19, Pennsylvania

Purpose/Description: Gohot punches a program in self-loading, self-reproducing form. This tape, and any of its descendants, loads itself or reproduces itself, depending on the initial instruction entered at the typewriter. The program tape produced by Gohot is 20-40% shorter and 20-40% faster than the same program in SPS output form.

Method: N/A

Restrictions/Range: The program to be processed by Gohot must lie entirely within cells 00401-19999 and must use decimal arithmetic. Record marks throughout the program do not constitute an obstacle to Gohot.

Storage Requirements: 00000-00299 (tables are restored at end)

Equipment Specifications: Memory 20K, 40K, 60K, and no other special features required.

Additional Remarks: Gohot was written in actual and is not relocatable. Running time depends on the length of the program to be processed. Programming hours .25

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 1.6.019

FORTRAN II DIAGNOSTICIAN (CARD)
James Snediker, Charles Snyder, & Jack Burgeson

Direct Inquiries to: Jack Burgeson
IBM Akron

(Continued on next column)

Ed Schaefer
B. F. Goodrich, Akron

Purpose/Description: To diagnose (error check) Fortran I, Fortran II, or any subset thereof, source decks prior to compilation. Will diagnose source decks destined for:

650 (Fortransit III only)	1620
704	7070
705	7072
709	7074
1401	7080
1410	7090

Method: N/A

Restrictions/Range: N/A

Storage Requirements: 20K

Equipment Specifications: 20K Card 1620 with indirect addressing

Additional Remarks: The language is SPS with patches.
Most coding errors, such as mixed mode expressions, improperly written statements, undefined labels, missing statement numbers, improper subscripting, open DO loops, unmatched parenthesis, improper modification of DO indices within a DO loop, duplicate statement numbers, and others are picked up by this program. Provision is made for batch diagnosing.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 2.0.001

INTERPRETIVE PROGRAMMING SYSTEM (IPS) (Tape)

Lawrence C. Brown
Midwestern Regional Office
IBM Corporation
618 South Michigan Avenue
Chicago 5, Illinois

Purpose: IPS is an interpretive programming system for the 1620. The one-address interpretive language includes the commands of the Intercom System -- widely used on the Bendix G-15.

Restrictions, Range: The only subroutines supplied are sine-cosine, logarithm, exponential, square root, arctangent, and fraction selection. The single precision system carries five significant digit floating point numbers. The double precision system carries twelve significant figures.

Method: Floating arithmetic is rounded, the trancendental subroutines are truncated. Single precision subroutines are calculated by Hastings Approximations, except for square root which is done by the "odd-number subtraction" method. The double precision subroutines are done by Taylors series after suitable argument reduction. The double precision square root is done by "odd-numbered subtraction".

Storage Requirements: 20,000 digit storage.

Source Language: Written in 1620 absolute, revised version created in SPS language.

Remarks: This is an independent system, which includes relocatable subroutines but, the program is non-relocatable.

Equipment Specifications: 1620 with 20K storage, paper tape I/O. Hardware divide required for the double precision system, optional for single precision. No use is made of indirect addressing, but it will not cause any conflict if installed.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 2.0.002

INTERPRETIVE PROGRAMMING SYSTEM (IPS) (Card)

Lawrence C. Brown
Midwestern Regional Office
IBM Corporation
618 South Michigan Avenue
Chicago 5, Illinois

Abstract data for this program is identical to data for program number 2.0.005 except that this program is for the IBM 1620 card system.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 2.0.003

An Interpretive System for Performing Operations with Complex Numbers (Tape)
W. D. Glauz and J.O. Hancock
School of Aeronautical & Engineering Sciences
Purdue University

(Continued on next page)

Direct Inquiries to: W. D. Glauz
School of Aeronautical & Engineering Sciences
Purdue University
Lafayette, Indiana
92-61435

Purpose/Description: The program performs various operations with complex numbers. It is written as an interpretive system which interprets OP codes 80-99 and performs the indicated operation with floating point numbers.

Mathematical Method: N/A

Restrictions, Range: Those imposed by accuracies of SPS two pass floating point subroutines.

Storage Requirements: 402-4113 or 402-11262 including SPS Subroutines. See description page 18.

Equipment Specifications: Tape 1620; 20K; no other special features required.

Additional Remarks: Program is written to be compiled with SPS two pass compiler and subroutines. It uses floating point arithmetic and numbers must be entered in standard 60 ⊦ floating point notation. System used successfully on approximately 10 programs to date. (7/25/61)

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 2.0.004

IBM 650 Simulator Program (Card)
F. C. Toscano

Direct Inquiries to: F. C. Toscano
IBM Corporation
525 South Flower Street
Los Angeles 17, California

Purpose/Description: Simulation of the IBM 650 on the IBM 1620. It allows execution of 650 language programs in a 1620 without reprogramming.

Method: N/A

Restrictions/Range: The Simulator assumes an 80/80 numeric card input/output, with eight 10-digit words per card. The user can modify the Simulator to include simple control panel functions and alphabetic, if desired.

Storage Requirements: N/A

Equipment Specifications:

To Simulate:	Requires:
2000 word basic 650	40,000 digit 1620 with divide
4000 word basic 650	60,000 digit 1620 with divide
1000 word basic 650	20,000 digit 1620 with divide

The Simulator assumes a card I/O 1620 and a card I/O 650. Simple modifications are given in the writeup to simulate 650 card I/O by means of the 1620 paper tape and/or typewriter I/O.

Additional Remarks: The Simulator program is written in SPS, and occupies lower memory to location 09021.

Internal execution speed of simulation is approximately 3 1/2 times slower than a very well optimized 650 program. Simulator was debugged using the 650 C. E. Diagnostic Program.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 2.0.005

IBM 650 Simulator Program (Tape)
F. C. Toscano

Direct Inquiries to: F. C. Toscano
IBM Corporation
525 South Flower Street
Los Angeles 17, California

Purpose/Description: Simulation of the IBM 650 on the IBM 1620. It allows execution of 650 language programs in a 1620 without reprogramming.

Method: N/A

Restrictions/Range: This program is the tape system of the program No. 2.0.008.

Storage Requirements: N/A

(Continued on next column)

Equipment Specifications: 1620 tape system

Additional Remarks: The Simulator program is written in SPS, and occupies lower memory to location 09021.

Internal execution speed of simulation is approximately 3 1/2 times slower than a very well optimized 650 program. Simulator was debugged using the 650 C. E. Diagnostic Program.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 2.0.006

INTERPRETIVE ROUTINE FOR THE IBM 1620 (Tape)
Patricia Lussow

Direct Inquiries to: Patricia Lussow
LME
Advanced Electronics Center
Ithaca, New York

Purpose/Description: The Floating Point Interpretive Routine has been designed so that the IBM - 1620 can be operated without exhaustive knowledge of computer programming and a minimum of preparation. Routine includes arithmetic, logical input-output instructions, looping, built-in trace and a control routine for operator machine interaction.

Method: N/A

Restrictions/Range: N/A

Storage Requirements: Entire 20,000 positions of core

Equipment Specifications: Tape system, memory 20K and automatic divide. No other special features required.

Additional Remarks: Operating Procedures and Programming Instructions are designated in G. E. Technical Information series DF61ELC11 and DF61ELC72.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 3.0.001

VARIABLE FIELD SQUARE ROOT SUBROUTINE (Card)
W. H. Jefferys

Direct Inquiries to: W. H. Jefferys
Van Vleck Observatory
Wesleyan University
Middletown, Conn.

Purpose/Description: To take the square root of any number, given an arbitrary number of digits. The resulting square root has as many digits as the number input to the subroutine.

Mathematical Method: Odd-Number Subtraction Method.

Restrictions, Range: X, the number whose square root is to be taken, must be greater than or equal to zero. If it is negative, the routine will halt after printing "SQRT NEG NO", and then take the square root of /X/.

Storage Requirements: If N is the number of digits in the longest number whose square root is to be taken, the routine requires 422 + 2N digits for the Indirect Addressing version, and 530 + 2N digits for the version which does not require indirect addressing.

Equipment Specifications: There is a version for machines with indirect addressing, and another for machines without indirect addressing.

Additional Remarks: The routine is written in SPS, 2-Pass. It is completely relocatable. The numbers involved are fixed point.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 3.0.002

1620 FIXED POINT SQUARE ROOT (CLOSED) SUBROUTINE (Card)
Sarah Snook

Direct Inquiries to: Sarah Snook
IBM Corporation
Time & Life Building
1271 Avenue of the Americas
New York, New York
JU 6-2050, Ext. 348

Purpose/Description: This subroutine evaluates the square root of any fixed point number to any number (L) of places. The user may change the size of "L" at will and the subroutine will automatically adjust the size of its calculation. Reassembly is not necessary.

(Continued on next page)

Mathematical Method: Odd Integer

Restrictions, Range: The argument of the subroutine must be exactly 2 "L" digits in length. The argument will be destroyed in the course of the calculation. The "L" low order digits of the argument will be replaced by the result. The minimum value that "L" may assume is 2. The only upper bound upon "L" is the amount of storage available.

Storage Requirements: 630 locations+L+2 locations for Odd Integer field.

Equipment Specifications: Memory 20K; no other special features required.

Additional Remarks: The subroutine is supplied in symbolic form, on cards, for assembly with the user's program. It is completely relocatable. It has successfully calculated roots of numbers to as many as 2000 places. The general timing formula is the following: $T=10.5+9.66L+.580L^2$ millisecs. where L is the number of digits in the result.

IBM 1620 PROGRAM LIBRARY ABSTRACT — File Number 5.0.001

SIMULTANEOUS EQUATION PROGRAM (Tape)

D. N. Leeson
IBM
Eastern Regional Office
425 Park Avenue
New York, New York

Purpose: This program generates the solutions to a linear system of maximum size, 39 x 39.

Restrictions, Range: All arithmetic is done in 10 digit excess 50 floating point.

Method: Variation on the Gaussian elimination technique, known as the product matrix method, is employed.

Storage Requirements: For the maximum program (39), all of core is required.

Remarks: The program will yield the solution to the linear system for up to 99 constant vectors without matrix inversion.

Equipment Specifications: 1620, paper tape, 20K core. No other devices are necessary.

IBM 1620 PROGRAM LIBRARY ABSTRACT — File Number 5.0.002

SIMULTANEOUS EQUATION SOLUTION (Card)

D. N. Leeson
IBM
Eastern Regional Office
425 Park Avenue
New York, New York

Purpose: This program generates the solutions to a linear system of maximum rank 39 X 39. One may have 99 constant vectors per matrix of coefficients.

Restrictions, Range: 39 X 39

Accuracy: Rounding error for very large systems noticeable.

Speed: Variable dependent upon problem size.

Method: Calculation of the product matrix. Arithmetic; floating.

Storage Requirements: All of core is required for the maximum problem.

Equipment Specifications: 1620 with 1622 attachment. Division feature not required.

Additional Remarks: This program uses SPS Language, and is non-relocatable.

IBM 1620 PROGRAM LIBRARY ABSTRACT — File Number 5.0.003

EIGENVALUES OF REAL SYMMETRIC MATRICES ON THE 1620 DATA PROCESSING SYSTEM (card)

Neil Lewis
IBM
818 Kapiolani Blvd.
Honolulu 13, Hawaii

Purpose: Will solve for the eigenvalues and associated eigenvectors of a real, symmetric matrix to order 50.

(Continued on next column)

Restrictions, Range: The program consits of 3 basic parts.

A) Phase 1 -- a matrix loading program allowing ease of data preparation and including certain error detection features. Corrections are facilitated by direct keyboard entry of corrected records.

B) Phase 2 -- eigenvalue solution phase. Solves by a modification of the serial, threshold, Jacobi method. Eigenvalues are typed out at the conclusion of phase 2. Rate of convergence is also indicated on the typewriter. Sense switch control allows the selection of punched card output of the rotation angles to be used in phase 3.

C) Phase 3 -- solves for the N eigenvectors associated with the phase 2 eigenvalues. Vectors are printed out on the typewriter together with identifying information.

Method: Floating point arithmetic is used for all calculations in phase 2 and 3. No other subroutines are used in any of the three phases.

Storage Requirements: 20,000 positions of core storage are utilized by the program.

Source Language: Programming language is SPS.

Remarks: Eigenvalue for a 20 x 20 well behaved matrix was 40 minutes. Precision for a 20 x 20 well behaved matrix was 6 significant digits.

Equipment Specifications: Basic 1620 card system
Basic 1620 card system with direct division and indirect addressing.

IBM 1620 PROGRAM LIBRARY ABSTRACT — File Number 5.0.004

EIGENVALUES OF REAL SYMMETRIC MATRICES ON THE 1620 DATA PROCESSING SYSTEM (Tape)

Neil Lewis
IBM Corporation
818 Kapiolani Boulevard
Honolulu 13, Hawaii

Abstract data for this program is identical to data for program number 5.0.003 except that this program is for the IBM 1620 tape system.

IBM 1620 PROGRAM LIBRARY ABSTRACT — File Number 5.0.005

Evaluation of Determinants (Card)

D. N. Leeson

Direct Inquiries to: D. N. Leeson
425 Park Avenue
ERO
New York

Purpose/Description: To evaluate determinants

Mathematical Method: Crout Reduction

Restrictions, Range: The determinant may not have a rank exceeding 40 or less than two.

Storage Requirements: All of core

Equipment Specifications: Card 1620 20K core. No other devices necessary.

IBM 1620 PROGRAM LIBRARY ABSTRACT — File Number 5.0.006

MATRIX INVERSION (Tape)

Dale Anderson

Direct Inquiries to: Dale Anderson
IBM Corporation
340 S. Broadway
Akron 8, Ohio

Purpose/Description: This program will invert any non-singular square matrix of size 22 X 22 or less. Provision is made for re-inversion to check accuracy. Input is from tape or typewriter, output is on typewriter. Since this program is written in Fortran, it may be applied with equal facility to a card 1620; with minor I/O changes to any hardware accepting the Fortran language.

Method: N/A

(Continued on next page)

Restrictions/Range: Matrix must be square, of order 22 X 22 or less, non singular.

Storage Requirements: Close to all 1620 storage is used.

Equipment Specifications: Basic paper tape 1620

Additional Remarks: The language is Fortran (approximately 80 statements).

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 5.0.007

SOLUTION OF SIMULTANEOUS LINEAR EQUATIONS (Cards)
Burr Preston

Direct Inquiries to: Burr Preston
IBM Corporation
520 N. Dearborn Street
Chicago 10, Illinois
WHitehall 4-1364

Purpose/Description: This program solves sets of nonhomogeneous simultaneous linear equations and provides either printed or punched output with heading. It is designed for ease of use. Operating instructions and error messages are automatically typed. Data values are entered in free form notation as a group of digits with a decimal point. An optional power of ten may be added to each value.

Method: The Jordan method of elimination is used.

Restrictions/Range: A maximum of 26 equations in 26 unknowns may be solved. A maximum of eight significant digits per matrix element is allowed.

Storage Requirements: The entire core for 26 equations.

Equipment Specifications: Memory 20K. Card Input-Output and no other special features required.

Additional Remarks: The program is written in Fortran. All computation is done in standard Fortran single precision floating point arithmetic. Read and compute time for three equations is five seconds. Typing of the answer takes an additional seven seconds. Read and compute time for eight equations is 25 seconds with typing the answer requiring an additional 19 seconds. A test for zero divisor is included. A typewriter message indicates when a pivotal element is smaller in absolute value than a vlaue selected by the operator. At this point the solution may be continued or the next problem read in.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 6.0.001

REGRESSION ANALYSIS PROGRAM (tape)

D. N. Leeson
IBM
Eastern Regional Office
425 Park Avenue
New York, New York

Purpose: This program performs a complete regression analysis on a maximum of 24 variables.

Restrictions, Range: All arithmetic is done in 10 digit excess 50 floating point.

Method: All mathematical models are linearized, using a special technique. The Gaussian least squares technique is applied.

Storage Requirements: The program with a maximum number of variables (24) occupies all of core for a 20,000 position 1620. Speed cannot be determined due to the many configurations of the problems. The program is not relocatable.

Remarks: This program will fit nonlinear functions and surfaces. Data may be pretransformed by any one of 21 available transformations. The system is in 2 passes. Pass 1 prepares data as input to Pass 2.

Equipment Specifications: Tape 1620. 20K Core-Divide not required.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 6.0.002

REGRESSION ANALYSIS PROGRAM (card)

D. N. Leeson
IBM
Eastern Regional Office
425 Park Avenue
New York, New York

(Continued on next column)

Purpose: This program performs a complete regression analysis on a maximum o 24 variables.

Restrictions, Range: All arithmetic is done in 10 digit excess 50 floating point.

Method: All mathematical models are linearized, using a special technique. The Gaussian least squares technique is applied.

Storage Requirements: The program with a maximum number of variables (24) occupies all of core for a 20,000 position 1620. Speed cannot be determined due to the many configurations of the problems. The program is not relocatable.

Remarks: This program will fit nonlinear functions and surfaces. Data may be pretransformed by any one of 21 available transformations. The system is in 2 passes. Pass 1 prepares data as input to Pass 2.

Equipment Specifications: Card 1620. 20K. Core-Divide not required.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 6.0.003

SCRAP (Sixteen-twenty Card Regression Analysis Program) (Card)
D. N. Leeson

Direct Inquiries to: D. N. Leeson
425 Park Avenue
New York City, New York
PL 1-6060

Purpose/Description: This program performs a complete linear or non linear regression analysis for the card 1620 system. A plotback program is also included. Output of all phases is on cards for subsequent listing. A typewritten output is also available.

Mathematical Method: Gaussian Least Square Technique

Restrictions/Range: No more than 23 variables total may be processed. The linearity case y =ax+b may not be performed.

Storage Requirements: 20K for maximum program.

Equipment Specifications: Memory 20K. No other special features required.

Additional Remarks: Language - SPS for all parts. Floating point arithmetic. Nonrelocatable.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 6.0.004

STRAP (Stepwise Regression Analysis Program) (Tape)
L.S. Holmes & A. R. Colville

Direct Inquiries to: L. S. Holmes
A.R. Colville
IBM Corporation
Beaumont, Texas

Purpose/Description: STRAP is a multiple stepwise regression analysis program containing provisions for transforming input variables. It is useful in determining the relationships between the independent and dependent variables of a set of observations by an equation of the form:

$$Y = a_0 + \sum_{i=1}^{i=n} a_i x_i$$

Where Y is the dependent variable, x_i are the independent variables, and a_i are the coefficients to be determined.

Mathematical Method: N/A

Restrictions/Range: N/A

Storage Requirements: 20,000 positions

Equipment Specifications: Basic 1620, paper tape input & output.

Additional Remarks: Floating Decimal manipulations. Problem size 39 independent variables, 'any 1 of 10 dependent variables.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 6.0.005

FREQUALIZER (Tape)
Robert Axelrod

Direct Inquiries to: Paul Sanders
Statistical Services
Abbott Laboratories
North Chicago, Illinois

(Continued on next page)

Purpose/Description: This program analyzes the frequencies present in a time series by means of power spectra.

Method: Fourier transform of auto-covariance function.

Restrictions/Range: Maximum of 200 lags, any number of data points.

Storage Requirements: 20,000 digits

Equipment Specifications: Memory 20K, and no other special features required.

Additional Remarks: Running time: $(MN \quad 10M^2) / 2000$ minutes
N data points
M lags in auto-covariance function

Language: Fortran (Tape)

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 6.0.006

STEPWISE MULTIPLE LINEAR REGRESSION (Tape)
R. Bukacek & W. Galle

Direct Inquiries to: W. J. Galle
Armour & Company
Operations Research
401 N. Wabash
Chicago, Illinois

Purpose/Description: Accepts sets of observations and forms linear regressions in a stepwise fashion subject to statistical criterion (F-Test).

Method: Stepwise linear regression

Restrictions/Range: Maximum number of independent variables = 18, $1 \leq N_{ind} \leq 18$: Maximum number of dependent variables on input tape = 25 - Nind, $1 \leq N_{Dep} \leq 25 - N_{ind}$. Maximum number of independent variables which can be Apriori Suppressed from consideration in stepwise process = 15 $0 \leq \; < \leq 15$

Storage Requirements: 20K

Equipment Specifications: Memory 20K, and paper tape. No other special features required.

Additional Remarks: Restrictions above apply to 20K basic tape machine. See attached writeup for complete description and notes.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 6.0.007

Stepwise Multiple Linear Regression Analysis for the IBM 1620 (Card)
D. G. Wyman

Direct Inquiries to: D. G. Wyman
IBM Corporation
401 Grand Avenue
Oakland, California

Purpose/Description: The 1620 Stepwise Regression Analysis Program has been coded in SPS as a series of independent subroutines. Each can be assembled independently as long as the data areas are consistent. This should allow easy modification. With efficient utilization of storage, a problem of 35 variables can be run on a basic 1620. Analysis of variance is combined with Multiple Regression Analysis to control the selection of terms for an equation.

Method: By M. A. Efroymsen, Mathematical Methods for Digital Computers, Chapt. 17, ed. A. Ralston and H. Wilf

Restrictions/Range: Single precision floating point has been used throughout. 42 variables is maximum for Phase I, i.e., simple correlation matrix. 35 variables can be run in Phase II, the Stepwise solution. Any of 13 transformations can be used up to 70 per observation. Data input format must be defined by a header card.

Storage Requirements: 20,000 positions

Equipment Specifications: Memory 20K. No other special features required.

Additional Remarks: The program has been coded in SPS using SPS floating point subroutines for all of the mathematics. Programs are compiled independently and run by loading and executing the routines in sequence. Operation is continuous. About 1050 instructions are used with an additional 340 for a report generator not including SPS subroutines. Two of the eight routines use most of 20K memory.

The program is being used consistently by two card 1620 installations in the Oakland area. Cards or paper tape may be used as input/output.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 6.0.008

COMPLEX FORTRAN FOR THE 1620 (Tape)
Frank H. Maskiell

Direct Inquiries to: Frank H. Maskiell
The Pennsylvania Transformer Division
McGraw-Edison Company
Box 330
Canonsburg, Pennsylvania

Purpose/Description: The Fortran processor and subroutine tapes have been revised to utilize certain variables as complex numbers. This permits the addition, subtraction, multiplication or division of two or more complex variables by the simple instruction D = A op (B op C) ---.

Method: The complex numbers are treated in rectangular component form and the arithmetic operations accomplished by means of Fortran class A subroutines.

Restrictions/Range: The complex variable is accepted only as a floating point number.

Storage Requirements: 8600 positions are required for the subroutine package at the time of object running.

Equipment Specifications: Tape 1620, memory 20K.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 6.0.009

CORRELATING PROGRAM - UP TO 30 VARIABLES (Card)
Jack Burgeson

Direct Inquiries to: Jack Burgeson
IBM Corporation
340 S. Broadway
Akron 8, Ohio

Purpose/Description: Given M observations on N variables, the simple correlation coefficients of each variable with every other variable are found and printed.

Method: N/A

Restrictions/Range: M unlimited. N less than or equal to 30. Data cards must contain record marks in cc72.

Storage Requirements: Uses all storage

Equipment Specifications: Basic card 1620

Additional Remarks: The language is Fortran variant - has some alphabetic output and special point format.

Compiled on tape 1620 and converted through 047 to card 1620. A one digit change made in the Fortran input subroutine to read from cards instead of tape, hence, requirement for record mark in cc72 of data cards.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 6.0.010

ANALYSIS OF VARIANCE (Card)
Louis J. Granato

Direct Inquiries to: Louis J. Granato
IBM Corporation
631 Cooper Street
Camden, N. J.

Purpose/Description: Reduce the total variation in a set of data to components associated with possible sources of variability whose relative importance we wish to assess.

Mathematical Method: Sums of Squares

Restrictions, Range: Maximums of eight (8) factors, with not more than eight (8) levels per factor. Total data cannot exceed 12,935 digits.

Storage Requirements: N/A

Equipment Specifications: Basic 1620 with card I/O

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 7.0.001

POLYNOMIAL CURVE FITTING (Tape)

W. R. Graves
IBM
2640 Canal Street
New Orleans 19, Louisiana

Purpose: This program generates an approximating polynomial by the least squares technique. The equation so derived contains as many terms as necessary to bring the standard error of the dependent variable within a range specified by the user, or to fit a 15th order polynomial.

Printing of intermediate coefficients and the printing of a tabulation of observed vs calculated values of the dependent variable are under the control of program switches as is the inclusion of weighting factors.

The calculations utilize floating arithmetic with an 8 digit mantissa.

Restrictions, Range: Not given.

Method: A modified Gaussian elimination technique is used to solve the resulting set of simultaneous equations. Experimental data are recorded in standard 1620 FORTRAN format.

Storage Requirements: Not given.

Remarks: This program uses FORTRAN language.

Equipment Specifications: IBM 1620, 20K core, paper tape reader, paper tape punch. Will run on any 1620 for which FORTRAN is written.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 7.0.002

POLYNOMIAL CURVE FITTING (Card)
W. R. Graves

Direct Inquiries to: W. R. Graves
IBM
2640 Canal Street
New Orleans 19, Louisiana

Purpose/Description: This program generates an approximating polynomial by the least squares technique. The equation so derived contains as many terms as necessary to bring the standard error of the dependent variable within a range specified by the user, or to fit a 15th order polynomial.

Printing of intermediate coefficients and the printing of a tabulation of observed vs calculated values of the dependent variable are under the control of program switches as is the inclusion of weighting factors.

The calculations utilize floating arithmetic with an 8 digit mantissa.

Mathematical Method: A modified Gaussian elimination technique is used to solve the resulting set of simultaneous equations. Experimental data are recorded in standard 1620 FORTRAN format.

Restrictions/Range: Not given

Storage Requirements: Not given

Equipment Specifications: IBM 1620, 20K core, 1622 card read-punch. Will run on any 1620 for which FORTRAN is written.

Additional Remarks: This program uses FORTRAN language.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 7.0.003

1620 Fix Point Square Root (Card)
W. S. Sekscienski

Direct Inquiries to: W. S. Sekscienski, Project Engineer
University of Maryland
College Park, Maryland

Purpose/Description: To extract the square root of a 9 digit fixed point number.

Mathematical Method: N/A

Restrictions/Range: Argument must be 9 digits in length.

Storage Requirements: N/A

(Continued on next column)

Equipment Specifications: Minimum 1620, 20K, no special features.

Additional Remarks: Language SPS; Totally relocatable. This program also contains a small 13 instruction test program at the users discretion.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 7.0.004

POLYNOMIAL CURVE FIT (Tape)
Dale Anderson

Direct Inquiries to: Dale Anderson
IBM Corporation
340 S. Broadway
Akron 8, Ohio

Purpose/Description: This program fits an n^{th} degree polynomial to m sets of weighted or unweighted data points (x, y). Provision is made for processing the same set of (x, y) points through polynomials of increasing degree n. A complete evaluation is made of each fit and statistics indicating "goodness of fit" typed out.

Method: Least squares solution of simultaneous equations.

Restrictions/Range: n less than or equal to the smaller of (13, M-1). m less than or equal to 100.

Storage Requirements: N/A

Equipment Specifications: Basic paper tape 1620. Because of the coding language used, it can easily be converted to card 1620 - with I/O modifications to any hardware accepting Fortran coding.

Additional Remarks: The language is Fortran (approximately 140 statements).

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 9.2.001

1620 SUBDIVISION PROGRAM (Tape)

H. W. Van Ness
C. E. Berry
K. J. Love
IBM
1212 S. W. 6th Avenue
Portland 4, Oregon

Purpose: Compute necessary data for the subdivision of land into smaller parcels. The program starts with a closed boundry traverse and proceeds to compute all necessary curves and tangents. The design engineer then submits data for lot computations and receives complete information for staking and plotting the subdivision. Lot characteristics are checked against zoning requirements. Output includes co-ordinates of points; length and bearing of lines; length and radius of arcs; and area, depth, and width of lots.

Restrictions, Range: Up to 250 points and 25 curves may be processed at one time.

Method: Does not apply.

Storage Requirements: Four program passes are required -- utilizing all of the 20,000 positions except in Pass I and the co-ordinate type out.

Equipment Specifications: Minimum 1620. 20,000 positions of core and paper-tape input-output.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 9.2.002

CUT AND FILL (Tape)

Ben A. Shaw
IBM
690 N. Robert Street
St. Paul 1, Minnesota

Purpose: Compute grades, apply typical sections, compute slope interests, areas, and volumes when given P.V.I. Stations, Elevations, and Lengths of Vertical Curves, Typical Sections and where they are to be used, Shrinkage Factors, and Preliminary Terrain Cross Sections.

Restrictions, Range: This program does not compute horizontal curve transitions. It is limited to 30 Terrain Points/ Cross Section, Ten Typical Sections, and ten P.V.I's. The horizontal distances are to even feet, and the elevations are to tenths of a foot.

Method: Does not apply.

(Continued on next page)

Storage Requirements: 20,000 digits.

Source Language: Machine language.

Remarks: Speed: 13 to 30 seconds/cross section, depending on output.

Equipment Specifications: 1620/1621.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 9.2.003

CUT AND FILL (Card)
Ray Peck

Ray Peck
IBM-San Francisco
340 Market Street
San Francisco 11, California

Abstract data for this program is identical to data for program number 9.2.002 except that this program is for the IBM 1620 card system.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 9.2.004

WATERWAY COMPUTATIONS (TAPE)
C. E. Carlson and J. F. Feeney

Direct Inquiries to: Charles E. Carlson
Bridge Section
Wis. Highway Commission
Madison, Wisconsin
ALpine 6-4411, Ext. 471

Purpose/Description: The purpose of this program is to compute the velocity, area, and flow for an individual channel in a flow system and the average velocity, area, and flow for the entire network.

Mathematical Method: Manning's formula.

Restrictions, Range: A maximum of 25 water elevations.

Storage Requirements: See sheet.

Equipment Specifications: 1620 Tape System; Memory 20K; No Special Features Required.

Additional Remarks: Easily converted to Card System.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 9.2.005

SKEWED BRIDGE ELEVATIONS (TAPE)
J. F. Gibbons and C. E. Carlson

Direct Inquiries to: C. E. Carlson
Bridge Section
Wis. Highway Commission
Madison, Wisconsin
ALpine 6-4411, Ext. 471

Purpose/Description: The program computes slab elevations and geometry for bridge superstructures with skewed substructure units on a vertical curve with straight horizontal alignment. Horizontal and vertical geometry is found at the intersection of a chosen series of offset lines with a skewed line. These skewed lines may be at specific stations, at quarter points of spans, or at constantly incremented stations.

Mathematical Method: Not applicable.

Restrictions, Range: A maximum of fifty beams or offsets.

Storage Requirements: 20K

Equipment Specifications: 1620 Tape System; Memory 20K; No Other Special Features Required.

Additional Remarks: Input to the computer may be either paper tape or typewriter. Geometry for flared bridges may be obtained by the manipulation of input data. Provisions are made for up to 50 offsets divided into 1 to 5 groups.
Program language - FORTRAN
Run successfully about 100 times to date - August 22, 1961.
The program is easily converted to a Card System.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 9.2.006

1620 TRAVERSE ANALYSIS PROGRAM (Card)
D. T. Mitchell

Direct Inquiries to: D. T. Mitchell
IBM Corporation
Midwestern Regional Office
618 South Michigan
Chicago 5, Illinois

Purpose/Description: This program will solve traverse problems requiring balancing of misclosure or solution for unknown azimuths and/or distances. No provision is made to handle other than straight-line courses. Areas of traverses can be calculated (user's option). All possible solutions for problems are presented in the output.

Method: Standard methods outlined in writeup. All output is via the typewriter.

Restrictions/Range: All sines and cosines are calculated within 2x10-8 insuring 3-decimal place accuracy in latitudes and departures.

Storage Requirements: 20K Core is required.

Equipment Specifications: Basic 1620 without any features;

Additional Remarks: The source language is machine.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 9.2.007

1620 TRAVERSE ANALYSIS PROGRAM (Tape)
D. T. Mitchell

Direct Inquiries to: D. T. Mitchell
IBM Corporation
Midwestern Regional Office
618 South Michigan
Chicago 5, Illinois

Purpose/Description: This program will solve traverse problems requiring balancing of misclosure or solution for unknown azimuths and/or distances. No provision is made to handle other than straight-line courses. Areas of traverses can be calculated (user's option). All possible solutions for problems are presented in the output.

Method: Standard methods outlined in writeup. All output is via the typewriter.

Restrictions/Range: All sines and cosines are calculated within 2x10-8 insuring 3-decimal place accuracy in latitudes and departures.

Storage Requirements: 20K Core is required.

Equipment Specifications: Basic 1620 without any features; paper tape reader.

Additional Remarks: The source language is machine.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 9.3.001

GAS NETWORK ANALYSIS (Tape)

R. E. Edsall
IBM
5930 Hohman Avenue
Hammond, Indiana

Purpose: The analysis of a gas distribution network is necessary when a gas utility is considering the modification and/or expansion of a gas system or when an increased load on the system is contemplated. With the use of this program, such an analysis can be made for as many as 750 pipes in a low and/or medium pressure system.

Restrictions, Range: The program will handle a gas network of approximately 750 pipe sections and 250 loops. The program requires an assumed flow rate and friction factor for each pipe section as input. The flow and friction can be in any units provided the units chosen remain constant for a given network. Rather than friction, a user may specify a diameter and length of pipe section. The accuracy depends upon the tolerance factor within the program which may be changed by the user.

Speed: .3 sec/loop/iteration exclusive of input and output.

Method: Modified Hardy Cross Method.

(Continued on next page)

Storage Requirements: The maximum network requires 20,000 positions of storage. Smaller networks leave upper core available.

Remarks: This program is an independent and is relocatable by changing "DORG" statements of SPS.

Equipment Specifications: Basic paper tape system with 20,000 positions of core. Two versions of program are available--one for divide hardware and one using the divide subroutine.

Source Language: SPS.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 9.3.002

MULTICOMPONENT DISTILLATION TOWER DESIGN CALCULATIONS (Tape)

Ray N. Sauer
IBM
2601 South Main Street
Houston 2, Texas

Purpose: To estimate the distillation tower requirements for a given separation, feed rate and thermal condition; and set of relative volatilities.

Restrictions, Range: 30 components.

Method: Short cut methods of Feuske, Underwood, and Gilliland.

Storage Requirements: FORTRAN program with SPS patcher that fits within 20K.

Equipment Specifications: 1620 with paper tape and 20K memory.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 9.3.003

GAS NETWORK ANALYSIS (Card)

Direct Inquiries to: IBM Public Utility Department
Midwestern Region
618 South Michigan Avenue
Chicago 5, Illinois

Purpose/Description: With the use of this program, an analysis can be made for as many as 750 pipes in a low and/or medium pressure system with consideration given to modification and/or expansion.

Method: N/A

Restrictions/Range: See purpose

Storage Requirements: 20,000 core locations

Equipment Specifications: 1622 with Autodivide

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 9.3.004

M-100 MOMENT OF INERTIA AND CENTROID CALCULATIONS (Card)
G. J. Reed

Direct Inquiries to: R. C. Wenrick
AFC Industries Inc.
P. O. Box 1666
Albuquerque, New Mexico

Purpose/Description: This program is used to compute the Moments of Inertia, area, and Centroid of a complicated two dimensional body. The system is divided into a grid system with grid spacing and formula number for each rectangle entered as input.

Method: N/A

Restrictions/Range: The code will handle up to a maximum of 65x and 65y spaces.

Storage Requirements: 19,534 core locations.

Equipment Specifications: Memory 20K, and no other special features required.

Additional Remarks: Language is SPS. The running time is dependent on the number of grid spaces required to define the body. The time may be approximated by T = (.19) NBC 38 seconds. NBC is the number of divisions in the grid system.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 9.3.005

M-100 MOMENT OF INERTIA AND CENTROID CALCULATIONS (Tape)
G. J. Reed

Direct Inquiries to: R. C. Wenrick
AFC Industries Inc.
P. O. Box 1666
Albuquerque, New Mexico

Purpose/Description: This program is used to compute the Moments of Inertia, area, and Centroid of a complicated two dimensional body. The system is divided into a grid system with grid spacing and formula number for each rectangle entered as input.

Method: N/A

Restrictions/Range: The code will handle up to a maximum of 65x and 65y spaces.

Storage Requirements: 19,534 core locations.

Equipment Specifications: Memory 20K, and no other special features required.

Additional Remarks: Language is SPS. The running time is dependent on the number of grid spaces required to define the body. The time may be approximated by T = (.19) NBC 38 seconds. NBC is the number of divisions in the grid system.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 9.4.001

ELECTRIC LOAD FLOW PROGRAM (Tape)

Frank Mozina
Systems Engineer
IBM Corp.
421 7th Avenue
Pittsburgh 19, Pa.

Purpose: The program is designed to calculate voltages and power flows in a system of a maximum size of 150 buses and 240 lines, and allow changes to be made to the base system and be rerun.

Restrictions, Range: All calculations are done in a fixed point.

a) Net load or generation at any bus must be less than 10,000 Megawatts and Megavars.

b) The self impedance of any bus must have both R and X components of less than 1.00000 per unit.

c) The sum of squares of G and B components of self admittance of any bus must be less than 1,000,000.000 per unit.

d) The accuracy of the results may be predetermined by the operator by specifying tighter tolerance in the iterative solution.

Speed: Average time per iteration:

Time in milleseconds = 600.7 x No. of buses + 112.8 x No. of lines + 516.2 x No. of Generator Buses

Method: Solution is obtained by the Gauss-Seidel iteration method.

Storage Requirements: Full 20K memory is required, with the program broken down into 5 passes.

Source Language: SPS 2 PASS.

Remarks: This is an Independent Program and is assembled into fixed locations but is not relocatable unless reassembled.

Equipment Specifications: Basic 1620, 20K paper tape system.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 9.4.002

LOCATION OF SHUNT CAPACITORS ON RADIAL LINES (Tape)

L. S. Rankine, R. F. Steinhart
IBM
425 Park Avenue
New York, New York

Purpose: This program may be used by electric utilities engineers to compute optimum locations for shunt capacitor banks in radial distribution systems so as to minimize losses and to improve voltage. It may also be used to demonstrate one of the many ways in which digital computers may be used by utilities engineers.

(Continued on next page)

Method: This program is based upon the methods presented in the following Electrical World Articles, by L. J. Rankine.

Date	Title
October 3, 1955	Place Shunt Capacitors to Save Line Losses
December 2, 1957	Two-thirds Rule Used for Capacitors KVAR
September 26, 1960	Method of Locating Shunt Capacitors Suitable for Computer Salutions.

Restrictions, Range: Four standard capacitor bank sizes are considered.

Storage Requirements: 12,000 locations are used.

Equipment Specifications: Basic 1620 - Tape input/output.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 9.4.003

ELECTRIC LOAD FLOW PROGRAM (Card)

Frank Mozina
Systems Engineer
IBM Corporation
421 7th Avenue
Pittsburgh 19, Pennsylvania

Abstract data for this program is identical to data for program number 9.4.001 except that this program is for the IBM 1620 card system.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 9.4.004

Selection of Economic Conductor Size - Specific Case
New England Electric System Program #18 (Card)
R. H. Snow

Direct Inquiries to: R. H. Snow
New England Electric System
245 South Main Street
Hopedale, Massachusetts
GReenleaf 3-0243 Ext. 32

Purpose /Description: Given installed costs, resistances, a load forecast, unit loss costs, and other pertinent data, this program calculates cumulative present worth of total annual costs for any four conductor sizes, and prints these costs for each year for a period not exceeding 20 years, on a 1000 wire-foot basis. Results are presented in tabular form and may easily be transferred to a graph, if desired.

Mathematical Method: Repetitive calculations of present worth of loss costs plus carrying charges, cumulated yearly.

Restrictions, Range: On Page 3 of the write-up, note that the depreciation rate, fixed charge rate, interest rate, and required return are built into the program as specific values. They are, however, all on separate cards, and can be changed according to the accounting practices of the user.

Storage Requirements: About 3000 memory locations are required, exclusive of tables and subroutines.

Equipment Specifications: IBM 1620 (20 K memory) and 1622 reader.

Additional Remarks: The speed varies with number of years in load forecast, Calculations and print-out for a ten year period required about 2 minutes.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 9.4.005

Economic Conductor Size Selection by Kelvin's Law (Tape)
R. F. Steinhart

Direct Inquiries to: R. F. Steinhart
IBM Corporation
New York City, New York

Purpose/Description: To choose the conductor size that minimizes the overall cost of material and line losses.

Mathematical Method: Kelvin's Law

Restrictions, Range: Does not apply

Storage Requirements: 20 K

Equipment Specifications: Any 1620 System

Additional Remarks: FORTRAN with machine language. The speed is about 20 seconds/case.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 9.4.006

SHORT CIRCUIT ANALYSIS (Card)
George S. Haralampu

Direct Inquiries to: George S. Haralampu
New England Electric System
441 Stuart Street
Boston 16, Massachusetts
COmmonwealth 6-5800, Ext. 372

Purpose/Description: This program is to be used for the determination of current distribution constants, bus voltages, and x/r ratios under faulted conditions. This program is a one pass program, and complex network impedances are used.

Mathematical Method: Gauss-Seidel iterative method

Restrictions, Range: 33 buses and 58 lines

Storage Requirements: 20,000 digits

Equipment Specifications: Computer, IBM 1620, 20 K core, 1620 Card Reader and Punch.

Additional Remarks: The speed is approximately 1.5 seconds per bus per iteration. Negative impedances, such as those obtained in mutual equivalents, should be avoided.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 9.4.007

Short Circuit Calculations (Card)
G. S. Haralampu

Direct Inquiries to: G. S. Haralampu
441 Stuart Street
Boston 16, Massachusetts
COmmonwealth 6-5800
Extension 372

Purpose/Description: This program is to be used for the determination of current distribution constants, bus voltages, X/R ratios, and impedances to the point of fault, under faulted conditions.

Mathematical Method: The Gauss-Seidel iterative method is used to solve the nodal current equations.

Restrictions, Range: The program accommodates a system of 80 buses and 119 lines and is done in three passes. Complex impedance networks are used.

Storage Requirements: 20,000 digits

Equipment Specifications: Cards; 20 K memory

Additional Remarks: The speed is approximately 1.5 seconds per bus per iteration. The coding system used is FORTRAN. The mode of distribution are cards.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 9.4.008

TRANSMISSION LOSSES AND PENALTY FACTORS (card)
David Hayward

Direct Inquiries to: David Hayward
New England Electric System
441 Stuart Street
Boston 16, Massachusetts

Purpose/Description: This program will figure generated power, losses and received power and the penalty factor at each entry point of the system represented by the B-constant matrix. It does not figure the B-constants. They must be available to use the program.

Method: The following equations are the basis of the program

Loss = Penalty Factor =

Restrictions/Range: The program is limited to a 28 by 28 B-constant matrix

Storage Requirements: The program uses essentially the entire 20K core. The speed depends on the matrix size -- once the B-constants have been read an average case might take about 2 minutes.

(Continued on next page)

Equipment Specifications: Cards, 20K memory.

Additional Remarks: The information for this program was obtained largely from Chapter 5 of Economic Operation of Power Systems by Leon K. Kirchmayer published by John Wiley and Sons, Inc.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 9.4.009

CURVE FITTING - SIMULATED PLANT RECORD METHOD (Card)
William D. Garland

Direct Inquiries to: William D. Garland
New England Electric System
441 Stuart Street
Boston 16, Massachusetts

Purpose/Description: This program is designed to find the best fitting average life within each generalized empirical curve tried for a plant account (cf. Methods of Estimating Utility Plant Life, Edison Electric Institute, 1952).

The best of all fits derived for a series of curves (such as the Iowa curves) is selected by visually examining the output data for the least sum of squared differences between the book balances and the balances simulated for the best fit lives.

Method: A. Formula Terms:
LU = longer life assumed
LL = shorter life assumed
LC = best fit life as calculated
BO = book balances
BU = balances simulated for LU
BL = balances simulated for LL
BC = balances simulated for LC

B. Formula:

$$LC = LL + (LU - LL) \left[\frac{\Sigma(BO - BL)(BU - BL)}{\Sigma(BU - BL)^2} \right]$$

Note: Result accepted only when

$$\left[\frac{\Sigma(BO - BL)(BU - BL)}{\Sigma(BU - BL)^2} \right] \text{ is} > -.55 \text{ and} < 1.55.$$

Restrictions/Range: N/A

Storage Requirements: 9,950 - program and fixed point divide routine.

Equipment Specifications: IBM 1620 Computer with a 20K memory card and a 1622 Card Reader-Punch

Additional Remarks: The speed depends on accuracy of starting assumption given program. The best fit for one curve is nonetheless produced within a few seconds at most.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 9.6.001

STRAIN GAGE DATA REDUCTION ON THE IBM 1620 (Card)
R. C. Wenrick

Direct Inquiries to: R. C. Wenrick
ACF Industries
P. O. Box 1666
Albuquerque, New Mexico
CH 7-0361, Ext. 511

Purpose/Description: To reduce data as recorded for rectangular strain gage rosettes by the Gilmore, B and K or similar recorders.

Method: N/A

Restrictions/Range: 100 Channels of data may be reduced with one pass through the system.

Storage Requirements: About 18,000

Equipment Specifications: Memory 20K, Automatic Divide, and no other special features required.

Additional Remarks: The language is SPS. Although Indirect addressing and automatic divide features are used, very few corrections are required to enable a basic machine to process the data. The program has been used for reduction of more than 10,000 rosettes. The input has been prepared to a great extent by the tape punching facilities of the Gilmore.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 9.6.002

STRAIN GAGE DATA REDUCTION ON THE IBM 1620 (Tape)
R. C. Wenrick

Direct Inquiries to: R. C. Wenrick
ACF Industries
P. O. Box 1666
Albuquerque, New Mexico
CH 7-0361, Ext. 511

Purpose/Description: To reduce data as recorded for rectangular strain gage rosettes by the Gilmore, B and K or similar recorders.

Method: N/A

Restrictions/Range: 100 Channels of data may be reduced with one pass through the system.

Storage Requirements: About 18,000

Equipment Specifications: Memory 20K, Automatic Divide, and no other special features required.

Additional Remarks: The language is SPS. Although Indirect addressing and automatic divide features are used, very few corrections are required to enable a basic machine to process the data. The program has been used for reduction of more than 10,000 rosettes. The input has been prepared to a great extent by the tape punching facilities of the Gilmore.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 9.7.001

Distribution of Water Flow in a Pipe Network (Tape)
C. Bartholet

Direct Inquiries to: C. Bartholet
IBM Corporation
Boston, Massachusetts

Purpose/Description: This program balances the flow of water in a pipe network starting with assumed flows and produces the corrected system flows.

Mathematical Method: Hardy Cross

Restrictions, Range: Maximum of 150 pipes and 67 loops

Storage Requirements: Entire 20K memory

Equipment Specifications: As submitted to the program library, the basic paper tape 1620 is required. The FORTRAN source program in the documentation may be compiled for any configuration.

Additional Remarks: Program based on IBM 650 Program 9.7.002 entitled "Hydraulic Network Analysis." The speed is approximately one second per pipe per iteration.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 9.7.002

GENERALIZED PLOTTER II (Cards)
Jack Burgeson

Direct Inquiries to: Jack Burgeson - IBM
340 S. Broadway
Akron 8, Ohio

Purpose/Description: Given up to 180 pairs of Y values equally spaced along the X axis, this program scales them to the range 0-50 and plots them on the 1620 typewriter. Baseline indication is plotted also.

Method: Not applicable

Restrictions/Range: Up to 180 pairs of Y values

Storage Requirements: All of storage is used

Equipment Specifications: Basic card 1620

Additional Remarks: The language is Gotran

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 9.7.003

GENERALIZED PLOTTER (Cards)
Jack Burgeson

Direct Inquiries to: Jack Burgeson - IBM
340 S. Broadway
Akron 8, Ohio

Purpose/Description: Given up to 400 Y values, equally spaced along the X axis this program scales these to a range 0-50 and plots them on the 1620 typewriter. Baseline indication is plotted also.

Method: Not applicable

Restrictions/Range: Up to 400 points

Storage Requirements: Uses all storage

Equipment Specifications: Uses basic card 1620

Additional Remarks: The language is Gotran

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 9.7.004

S-100 STRESS ANALYSIS OF A FLANGE WITH A TAPERED HUB (card)
D. A. Oliver

Direct Inquiries to: R. C. Wenrick
ACF Industries Inc.
P. O. Box 1666
Albuquerque, New Mexico
CH 7-0361, Ext. 511

Purpose/Description: The discontinuity and membrane effects in a tapered hub, used to connect a flange to a thin shell, are computed.

Method: Approximations as described in ASME "Design Data and Methods;"

Restrictions/Range: The tapered hub must be "long" to give accurate results.

Storage Requirements: 18,500 core positions

Equipment Specifications: Memory 20K, Automatic Divide, and no other special features required.

Additional Remarks: Language is SPS. Running time depends on the number of increments the hub is divided into, and the number of intervals at which printed results are requested. The program can be reassembled in order to use the subroutines not requiring the divide hardware.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 9.7.005

S-109 STRESS ANALYSIS OF A FLANGED TAPERED HUB (Card)
R. C. Wenrick

Direct Inquiries to: R. C. Wenrick
ACF Industries Inc.
P. O. Box 1666
Albuquerque, New Mexico

Purpose/Description: This program can be used to size tapered sections used for damping the discontinuities produced at Flange-shell junctures or can provide stress and discontinuity levels of existing designs.

Method: Timeshenko, "Theory of Plates and Shells" and authors.

Restrictions/Range: N/A

Storage Requirements: 30,000 core locations

Equipment Specifications: 40K, Automatic Divide and no other special features required.

Additional Remarks: The program is written in SPS and utilizes three library subroutines which are the following:

1) L-109 Computation of O and 1st Order Bessel Functions
2) L-103 Floating Point Output Routine
3) L-105 Solution of Simultaneous Equations.

The running time varies between 4 and 6 minutes depending on the hub dimensions. It has been run 96 times successfully. All subroutines are included in the card deck.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 10.1.001

LINEAR PROGRAMMING FOR THE 1620 (Tape)

C. R. Nichols
IBM Corporation
9250 Wilshire Blvd.
Beverly Hills, California

Purpose: A generalized code for the solution of linear programming problems. Allows variable format input; output gives complete details of results. Optional routines allow previously solved problems to accept changed cost and/or requirement coefficients with subsequent re-solution.

Restrictions, Range: The basic 1620 with paper-tape reader is required. Program runs on any available core size, with the matrix size being limited according to the expression.

$$(M+2)(N+3) \leq \frac{(\text{Memory} - 3760)}{10}$$

Where M= number of restricting equations.
N= number of non-basis variables.
Memory = core size in digits.

All comptations are done in 2-and-8 floating point.

Speed: Speed of solution is dependent upon the size and density of the matrix being solved. A 30 by 40 matrix which is reasonably block-diagonal will require about 20 seconds per iteration.

Method: The two main routines of the program are the simplex algorithm and the "dual algorithm." All computations are in 2-and-8 floating point.

Storage Requirements: Storage locations 00012 through 03750 are occupied by sub-programs and floating point routines. The rest of memory is available for matrix storage.

Source Language: SPS.

Remarks: The program is a self-contained series of subroutines.

Equipment Specifications: Basic 1620 with 1621 paper tape reader.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 10.1.002

LINEAR PROGRAMMING CODE FOR THE IBM 1620 WITH CARD INPUT AND OUTPUT (Card)
Katherine Krieger

Ray Dietz
IBM
51-05 Queens Blvd.
Woodside 77, N. Y.

Purpose: Solves linear programming problems with output of detailed results. That is, given coefficients aij, cost coefficients cj, and requirements b_i, determine xj such that

$$aij\ xj = b_i \text{ with } x_j \geq 0$$

and

$$c_j\ x_j = \text{maximum}$$

Computations are performed by the Dual Algorithm until a feasible solution is obtained. Control is then given to the Simplex Algorithm for optimization. Cost changes and requirement changes can be made after loading original matrix or after solving original matrix.

Restrictions, Range: The size of the problem is restricted by the following relationship.

$$(m-2)\ (n-3) \geq \frac{\text{memory} - 3920}{10}$$

where: m is the number of restrictions
n is the number of non-basis independent variables
memory is 20,000, 40,000, or 60,000.

The precise time required per iteration depends on the size and density of the matrix. As an approximation, a problem with 30 equations and 40 non-basis variables requires about 20 seconds per iteration.

All computations are performed in 2-and-8 floating point form. Matrix input can be either fixed point or floating point.

Method: Not given.

Storage Requirements: Any size storage can be used. The larger the storage, the larger the problem that can be solved.

Source Language: The program is written in actual machine language.

Equipment Specifications: Basic 1620 with card input and output.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 10.1.003

TRANSPORTATION PROGRAM FOR THE IBM 1620 (Tape)

D. E. Madden
IBM
9250 Wilshire Blvd.
Beverly Hills, California

G. Smith
IBM
3424 Wilshire Blvd.
Los Angeles, California

Purpose: The program provides an optimal solution to transportation problems (special type linear programming problems) and is based on the maximal flow in networks. The cost is minimized for shipping a product from a set of sources to a set of destinations. Other applications include vehicle distribution, production scheduling, transshipment, and personnel assignment.

Restrictions, Range: Input consists of sources (M), destinations (N), and costs for shipping form sources to destinations. These values must be non-negative and five positions each. All calculations are performed in fixed-point arithmetic.

Maximum matrix sizes for 20 K core.

M	2	35	321
N	326	35	2

Speed: A 24 x 20 matrix with 44 iterations required four minutes for solution, plus I/O time. A 110 x 8 matrix required ten minutes for solution, plus I/O time.

Method: The program is based on the maximal flow in networks as proposed by Ford and Fulkerson (Management Science 3 (1): 24-32, October, 1956)

Storage Requirements: For 20,000 positions of storage, matrices may be stored of the size noted in restrictions above.

Source Lanugage: The program is coded in machine language.

Remarks: This program is a self-contained (independent) program and is non-relocatable.

Equipment Specifications: IBM 1620, 20K storage, paper tape reader, paper tape punch.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 10.1.004

MXV Program for Linear Program Matrix Preparation (Card)
E. I. Motte

Direct Inquiries to: E. I. Motte
Union Oil Company of California
Oleum Refinery
Rodeo, California
Rodeo 4411

Purpose/Description: The purpose of this program is to prepare a linear program matrix for the Nichols, Nickel, Davis Card Linear Program. Machine preparation of this matrix has the following advantages:

1. Calculation errors are eliminated.
2. The input data to the MXV has physical meaning and can readily be scanned for errors.

This program performs a matrix by vector multiplication to prepare a linear program input vector. The range of multiplication, vector number assigned to output vector, and ID of output vector are all controlled by control cards shich may be interspersed with matrix loading.

Mathematical Method: N/A

Restrictions/Range: The range of both equations and vectors can be specified for each MXV calculation. Zero elements in output vectors are not punched out.

Storage Requirements: Program stored in locations 00000 to 02690.

Equipment Specifications: IBM 1620, 20K, indirect addressing card input/output

Additional Remarks: The approximate running time is 7 minutes to produce 30 vectors which have about 40 equations. Have run program approximately 30 times successfully to 6/24/61. SPS two pass. Fixed Point calculations, input and output in form XXXX.XXXXXX. Matrix size = (M 2) (N 2) (Memory - 2690)/10. Where M = number of equations, N = number of vectors

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 10.1.005

TRANSPORTATION PROGRAM FOR THE IBM 1620 (Card)
J. N. Boles

Direct Inquiries to: James N. Boles
University of California
207 Giannini Hall
Berkeley 4, California
Thornwall 5-6000, Ext. 3349

Purpose/Description: This program is a simple adaptation of the Transportation Program for the IBM 1620 (Tape) by Madden and Smith, File No. 10.1.003. It provides an optimal solution to the linear programming transportation problem.

Mathematical Method: The method used is that of Ford and Fulkerson (Management Science 3 (1): pp. 24-32, October, 1956.

Restrictions/Range: Input data are the number of rows (sources), M, the number of columns (destinations), N, their product MN, surpluses, A_i deficits, B_j, and costs Cij. $\sum_{i=1}^{M} A_i = \sum_{j=1}^{N} B_j$. Fixed point arithmetic is used. Problem size must be such that $10\,MN + 24\,M + 19\,N \leq 14{,}566$

Storage Requirements: 20K

Equipment Specifications: Memory 20K, 1622 Card-Read-Punch; no other special features required.

Additional Remarks: Basic machine language. Fixed point arithmetic. Non-relocatable. Uses modified SPS loader for both data and program.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 10.1.006

Linear Programming Code for the Card 1620 with Punched Card Option for Final Output (Card)
Lou Davis and Art Nickel

Direct Inquiries to: Lou Davis or Art Nickel
IBM Corporation
401 Grand Avenue
Oakland 19, California
TEmplebar 4-7070

Purpose/Description: Solution of linear programming problems with output of detailed results. Given coefficients a_i j, cost coefficients c_j, and requirements b_i, determine x_j such that

$$\sum_j a_{i,j} x_j = b_i \text{ with } x_j \geqslant 0$$

$$\sum_j c_j x_j = \text{maximum}$$

Method: Computations are performed by the Dual Algorithm until a feasible solution is obtained. Control is then given to the Simplex Algorithm for optimization. Many, many things go on before this stage is reached and after. It is quite important to read the instructions for order of program input (Appendix A) and data input carefully.

a. Accuracy: All computations are performed in 2-and-8 floating point arithmetic.

b. Derivation-Reference: Some (Nichols') notation and techniques were derived from the writeup of the "Linear Programming Code for the Augmented 650" by O. R. Perry. Reference is also made to C. R. Nichols' writeup for the 1620 paper tape input/output version.

Restrictions/Range:

a. Requires a 1622 Card Read-Punch Unit. This program was rewritten for a 20K machine. Certain changes in the program deck are necessary to enable it to run on a 40K or 60K machine. These changes are indicated in Appendix E. The size of the problem which can be handled is restricted by the following relationship:

$$(m\ \ 2)\ (n\ \ 3) \leq \frac{\text{memory} - 3920}{10}$$

where m is the number of restrictions, n is the number of non-basis independent variables, and memory is 20K, 40K, or 60K.

(Continued on next page)

b. Data must be prepared in the format specified in Appendix B.

c. Output may be either on the typewriter or on cards. The optional final matrix punchout is on cards. (see Addendum No. 1 to program writeup).

Storage Requirements: Any size memory - see Restrictions.

Equipment Specifications: Basic 1620 with Card input and output.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 10.2.001

An Inventory Management Simulator (Card)
C. J. Welker & G. M. Goodfriend

Direct Inquiries to: C. J. Welker
G. M. Goodfriend
IBM Corporation
618 S. Michigan Avenue
Chicago 5, Illinois

Purpose/Description: This simulator will allow various inventory control policies to be studied as they are applied independently to each item. Jointly replenished items, such as a group of items whose individual order quantities summed must not exceed a carload, cannot be accomodated. However, a group of items which have the same review period or method of order point/order quantity determination may be conveniently batched.

Mathematical Method: N/A

Restrictions/Range: N/A

Storage Requirements: N/A

Equipment Specifications: This program was written in the FORTRAN language and has been compiled for the IBM 1620. With minor modification of the input/output statements, it can readily be compiled for any computer which accepts FORTRAN.

Additional Remarks: Flexibility is available in the following respects. Both the order point and order quantity may be fixed or variable as specified. Review may be periodic or occur every transaction. A forecast through the lead time is available by means of exponential smoothing with trend correction and an option of adjusting for seasonality. Lead time may either be fixed or be generated by Monte Carlo techniques. At any time, as in a good real world system, modification may be made of the order point, order quantity, safety stock level and the exponential smoothing factor.

The output will present a running account of all significant happenings. In summary; for each item the average inventory level, service percentage, number of out of stocks, number of replenishment orders and approximate standard deviation of forecast error are reported.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 10.2.002

THE INVENTORY MANAGEMENT SIMULATOR (Tape)

C. J. Welker & G. M. Goodfriend
IBM Corporation
618 S. Michigan Avenue
Chicago 5, Illinois

Abstract data for this program is identical to data for program number 10.2.001 except that this program is for the IBM 1620 tape system.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 10.2.003

AN INVENTORY MANAGEMENT SIMULATOR (Card)
J. L. Spivack & Cliff Smith

Direct Inquiries to: John L. Spivack
IBM Corporation
1955 The Alameda
San Jose, California

Purpose/Description: This simulator allows the user to test various decision rules concerning the management of inventory levels, ordering quantities, and forecasting techniques. It gives costs for each set of decision rules.

Method: N/A

Restrictions/Range: N/A

Storage Requirements: N/A

(Continued on next column)

Equipment Specifications: This program was written in the 1620 Fortran language (including the Say Subroutine).

Additional Remarks: This program was modified from the 650 program written by Welker and Goodfriend and includes such things as Say statements (headings) and cost evaluations.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 10.2.004

Sales Forecasting Simulator Using First Order Exponential Smoothing (Card)
Craig I. Johnson

Direct Inquiries to: Craig I. Johnson
IBM Corporation
1730 Cambridge Street
Cambridge, Massachusetts

Purpose/Description:

1. To provide a method for investigating the applicability of the technique of exponential smoothing for forecasting demand for a specific product.
2. To demonstrate the technique of exponential smoothing

Method: Exponential smoothing

Restrictions/Range: Will analyze demand for twenty-four (24) periods on each run. Restrictions are normal Fortran Input/Output.

Storage Requirements: Approximately 18,500 digits

Equipment Specifications: Memory 20K, and no other special features required.

Additional Remarks: The language is Fortran. Non-relocatable. It runs successfully about 20 minutes.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 10.3.001

1620 LESS (Least-Cost Estimating and Scheduling) (Tape)

Mr. Joe Rose
Mr. Loe Granato
IBM Corporation
632 Cooper Street
Camden 2, New Jersey

Purpose: To calculate the Critical Path of any project. This would include: Earliest start date; Latest start date; Earliest finish date; Latest finish date; Total float line; and Free float line.

Restrictions, Range: Will handle 2500 events, any number of arrows (jobs).

Method: Does not apply.

Storage Requirements: 20K

Equipment Specifications: 20K 1620 Paper tape I/O. No divide hardware necessary.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 10.3.002

LESS (Least-Cost Estimating and Scheduling) (Scheduling Portion) (Tape)

Ray N. Sauer
IBM
2601 S. Main Street
Houston 2, Texas

Purpose: For a project that may be described in terms of an arrow diagram of its component jobs. This program finds the minimum project completion time. The earliest and latest start and finish time for each job, consistent with this minimum completion time, are calculated.

Restrictions, Range: 967 jobs with 650 nodes.

Method: Standard.

Storage Requirements: 20,000 positions of core.

Equipment Specifications: Paper tape 1620 with no special feature.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 10.3.003

LESS (Least-Cost Estimating and Scheduling)(Scheduling Portion)-(Card)
Ray N. Sauer-IBM

Direct Inquiries to: Ray N. Sauer
IBM
2601 South Main
Houston 2, Texas
CA-3-4721

Purpose/Description: For a project that may be described in terms of an arrow diagram of its component jobs; this program finds the minimum project completion time. The earliest and latest start and finish times for each job and the total and free float time are calculated.

Mathematical Method: Standard

Restrictions, Range: The sum of nodes and job arrows may be as high as 1672

Storage Requirements: Program - 3275 digits

Equipment Specifications: 20K; 1622 Card Read Punch. No other special features required

Additional Remarks: Programmed in SPS. The usual restriction on numbering of jobs and order of input have been removed.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 10.3.004

LESS II (Least - Cost Estimating and Scheduling)(Scheduling only) (Tape)
R. Poland

Direct Inquiries to: R. Poland
IBM Corporation
South Bend, Indiana
CE 2-8251

Purpose/Description: Critical path scheduling routine in which time (Duration) units are expressed in terms of hours or days. The output is listed in the same units of time.
Demonstration tape with data included.

Method: N/A

Restrictions/Range: Will handle 2200 events.

Storage Requirements: None.

Equipment Specifications: Memory 20K; Automatic Divide; No other Special Features Required.

Additional Remarks: Demonstration tape runs approximately 15 minutes for three forms of output - undefined time interval, time in terms of shop days and in terms of hours.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 10.3.005

CRITICAL PATH SCHEDULING (Cards)
Chuck Snyder & Jim Snediker

Direct Inquiries to: Jack Burgeson
IBM Corporation
340 S. Broadway
Akron 8, Ohio

Purpose/Description: The purpose of this brief program is, primarily, to illustrate how simple the Critical Path Scheduling algorithm (a type of Dynamic Programming) really is. This is accomplished by coding the entire critical path finding portion in the Fortran language for up to 180 jobs in less than one page of statements.

Method: Dynamic programming algorithm

Restrictions/Range: 180 jobs. Finds total project time and indicates critical jobs.

Storage Requirements: N/A

Equipment Specifications: Basic card 1620. Program available on cards in Fortran form. Could easily be translated to any machine configuration accepting Fortran language.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 11.0.001

THE CHINESE BAR & RING PUZZLE (Card)

D. N. Leeson
IBM Corporation
425 Park Avenue
New York City, N. Y.

Purpose: This program generates as optimal solution to the Chinese Bar & Ring Puzzle. The program has only intellectual interests and serves no useful function unless one is interested in the problems of generating a reflective gray code.

Method: Not given. SPS Language.

Restrictions, Range: Does not apply.
Speed; Variable depending upon initial game conditions.

Storage Requirements: 2,500 core positions.

Equipment Specifications: 1620 with attached 1622.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 11.0.002

1620 SIMULATION OF A ONE-ARMED BANDIT (Tape)
Dick Conner

Direct Inquiries to: Dick Conner
IBM Corporation
421 Seventh Avenue
Pittsburgh 19, Pennsylvania

Purpose: The program uses a pseudo-random number generator to select and print a combination of three characters from a six character set ($, *, @, -, /, ✱). The payoff, if any, is calculated and printed in edited format. Each depression of the "start" key initiates another play. The pseudo-random number generator also determines how long each wheel spins, by varying the interval between printing of the characters; but there is no significant correlation between this delay and the character selected.

Stakes, which may be changed between plays, are determined by the sense switch settings, thus affording the bettor a choice of fifteen different amounts to bet, from five cents to ninety cents. The sixteenth combination of switch settings causes the player's net winnings or losses to be printed in edited format, and the program to reinitialize for another player. The "house man" can at any time cause printing of grand totals of bets, payoffs and net profit for the day.

Restrictions, Range: Not given.

Method: Runcible pseudo-random number generator, partially initialized by player to prevent identical output each time the program is loaded.

The mode of arithmetic is fixed point, with maximum grand total permitted equal to $999,999,999.99, which permits several months of continuous play.

Storage Requirements: Locations 00000 through 05455, not relocatable.

Source Language: 1620 SPS.

Remarks: Running Time: Due to random times the wheels spin, running time per play varies from about nine seconds to about 13.5 seconds.

Equipment Specifications: Standard 1620 paper tape. The I/O equipment is used only for loading. The end-of-job memory clearing routine works only on a 20K machine.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 11.0.003

Chinese Bar and Ring Puzzle (Tape)
D. N. Leeson

Direct Inquiries to: D. N. Leeson
IBM Corporation
425 Park Avenue
PL 1-6060

Purpose/Description: This program generates an optimal solution to the Chinese Bar and Ring Puzzle.

Mathematical Method: Not Given

(Continued on next page)

Restrictions, Range: N/A

Storage Requirements: 2500 Core Positions

Equipment Specifications: Paper Tape 1620, memory 20K and no other special features required.

Additional Remarks: The program has intellectual interest only and serves no useful function other than to demonstrate a reflective binary grey code.

IBM 1620 PROGRAM LIBRARY ABSTRACT — File Number 11.0.004

THE EXECUTIVE GAME (Tape)
E. Jury & J. A. N. Lee

Direct Inquiries to: Dr. J. A. N. Lee
Queen's University Computing Center
Ontario, Canada

Purpose/Description: To familiarize business students with the processes of business decisions and the resulting effects on the market. This program is a translation of the U.C.L.A. game for the IBM 650.

Method: N/A

Restrictions/Range: Eight teams

Storage Requirements: Total memory

Equipment Specifications: Memory 20K and no other special features required

Additional Remarks: This program is written in I.P.S. The need for an automatic divide feature will be a function of which I.P.S. tape is available. The 1620 User's Group has permission to publish this program and preliminary writeup, but its use should be restricted to members of the Group only. A more complete writeup will be available later. This has been put in this form following many requests from users.

IBM 1620 PROGRAM LIBRARY ABSTRACT — File Number 11.0.005

BLACKJACK GAME (Tape)
A. J. Lang

Direct Inquiries to: A. J. Lang
Fairchild Camera and Instrument Corporation
Du Mont Military Electronics Department
Defense Products Division
750 Bloomfield Avenue
Clifton, New Jersey

Purpose: The program to play the game of blackjack (commonly known as "21") was designed for demonstration purposes for the 1620 Data Processing System.

Mathematical Method: Lehrmer's Method for Generation of Random Numbers.

Restrictions, Range: Does not apply.
Speed; Time to execute card shuffle = approximately four seconds.

Storage Requirements: 6607 core positions.

Equipment Specifications: 1620 with attached 1621. No other special features are required.

IBM 1620 PROGRAM LIBRARY ABSTRACT — File Number 11.0.006

1620 BLACKJACK DEMONSTRATION (Card)
Earl E. Hitt

Direct Inquiries to: Earl E. Hitt
IBM Corporation
3800 Lindell Boulevard
St. Louis, Missouri

Purpose/Description: Demonstration Game of Blackjack between the 1620 as dealer and two players. 1620 deals two cards to each of two players and itself. Players may take additional cards as they desire. 1620 makes these decisions for itself. Progress of game is clearly pictured on typewriter, and choice comments are typed out at end of each hand giving almost human image to 1620.

Method: N/A

(Continued on next column)

Restrictions/Range: Cannot go for doubles on 10 or 11, cannot split like cards for a double play on one hand. Specific suit is not used as it does not matter. The "internal" deck of cards has 4 aces, 4 kings, 4 queens etc.

Storage Requirements: Less than 20K

Equipment Specifications: Standard Card 1620

Additional Remarks: Good illustration of decision ability of 1620. Game is one big maze of decisions. Comments typed out at end of hand give good visual picture of 1620's ability to analize all possible resulting conditions between dealer and two players as to loses, wins, double wins, etc.

IBM 1620 PROGRAM LIBRARY ABSTRACT — File Number 11.0.007

BBC VIK THE BASEBALL DEMONSTRATOR (Card)
Jack Burgeson & Paul Burgeson

Direct Inquiries to: Jack Burgeson
IBM Corporation
340 S. Broadway
Akron 8, Ohio

Purpose/Description: To demonstrate the capabilities of the 1620 as a simulator by "playing" a game of baseball.

Method: N/A

Restrictions/Range: N/A

Storage Requirements: All of storage is used.

Equipment Specifications: 20K memory card 1620. No other special features required.

Additional Remarks: SPS with patches is the language.

IBM 1620 PROGRAM LIBRARY ABSTRACT — File Number 11.0.008

BBC VIK THE BASEBALL DEMONSTRATOR (Tape)
Jack Burgeson & Paul Burgeson

Direct Inquiries to: Jack Burgeson
IBM Corporation
340 S. Broadway
Akron 8, Ohio

Purpose/Description: To demonstrate the capabilities of the 1620 as a simulator by "playing" a game of baseball.

Method: N/A

Restrictions/Range: N/A

Storage Requirements: All of storage is used.

Equipment Specifications: 20K memory card 1620. No other special features required.

Additional Remarks: SPS with patches is the language.

IBM 1620 PROGRAM LIBRARY ABSTRACT — File Number 11 0 009

RANDOM WALK (SIMULATION) (Tape)
Anton Colijn, J. E. L. Peck & Robert Rossander

Direct Inquiries to: Anton Colijn, J. E. L. Peck & Robert Rossander
University of Alberta Computing Center
Calgary, Alberta
Canada

Purpose/Description: To demonstrate the flexibility of a variable work length computer, and to show the possibility of simulation on a computer. The main purpose is to give a demonstration which invites audience participation. The simulation is of a town with 50 streets and 50 avenues, in which a random walk begins at the centre and wanders about with probabilities for each direction supplied by the audience.

(Continued on next page)

Restrictions/Range: N/A

Storage Requirements: From approximately 00000 to 13000

Equipment Specifications: Tape system, memory 20K, automatic divide, indirect addressing. No other special features required.

Additional Remarks: The original program was written in the Symbolic Programming System, with fixed point input. No subroutines are required, and the program is not relocatable.

An average run takes approximately 30 seconds running time and from four to five minutes for the entire output.

The random number generator used is admittedly not the best, but has been found to be quite adequate.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 11.0.010

The 1620 Self-Demonstrator (Tape)

Jack Miess

Direct Inquiries to: Jack Miess
IBM Corporation
340 W. Washington Ave.
Madison, Wisconsin

Purpose/Description: This program demonstrates the 1620 Tape System by giving pertinent facts, punching and reading tape, typing and demonstrating arithmetic speed. It is a real attention-getter in showing the IBM 1620 Tape System.

Mathematical Method: N/A

Restrictions Range: None

Storage Requirements: N/A

Equipment Specifications: Memory 20K; no other special features required.

Additional Remarks: The second and last records on the program tape can be changed to suit individual needs. The first record on tape is program. The second record can be changed for specific organization. The last record can also be changed for specific organization.

IBM 1620 PROGRAM LIBRARY ABSTRACT File Number 11.0.011

1620 SIMULATION OF A ONE-ARMED BANDIT (Card)

Dick Conner

Direct Inquiries to: Dick Conner
IBM Corporation
421 Seventh Avenue
Pittsburgh 19, Pennsylvania

Purpose/Description: The program uses a pseudo-random number generator to select and print a combination of three characters from a six character set ($, *, @, =, /, ✳). The payoff, if any, is calculated and printed in edited format. Each depression of the "start" key initiates another play. The pseudo-random number generator also determines how long each wheel spins, by varying the intervalbetween printing of the characters; but there is no significant correlation between this delay and the character selected.

Stakes, which may be changed between plays, are determined by the sense switch settings, thus affording the bettor a choice of fifteen different amounts to bet, from five cents to ninety cents. The sixteenth combination of switch settings causes the player's net winnings or losses to be printed in edited format, and the program to reinitialize for another player. The "house man" can at any time cause printing of grand totals of bets, payoffs and net profit for the day.

Restrictions, Range: Not given.

Method: Runcible pseudo-random number generator, partially initialized by player to prevent identical output each time the program is loaded.

The mode of arithmetic is fixed point, with maximum grand total permitted equal to $999, 999, 999.99, which permits several months of continuous play.

Storage Requirements: Locations 00000 through 05455, not relocatable.

Source Language: 1620 SPS.

Remarks: Running Time: Due to random times the wheels spin, running time per play varies from about nine seconds to about 13.5 seconds.

Equipment Specifications: Standard 1620 Card. The I/O equipment is used only for loading. The end-of-job memory clearing routine works only on a 20K machine.

IBM 7070 Library Program Abstracts File no. 1.2.001
Available prior to January 1962

7070 - Addition to Basic Fortran

Russell Ranshaw
Computation and Data Processing Center
University of Pittsburgh
Pittsburgh 13, Pennsylvania

a. Purpose: The additions to Basic Fortran were made to bring the Basic Fortran System up to date. The additions are:

1. IF (SENSE SWITCH i) n_1, n_2
2. IF (SENSE LIGHT i) n_1, n_2
3. SENSE LIGHT i ON
4. ASSIGN n_1 TO v
5. GO TO v, $(n_1, n_2, ---)$

b. Machine Requirements:

Processor: The additions occupy 120 locations; at present they are assembled into 5000-5119. There is room, however, in a 5K machine to make the same additions.

Object: Electronic switches 1-9 may be used if SENSE LIGHT instruction for "lights" 1-9 are used.

c. General Description: The Machine language Realizations of the above statements are:

1. n IF (SENSE SWITCH i) n_1, n_2
   STMNTn BAS i, STMNT n_1
   B STMNT n_2
2. n IF (SENSE LIGHT i) n_1, n_2
   STMHT n BSF i, STMNT n_1
   B STMNT n_2
3. n (SENSE LIGHT) i ON
   STMNT n ESN i
4. n ASSIGN n_1 TO v
   STMNTn ZA3 +STMHTn_1
   ZST3 v
5. n GO TO v, $(n_1, n_2, ----)$
   STMNT n XLIN 94, v
   B 0+X94

d. Capabilities and Limitations: Does not apply.

IBM 7070 Library Program Abstracts File no. 1.2.002
Available prior to January 1962

7070 - Basic FORTRAN Punch With Carriage Control

George Greenacre
P. O. Box 8361
South Charleston 3, W. Va.

a. Purpose: This modification of the BASIC FORTRAN PACKAGE LOAD DECK allows carriage control of the 407 from a punched card output and also allows for use of all 120 type wheels on the 407.

b. General Description: The modification allows for carriage control of the 407 to be part of the FORMAT statement. The character occupies the space that would normally appear in type wheel 1 on the 407, but is deleted prior to punching. Therefore only 119 of the 120 type wheels can be used. The 407 panel is merely an adaptation of the 7400 UTILITY PANEL to the 407, and thus allows programs written for an on-line printer to be used without change.

c. Capabilities and Limitations: This requires that all output FORMAT statements have as their first character (at least 1H_)one of the following:

Blank	Single space before printing
O	Double space before printing
+	No space before printing
1	Skip to channel 1 before printing (page skip out)

This modification punches one card with the appropriate control characters in card columns 1-5 and 74 characters in card columns 7-80 (these will be printed in type wheels 2-75) and if necessary punches another card with 5 control characters and 45 characters (these will be printed in type wheels 76-120).

This modification assumes only one synchronizer (with a 7500 Card Read and 7550 Card Punch) and acts on both PRINT and PUNCH statements as if they were PUNCH. Someone could easily modify this to take care of both separately.

A _ _ _ _ UNIT RCD ERROR will be typed out if any character other than those listed above is used

The FORMAT statements can be used on a tape system, but this modification replaces some of the TAPE routines (Loc. 1200-1232) and therefore must be relocated to be used on a TAPE system.

d. Machine Requirements: This modification is designed for a card oriented 7070 with only one synchronizer and an IBM 407 with a control panel wired in accordance with the enclosed wiring diagram.

IBM 7070 Library Program Abstracts File no. 1.9.001
Available prior to January 1962

7070 - RSTRF - Function Subroutine for Basic Fortran

Russell Ranshaw
Computation and Data Processing Center
University of Pittsburgh
Pittsburgh 13, Pennsylvania

a. Purpose:. The Format statement for Basic Fortran does not include printer control options. RSTRF has been written to restore the 7400 printer paper when desired. Fortran use:

ANYV = RSTRF (ANYV)

b. Machine Requirements: IW94 for linkage, 6 locations, 7400 printer on Sync. 2, 7400 utility panel.

c. General Description: The routine is supplied in 5/cd relocatable form, suitable for use with the Basic Fortran Package deck. Upon entry, the Routine prints a record consisting of one word, having control information to cause the 7400 to restore to channel 1. Control is then returned to the main Program.

d. Capabilities and Limitations: Does not apply.

IBM 7070 Library Program Abstracts File no. 1.9.002
Available prior to January 1962

7070 - XRANF - Function Subroutine for Basic Fortran

Russell Ranshaw
Computation and Data Processing Center
University of Pittsburgh
Pittsburgh 13, Pennsylvania

a. Purpose: This function provides a Fortran usage fixed point random numbers rectangularly distributed.

ANYV = XRANF (M)

where M is a fixed point number between 1 and 10, specifying the size of the number to be generated.

b. Machine Requirement: 1W94 for linkage, 10 locations.

c. General Description: See Random Number Generation and Testing IBM form No. C208011

d. Capabilities and Limitations: Does not apply.

IBM 7070 Library Program Abstracts File no. 1.9.003
Available prior to January 1962

7070 Generation of 1401 Optimized Programs (GOOP)

Contributed By

Author: Elmer D. Stonehill

Organization: The Ohio Oil Company

539 South Main Street, Findlay, Ohio

a. Purpose: To generate efficient 1401 card-to-tape, tape-to-printer, and tape-to-card programs which reduce 7070 programming effort and eliminate the need for 1401 programmers and 1401 program maintenance.

b. Machine Requirements:

7070 (1) 10K Memory, and (2) five Model 729II or 729IV Tape Units.

1401: (1) Model C3 Processing Unit with a minimum of 4K Memory, (2) 1402 Card-Read Punch, (3) 1403 Model 2 Printer, (4) One Model 729II or 729IV Tape Unit, (5) High-Low-Equal Compare, and (6) the Advanced Programming Package.

c. General Description: Parameters describing the input and output of the 1401 programs desired are input to the 7070 generator with the generated output being a 1401 program load deck and program listing. Although the generator program has 42 program phases consisting of 35,000 instructions, only 2-3 minutes of 7070 time is required per generation. The resulting 1401 programs process approximately 400 cards per minute (card-to-tape with a one-tooth clutch), 600 lines per minute (tape-to-printer, single-spaced and with print buffer), and 250 cards per minute (tape-to-card).

d. Capabilities and Limitations:

Card-To-Tape: extensive error checking including double punch and blank column detection; combining up to nine card records into one tape record or constructing up to nine different tape records from different types of input cards; and complete rearrangement of fields.
Tape-To-Printer: processing up to nine tape record formats with varying printing requirements for each format, including column headings, name and address printing, alphabetic descriptions, totaling, spacing and field rearrangement; printing several reports from one 7070 output tape; printing up to nine lines of column heading information out of 1401 memory; and accumulating and printing up to six levels of totals.

(Continued on next page)

II

Tape-To-Card: punching information selectively into cards from report tapes; card compatability with the 650 system (X over-punching and gang punching); and punching several types of cards from several tape record formats out of one file, including field rearrangement.

e. Note: If desired (a maximum of 4) copies of the GOOP Reference Manual will be supplied. One full reel of tape must accompany each request for the GOOP System.

IBM 7070 Library Program Abstracts — File no. 1.9.004 — Available prior to January 1962

ZEUS PROGRAM ANALYSIS (ZPA) COMPUTER SYSTEM

Contributed By:

Author: Operations Engineering Department

Organization: Western Electric Company, Inc.

Department 9215
204 Graham-Hopedale Road
Burlington, North Carolina

a. Purpose: The ZPA Computer System is a series of four programs designed to process PERT type networks on an IBM 1401/7070 computer system.

b. Machine Requirement: The programs in the system are written for an IBM 1401, 8K machine and an IBM 7070, 2 channel, 10K, tape oriented machine.

c. General Description: The four programs in the ZPA System are as follows:

1. ZPA Card to Tape (Program 01000 - 1401)
2. ZPA Calculation (Program 01500 - 7070)
3. ZPA Sort and Merge (Program 01550 - 7070)
4. ZPA Print and Edit (Program 01010 - 1401)

One reel of magnetic tape required for 7070 Program deck and listing.

The 1401 computer is used primarily as an input and output device. The 7070 is used to calculate network data, to merge activity descriptions with calculated data, and to sort the critical path and negative slack activities. Input to the system is on cards and the output is a series of printed reports. Any number of networks may be processed during the same computer run and each program of the system will process all networks without interruptions. Each network is separated by segment marks on tape. The existence of input errors in a network will not restrict the successful processing of other valid networks.

d. Capabilities and Limitations: There are certain requirements that must be considered in processing networks with the ZPA System. First, the programs were designed to process 'activity oriented' networks. Although 'event oriented' networks can be processed, some confusion could result in the interpretation of the program outputs. Second, the programs have been written to analyze networks with a maximum of 1,500 activities. Third, random numbering of network activities is not permissible. Events must be numbered sequentially in ascending order. The successor event number of an activity must be higher than its predecessor. Consideration of these requirements is important when preparing the basic network drawings.

IBM 7070 Library Program Abstracts — File no. 2.4.001 — Available prior to January 1962

650 to 7070 Tape Record Conversion (XXA15)

R. T. Miller, Jr.
Texas Instruments Incorporated
August 18, 1960

a. **Purpose:** To convert 650 tape records, written either alpha or numeric, to 7070 tape records.

b. **Machine Requirements:** One (1) 7500 card reader, two (2) 729 II or 729 IV tape drives, 10K words of core storage

c. **General Description:** The parameters of this routine are established from control card information. The information in these cards defines the 650 record, the format of the desired 7070 record, output blocking, individual record length (input and output), alpha/numeric words, field changes, and other information necessary to create a required 7070 file from an existing 650 file.

d. **Capabilities and Limitations:** The routine is capable of converting any 650 record of from 1 to 60 words in length to a 7070 record; these are certain limitations as to output records and field changes which are covered in detail under the section headed "Complete Description". The routine utilizes the IBM Input-Output Control System (IOCS).

IBM 7070 Library Program Abstracts — File no. 2:4.002 — Available prior to January 1962

7070 - Subroutine for IBM 7070

Rolls Royce Ltd.
P. O. Box 31
Derby, England

Purpose: To convert floating point numbers to fixed point numbers.

Usage: Normalize floating point number in acc. 1

Numbers of decimal places required in accs. 1, 2, in X52 (2, 5)

a BLX 51, R410S
a+1 Error exit
a+2 Normal exit

On exit the fixed point number is accs. 1, 2

Hardware: 24 locations

Index accs. 51 (2, 5), 52 (2, 5)

CØM
Accs. 1, 2

Method: 68 - Modified characteristic - number of decimal places required = Shift S required.

Restrictions: Should -2> S > + 18 the routine will branch to the error exit.

Note: On number of decimal places required in accs. 1, 2.

The subroutine will cater for positive or negative numbers of decimal places, therefore any modified characteristic can be converted.

Floating point number is available at CØM at the completion of the routine.

IBM 7070 Library Program Abstracts — File no. 2.4.003 — Available prior to January 1962

7070 - Subroutine for IBM 7070

Rolls Royce, Ltd.
P. O. Box 31
Derby, England

Purpose: To convert fixed point numbers to floating point numbers.

Usage: Fixed point number in acc. 1

The number of decimal places of fixed point number in X52 (2, 5)

a BLX 51, R415S

a+1 Normal Return

On exit floating point number will be in acc. 1

Hardware: 9 locations

Index accs. 51, 52, 53, all (2, 5)

Accs. 1, 2.

Method: 60 - number of leading zeros - number of decimal places = modified characteristic

Note: On number of decimal places. These can be positive or negative therefore, any number of decimal places can be catered for.

IBM 7070 Library Program Abstracts — File no. 2.4.004 — Available prior to January 1962

7070 - Simplified Priority Card to Tape Routine

Russell Ranshaw
Computation and Data Processing Center
University of Pittsburgh
Pittsburgh 13, Pennsylvania

a. Purpose: This routine will produce a tape file containing exact card images for use as input to a program. Both 8 word numeric and 16 word alphabetic input cards are handled automatically. A completely blank card will product a Segment mark on the output tape. A tape mark is automatically written and the tape rewound when the card reader is empty. The output tape and output density are specified on a control card. Card read errors may be corrected while the main program is being executed.

b. Machine Requirements: This routine utilizes __________ machine locations, 1W99 if input is alphabetic, Unit Record A Priority Branch location)0104), and 0159 tape priority Branch location. Alteration Switch 4 is interrogated if a card read error occurs. The standard 7500 utility panel is used. All priority is unmasked.

(Continued on Next page)

c. General Description: With the Program in storage, a priority branch to 0104 will occur when channel A is switched on. The routine reads the control card, sets up the tape operation, alters 0104 to enter the second phase of the routine, and returns control to the main Program. Succeeding interrupts read a data card using a 16 word RDW and interrogate the sign of the first word; if not, the output RDW is set to 8 words and a tape record written; if the sign is alphabetic, the card is checked for 16 blanks; if any non-blank is encountered, a tape record is written; if the card is blank, a segment mark is written. In all cases, a priority release occurs after the tape is written.

d. Capabilities and Limitations: Does not apply.

IBM 7070 Library Program Abstracts File no. 2.4.005
Available prior to January 1962

7070 - Load Subroutine

R. Haertle
AC Spark Plug Div GMC
Milwaukee, Wisconsin

a. Purpose: To load data at object time into specified locations. This may be fixed, floating, or alphabetic data.

b. Machine Requirements: Floating hardware, standard control panel, 165 storage words

c. General Description: Input data of the following form will be converted:

+12.345, -123.45E+7, +1, 0, +1234,

to the following internal form

+5212345000
-6012345000
+0000000001
+0000000000
+0000001234

d. Capabilities and Limitations: Input format must conform to detailed operational description.

IBM 7070 Library Program Abstracts File no. 2.9.001
Available prior to January 1962

7070 Modulus 11 Self-Checking Digit Calculator

Contributed by: Alex Serbinoff
IBM Datacenter
2925 Euclid Avenue
Cleveland 15, Ohio

a. Purpose: To affix Modulus 11 self-checking digits to numbers over a predetermined range or series of ranges.

b. Machine Requirements:

5 K four tape 7070 with program to be brought in from additional tape, card reader, or console card reader.

c. General Description:

The program is designed to compile check digits for numbers of from one to nine digits. A count and hash total of valid numbers is included for control purposes. The program calculates check digits at a rate of 900 per second.

IBM 7070 Library Program Abstracts File no. 3.1.001
Available prior to January 1962

7070 - IBM 7070 Program Modification Routine

R. B. Buttner and G. F. Crane
182 Purchase Street
Rye, New York

a. Purpose: The IBM 7070 Program Modification Routine is a subroutine which processes program modifications, prepared as outlined in the General Description, in such a manner that a program about to be tested is changed while it is being loaded into core storage. It offers the unique advantage of easy reassembly of the corrected program at any stage in its development.

b. Machine Requirements: The Modification Routine utilizes all available memory below word 0495. All memory assignments, with the exception of the tape error routine, may be changed through reassembly of the program. Overlap with the subject program is possible and often desirable.

For card input the following devices are required:

7500 Card Reader with Utility Control Panel
7603 Unit Record Synchronizer

For tape input the following devices are required:

Tape Units - one or two channels with associated tape units as required to load the subject program.

(Continued on next column)

Off-line Equipment - that equipment necessary to prepare a tape suitable as input to the Condensed Card Load Program (8 word numeric records) and the Modification Routine (16 word alpha records).

c. General Description: After being loaded into core storage, the Modification Routine reads an entry. The entry is first examined to see if it is an execute entry. If so, a branch to the first instruction on that entry is effected. If it is not an execute entry, a short edit is performed to insure that the format is correct (any deviation from the prescribed format will cause the entry to be disregarded). If the entry is found to be a 7070 instruction, its proper Operation code is extracted from a table and the IW, CL and address portions indicated in the entry are combined and the new instruction is moved into memory as directed. If the entry is found to be a constant, the information contained in the Operand field is moved into memory as directed.

d. Capabilities and Limitations: Any acceptable 7070 instruction, along with the operation DRDW and constants may be processed.

IBM 7070 Library Program Abstracts File no. 3.2.001
Available prior to January 1962

7070 DUAL PROGRAM PROCESSING SYSTEM
1. Supervisory Program
2. Associated Control & Card, tape I/O Macroes

Contributed By

Author: Maurice K. Morin

Organization: National Aeronautics and Space Administration
Langley Research Center
Langley Field, Va.

a. Purpose: To allow any two programs written within the framework of the system to operate simultaneously. The two programs are operationally independent. Either can start or end without affecting the operation of the remaining program in the computer. Completely controls and simplifies card and tape I/O.

b. Machine Requirements: (Include machine components, special features, storage requirements, control panels-standard or special)

System written for 5K 7070, 2 readers, 2 punches, 2 tape channels with up to 6 tapes on each channel.

The system can be easily adapted to a 10K 7070.

c. General Description: (Mathematical method, accuracy, speed, if appropriate)
NA

d. Capabilities and Limitations:

More efficient utilization of I/O interlock time, tape search and resweep time. Each program has only 1 reader, 1 punch and 1 tape channel available.

IBM 7070 Library Program Abstracts File no. 3.4.001
Available prior to January 1962

7070 - Tape Copy Routine

Russell Ranshaw
Computation and Data Processing Center
University of Pittsburgh
Pittsburgh 13, Pennsylvania

a. Purpose: This routine will read input tape records any reasonable size, in either high or low density, and write on output tape records of the same size, in either high, low, or the same density. Input or output tapes may be rewound or backspaced before copying.

b. Machine Requirements: The entire 7070 is assumed to be available for use. The routine is at present a 10K 7070. Any number of tape channels may be used, according to the copying pattern to be followed.

c. General Description: Psuedo-instructions, punched up to 8 per card, are interrogated. The "instruction" provides information as follows:

1. input tape
2. output tape
3. output density
4. Input backspacing
5. output backspacing
6. input rewind - yes or no } Before copy
7. output rewind-yes or no }
8. input rewind - yes or no } After Copy
9. output rewind- yes or no }

The routine is tape-limited in operating speed.

d. Capabilities and Limitations: The routine will copy up to 8989 word records, any density, any combination of segment marks, tape marks, record marks, and alphabetical or numerical records, an uncorrectable read error on the input file stop the current "instruction".

IBM 7070 Library Program Abstracts

File no. 3.4.002
Available prior to January 1962

7070 SIMPLE IOCS

Contributed By: Robert Judson
The B. F. Goodrich Company
Akron 18, Ohio

A. Purpose: To provide a simple method for handling tapes which uses priority routines to handle possible errors but not to save time. For small input-output scientific problems.

B. Object Routine Machine Requirements: Tape Units

C. Object Routine Produced: Routines to handle all priority possible tape commands. Operations which have no priority mode do not need and do not use this package.

D. Source Language Entry:

```
(1) XL        TCX,+ 3
    P (Tape Command) Any channel-unit, and RDW
                          (if applicable)
    B         *
```

E. Capabilities and Limitations: In case of an uncorrectable error, priority will be released to the B *. OK operations release priority to the following instruction. This procedure facilitates debugging as priority is released without otherwise affecting machine status.

Core zero should be done to clear all final status words. 4 instructions go into 0150-0153 and 131 locations any other place are used. These can be reduced by standardizing input-output channels and reducing the error messages. All accumulators are used by the package.

IBM 7070 Library Program Abstracts

File no. 3.4.003
Available prior to January 1962

7070 MATES (MAster Tape Executary ProgramS)

Author: Vincent J. Battaglia

Organization: INTERNATIONAL BUSINESS MACHINES
Chicago Downtown
618 S. Michigan Avenue
Chicago, Illinois

a. Purpose: The Librarian generates and maintains a master tape. It accepts programs in squeeze deck format and produces a single tape record plus an identification record for each program (or phase of a program). The Locator obtains programs from a Library tape under operator or program control.

b. Machine Requirements:

	STORAGE	TAPES	READER
LOCATOR:	140 words	1	7500 or 7501
LIBRARIAN:	236 words	3	7500 or 7501

c. Capabilities and Limitations: The card image input to the Librarian must be in numeric eight word load format on tape. Tape density on input and output of the Librarian is at the discretion of the user.

IBM 7070 Library Program Abstracts

File no. 3.4.004
Available prior to January 196_

TAPECHECK SUBROUTINE

Contributed By:

Author: H. Hyman, Applied Science

Organization: IBM Svenska AB
Gävlegatan 20
Stockholm 6, SWEDEN

a. Purpose: A subroutine for checking properly execution of tape reading and writing operations.

b. Machine Requirements: 1 electronic switch, 3 index words, locations # 97, # 99, # 100 and # 150, 80 ordinary storage locations, the priority mask register and initial and final status words (as required by tape units used).

(Continued on next column)

c. General Description: This subroutine will perform the reading or writing of a definite tape record, and make the necessary checks to ensure that the operation has been properly executed. If a transmission error takes place, several attempts to repeat the operation are made. If an error in the stated record length should occur, or if a transmission error cannot be rectified by repetition, a message will be typed out by the console typewriter, and the machine will stop. Processing with or without overlapping is optional. Average execution time: 1.6 milliseconds.

d. Capabilities and Limitations: Only the tape operations (P)TR, (P)TRR, (P)TW, (P)TWR, (P)TWZ and (P)TWC will be performed.

IBM 7070 Library Program Abstracts

File no. 4.3.001
Available prior to January 1962

Big File Generator (BFG)

Contributed By:

Author: Central Technical Group

Organization: Mutual Life Insurance Company of New York
1740 Broadway, New York City

a. Purpose:

To Generate data files from card input for use in testing 7070 programs.

b. Machine Requirements: (Include machine components, special features, storage requirements, control panels - standard or special).

1. 10,000 words of memory.
2. Card-to-Tape equipment to create an input tape to the BFG.
3. One 727 II, IV or 729 II, IV Tape drive (in addition to drives for files being created).

The BFG program can be patched for use with certain other machine configurations. See BFG writeup for details.

c. General Description: (Mathematical method, accuracy, speed, if appropriate).

d. Capabilities and Limitations:

1. The BFG is an extension of the IBM TFG program; records of the TFG type can ge generated by the BFG.

2. The BFG is preferable to the regular TFG when many larger records are to be created and only a few fields will be changed from record to record.

3. The BFG program can only be used with the PILOT program Tape System.

IBM 7070 Library Program Abstracts

File no. 4.4.001
Available prior to January 1962

7070 PAT COMPILER

Contributed By: W. J. Walker
IBM Corporation
N. Y. Financial
2 Broadway
New York 4, N. Y.

a. PURPOSE: The Pat Compiler Program compiles a PAT (Procedure for Automatic Testing) System tape supplying the desired utility programs used in testing.

b. MACHINE REQUIREMENTS:

5 K memory
1 Output Tape unit
1 Input Tape unit or 7500 card reader
Standard IBM Utility panel SW's 1 & 2 on A

c. GENERAL DESCRIPTION: The Pat Compiler program will create a 7070 Pat System Tape of program packets from either the card reader or a tape created off line in alpha card image form. As the Pat tape is being created each program packet number will be typed. The tape channel and unit will also be typed from each TFG control card encountered. Messages may also be typed to identify each Utility Program included on the PAT tape. This typed list will be in the same sequence as the programs on tape and serve as a reference sheet during use. The PAT Compiler Call card defines the beginning of a packet and contains the necessary information for compiling of the packet.

d. CAPABILITIES AND LIMITATIONS: Utility Programs can be compiled only in the normal logical sequence as specified by the control card.

IBM 7070 Library Program Abstracts

File no. 4.4.002
Available prior to January 1962

7070 PAT COMPILER SYSTEM

Contributed By:

Joseph C. Capps, Jr.
IBM Corporation
Los Angeles Datacenter
3424 Wilshire Blvd.
Los Angeles 5, California

A. Purpose: This system, consisting of several programs, is designed to assist the debugging of multiple object programs by facilitating the the preparation and use of a PAT system tape. This PAT Compiler System allows multiple programs and data to be incorporated into individual test packets on a single PAT tape, with the insertion of all utility routines needed by the PAT Compiler program.

B. Machine Requirements: The PAT Compiler System requires, as a minimum, a 5K core, four-tape IBM 7070 with either a 7500 or a 7501 Card Reader. The PAT Compiler program is available in two versions, one using the IBM 7070 IOCS system and requiring a 10K core 7070; the other not using IOCS and not requiring the 10K core 7070. Either PAT Compiler may be modified to run on any given input/output configuration by the insertion of a Configuration Control card, containing the desired machine configuration.

The object programs being tested must make use of the standard IBM 5/card Load Program. During testing, the PAT Compiler System places no restriction on the use of the computer by the object program.

C. General Description: For each program to be debugged, one control card must be punched. Its purpose is to separate the programs and to supply to the PAT Compiler pertinent information. Multiple sets, consisting of a control card, test data, and object program, may then be processed by the PAT Compiler program to produce a self loading PAT tape. The resulting PAT tape may then be used as many times as desired to test the programs.

Procedures are available within the PAT Compiler to add new programs or to delete old programs.

Each PAT Compiler program condensed deck consists of two parts: the PAT Compiler program itself, and the utility programs to be incorporated onto the PAT tape by the PAT Compiler program.

All the utility programs used by the PAT Compiler System are modified versions of the standard utility programs.

IBM 7070 Library Program Abstracts

File no. 4.4.003
Available prior to January 1962

7070 LORELI2 (LOcation REference LIsting)

Author: Mike Clark

Organization: Zurich Insurance

Direct Inquiries To: Vincent J. Battaglia
INTERNATIONAL BUSINESS MACHINES
Chicago Downtown
618 S. Michigan Ave.
Chicago, Illinios

a. Purpose: LORELI2 is a program used in conjunction with a modified Sort 90 program, designed to create a cross-reference listing of programs assembled by Autocoder 74.

b. Machine Requirements:

	STORAGE	TAPES
LORELI2:	5000 words	2
SORT 90:	5000 words	4, 6, or 8

c. General Description: The cross-reference of the object program is into these major areas:

1). Listing by address
2). Listing by Index word usage
3). Listing by Electronic switch usage
4). Listing by Accumulator usage

d. Capabilities and Limitations: The listing may or may not cross-reference the following based on Alteration switches.

1). Listing by Accumulator usage.
2). Comments statements (*in column 6)
3). Steps generated by IOCS or other macros or subroutines on the A74 assembly tape.

IBM 7070 Library Program Abstracts

File no. 4.4.005
Available prior to January 1962

1401 PAT Compiler for 7070

Contributed By

Author: William Ludwig

Organization: IBM Philadelphia Datacenter

1730 Pennsylvania Boulevard
Philadelphia 3, Pennsylvania

a. Purpose:

To compile the 7070 text tape on the 1401
To edit test packets for 7070 testing on the 1401.

b. Machine Requirements: (Include machine components, features, storage requirements, control panels--standard or special)

4K, 1401 with:
1. 2 tape drives
2. Advanced programming features.

c. General Description: (Mathematical method, accuracy, speed, if appropriate)

Not applicable

d. Capabilities and Limitations:

Designed to be used for a tape oriented 7070 system with a 7501 Console Card Reader.
It can be adapted for use with a 7500 Card Reader with very simple modifications.

IBM 7070 Library Program Abstracts

File no. 4.9.002
Available prior to January 1962

7070 SCAN

Contributed by:

Ronald J. Repking
IBM Corporation
Charleston, West Virginia

A. Purpose: To edit basic Fortran programs prior to doing a Fortran assembly.

B. Machine Requirements: Basic 7070. Program is set up to accept information from a card reader or a tape unit.

C. General Description: This program will find many common errors in Fortran programs. Over fifty errors are caught by this routine. For example:

1. Mixed arithmetic mode
2. Dimensioned variable written without subscripts
3. Intersecting D O loops
4. Misplaced commas in control statements
5. Unfulfilled branches and D O 's
6. Names that are used but never defined

D. Capabilities and Limitations: This routine was written to be inserted into a Fortran compiler system that will make batch assemblies using five tape drives without any card equipment, but it can be run separately. The tables have been set up to Basic Fortran specifications, i.e, 27 D O 's 150 variables, etc. Subscripts are not checked.

IBM 7070 Library Program Abstracts

File no. 5.1.001
Available prior to January 1962

7070 — 650 PANEL SIMULATOR

C.W. Kastner & J.W. Lake
Texas Instruments Incorporated

a. Purpose: This program is designed for use in conjunction with the IBM 7070 Program which simulates the IBM 650. This program simulates the 533 panel, thus eliminating the need for wiring 7070 read and punch panels to replace the 533 panels used by the 650 programs.

b. Machine Requirements: Index words 70 through 81, electronic switches 22 through 29, and 1500 instructions and locations that may be assembled anywhere outside of the area required by the IBM 7070 Simulation Program.

(Continued on next page)

The IBM 7070 Simulation Program with the Panel Simulator included can usually be run on a 5K core machine by removing unused portions of the program. If the entire system is required, you must have a 10K core machine. Some of the sections which can be easily removed are: ram segment, (-) OP codes, floating point, index registers, or any of the other routines which your particular installation does not use.

c. General Description: For each 650 program a set of read-and/or punch-format cards must be prepared. From these format cards, the program will set up the card image in memory just as the Type 533 panel would have read the card in, or will punch the card image just as the Type 533 panel would have punched it.

d. Capabilities and Limitations: The running time is increased only slightly above that of the usual procedure of using a board for each program.

IBM 7070 Library Program Abstracts — *File no.* 5.1.002 — Available prior to January 1962

7070 - Simulation of Basic 650 on Basic 7070

R. A. Cooper (Richard King and Jim Lake)
P. O. Box 1249,
Houston 1, Texas

a. Purpose: To simulate a basic 650 program on a basic 7070. The 650 control panel is also simulated.

b. Machine Requirements: (Include machine components, special features, storage requirements, control panels - standard or special)

1. 5K - 7070
2. 7500 Card Reader
3. 7550 Card Punch
4. 80-80 Alpha panels for reader and punch

c. General Description: (Mathematical method, accuracy, speed, if appropriate)

Most 650 programs run 2-1/2 to 3 times as fast on the 7070.

d. Capabilities and Limitations: The simulation routine will handle any minimum 650 program (650 Model II with one 533).

IBM 7070 Library Program Abstracts — *File no.* 5.1.003 — Available prior to January 1962

7070 - GRONK - a 7070 Simulator for the 650

Russell Ranshaw
Computation and Data Processing Center
University of Pittsburgh
Pittsburgh 13, Pennsylvania

a. Purpose: GRONK is a program for the IBM 650 to simulate an IBM 7070.

b. Machine Requirements:
1) IBM 650 (2000 words)
2) One input-output device
3) Index registers
4) Core Storage (9000-9059)
5) If used by program being simulated:
a) Automatic float
b) Tape units - max. of two for each of two channels.

The output devices are flexible, and may be established by the user.

c. General Description: GRONK's primary function is to provide potential 7070 users who currently have a 650 with a means of testing small 7070 programs and subroutines without the expense of 7070 time elsewhere.

d. Capabilities and Limitations: GRONK is able to simulate most of the 7070 features, including floating commands, priority processing, electronic switches, 99 index words, all three table-look-ups, and tapes. It will not, however, simulate the following:

1) Edit commands (ENA, EAN, etc.)
2) Double precision floating commands
3) Some tape commands:
a) TSEL
b) TSK
c) TEF
d) TSLD
e) TSHD
f) TRA
4) Diagnostic interrogate (109)
5) Alphabetic signs
6) Disks
7) Stacking latch commands

GRONK simulates the first 650 words of 7070 storage; if no tapes are used, an additonal 200 words become available.

IBM 7070 Library Program Abstracts — *File no.* 5.1.004 — Available prior to January 1962

7070 SIMULATING THE CARD 650 ON A TAPE ORIENTED 7070

Contributed By: John D. Fehd
IBM Corporation
Oakland, California

a. Purpose - - This program is designed to simulate card 650 programs at speeds ranging from 2 to 3 times faster than the present IBM 650 Simulator for the 7070.

b. Machine Requirements - - A 5K 7070 with one tape channel and two 729 tape drives. No control panels and no special features are required.

c. General Description - - This program is designed to handle multiple 650 programs on one or more tapes. A segment mark is to be placed just prior to each 650 program and the first record must give the console setting and program number. The 7070 can be halted just prior to each 650 program if desired (alt. SW). If a 650 program cannot be completed, it can be by-passed and the 7070 will start the next 650 program on the input tape.

d. Capabilities and Limitations - - Three types of 650 programs have been tested and timed on both the 650 and 7070 with the following results:

Limiter	650 Storage	Speed	650 I/O Speed
1. Read Bound	500 Words	9.0 to 1	200 cpm. input
2. Punch Bound	1800 Words	6.4 to 1	100 cpm. output
3. Compute Bound	1900 Words	3.8 to 1	44 cpm. input

This program uses five cards per tape record and the tapes are controlled by the IBM 7070 Input/Output Control System. It will not simulate any of the minus operation code instructions and it is restricted to one type 533.

Each 650 program that is to be simulated will require 1401 programs for input and output.

An operators manual and technical description will be supplied with the program.

IBM 7070 Library Program Abstracts — *File no.* 5.1.005 — Available prior to January 1962

SIMULATION OF CARD OR TAPE 650 ON THE 7070

Contributed By: L. J. Berg, R. Nunn, H. Monroe

Organization: Curtiss-Wright Corporation, Wood-Ridge, New Jersey

a. Purpose:

To simulate a card or tape 650 on a tape oriented 1401-7070 system.

b. Machine Requirements:

Minimum of 729 II or 729 IV tape drives for simulating unit record input and output. Additional tape drives as required for tape input and output. This system is designed for a 10K machine but can be reduced to a 5K machine.

c. General Description:

This operating technique combines the use of a portion of the PAT system (Procedure for Automatic Testing developed by IBM's New York Data Center), IBM's 650 Simulator Program, modifications to the Simulator Program and a 1401 Program developed at the Wright Aeronautical Division.

d. Capabilities:

A card deck containing the PAT System, the Simulator Program, and the 650 Program is developed for each 650 Program to be simulated. A series of these decks can be written on a reel of tape using a Type 1401C System. The card decks are made up so that:

1. The information which the Simulator Program normally calls for through the use of control cards is built into the package.
2. Instructions for initializing the succeeding package are included.
3. A routine to write a tape mark on the tape unit which simulates the card output is included.
4. Multiple data files may be processed using the same 650 Program without the need to prepare a separate input tape for each input file.
5. A dump (both core and tape) may be taken on any channel and tape drive.
6. 650 load cards are recognized by an alpha sign in word 10 rather than by a plus sign.
7. The output tape simulating card output may be written in either compressed or normal mode.

IBM 7070 Library Program Abstracts — File no. 5.2.001 — Available prior to January 1962

ABFLOATSIM — ABbreviated FLOATing point hardware SIMulator

Contributed By:

Author: H. Hyman, Applied Science

Organization: IBM Svenska AB

Gävlegatan 20
Stockholm 6, SWEDEN

a. Purpose: An interpretative subroutine which essentially simulates floating decimal hardware.

b. Machine Requirements: 2 index words and 126 ordinary storage locations.

c. General Description: When the subroutine is entered, ABFLOATSIM will perform instructions sequentially starting with the instruction immediately following the linkage instruction. These instructions may be floating decimal or ordinary 7070 instructions. Floating decimal instructions are written as for a machine equipped with floating decimal hardware. An unconditional branch instruction or a conditional branch instruction, where the branch condition is met, will, when it appears in the sequence, cause an exit from the subroutine. Average execution times: FZA - 1.4 ms; FA, FS, FAA, FSA - 2.0 ms; FM - 2.3 ms; FD - 4.3 ms; FBV, FBU - 1.0 ms.

d. Capabilities and Limitations: The normal restrictions on the floating decimal arithmetic (described in the 7070 Réference Manual) must be adhered to. The function of accumulator 2 is not simulated and consequently neither are the double precision floating decimal operations FAD, FADS, FR and FDD.

IBM 7070 Library Program Abstracts — File no. 6.1.001

IBM 7070 Linear Programming Code S1

Contributed By:

Author: A. E. Speckhard

Organization: International Business Machines

Western Region

a. Purpose: Instrument the original simplex algorithm with variations for the IBM 7070.

b. Machine Requirements: Basic 7070 with 5K memory, on-line card reader, punch, and printer. Modifications to the basic S1 code are available to provide operation on a tape oriented system.

c. General Description: Utilizes the original simplex algorithm with variations and has the following features:

1. Provides options for negative elements in the right hand side, two phase or mixed price solution, and specification of arbitrary transformations.

2. Describes the solution completely including cost ranges with upper and lower limiting variables, and activity ranges with upper and lower limiting variables.

3. Computation is in single precision floating point.

d. Capabilities and Limitations: The code is written in a special symbolic assembly language using subroutine structure and includes a highly flexible operating system. Maximum problem size with 10K memory is approximately 85 x 85 excluding slacks and artificials.

IBM 7070 Library Program Abstracts — File no. 6.1.001

IBM 7070 Linear Programming Code S2

Contributed By:

Author: D. C. Potter & A. E. Speckhard

Organization: International Business Machines

Western Region

a. Purpose: Instrument the revised simplex product form algorithm with variations and options for the IBM 7070.

(Continued on next column)

b. Machine Requirements: Basic 7070 with 10K memory, two tape channels, two tape units per channel, on-line card reader and printer. Modifications to the basic S2 code are available to provide operation on a tape oriented system.

c. General Description: Utilizes the revised simplex product form algorithm with variations and has the following features:

1. Provides options for negative elements in the right hand side, two phase or mixed price solution, reinversion and specification of arbitrary transformations, curtaining of column vectors, multiple cost rows, and multiple "B" vectors.
2. Accomodates large problems. A realistic limit is approximately 200-250 equations although larger problems may be run depending on availability of floating point hardware and program options desired by the user.
3. Describes the solution completely including cost ranges with upper and lower limitaing variables, and activity ranges with upper and lower limiting variables.
4. Operates in single or double precision floating point at option of the user. Input data is in single precision fixed point form.

d. Capabilities and Limitations: The code is written in a special symbolic assembly language using subroutine structure and includes a highly flexible operating system. Maximum problem size is approximately 400 equations and 10,000 variables.

IBM 7070 Library Program Abstracts — File no. 7.5.001 — Available prior to January 1962.

7070 A General Structure Factor Program for Crystallography

AUTHOR: Ryonosuke Shiono
The Crystallography Laboratory and
The Computation and Data Processing Center
University of Pittsburgh
Pittsburgh 13, Pennsylvania, U.S.A.

a. PURPOSE: To calculate the structure factors of crystals of Triclinic, Monoclinic or Orthorhombic classes (and also of Hexagonal, Tetragonal or Cubic with redundant atoms).

b. MACHINE REQUIREMENTS:
10,000 cores (or 5,000 cores)
1 7500 (Synchronizer 1) with IBM utility board
1 7550 (Synchronizer 1) with IBM utility board
1 7400 (Synchronizer 2) with IBM utility board
2 channels (1 and 2), 1 unit each

c. GENERAL DESCRIPTION: The expanded forms are used for the geometrical structure factors. A Sine-Cosine subroutine by series expansion is used. Fixed point.
Example of speed: $P2_1/c$, 3 kinds, 10 atoms, 1250 reflexions ca. 9 minutes with printing.

d. CAPABILITIES AND LIMITATIONS:

Maximum index of h, k, or l: ±999
Maximum number of reflexions: none
Maximum number of atomic scattering curves: = 13
Maximum number of atoms in one pass: 1500 (or 250 for 5000cores)

IBM 7070 Library Program Abstracts — File no. 8.1.001 — Available prior to January 1962

ARCTAN X

Applied Programming Dept.
IBM

a. Purpose: This program computes ARCTAN X (in radians) in floating decimal form for $-10^{49} < x < 10^{49}$

b. Machine Requirements: This program uses only fixed point operation codes and can be used on all 7070 configurations.

c. General Description: The arctangent is approximated by a continued fraction of the form

$$N\left(\frac{C_1|}{|C_2+(NC_1)^2} - \frac{C_3|}{|C_4+(NC_1)^2}\right)$$

after range adjustment. The average execute time varies from 0.1 milliseconds to 12.6 milliseconds depending on range. Maximum error is $2\cdot 10^{-8}$

d. Capabilities and Limitations: Input must be normalized floating decimal of form MM.DDDDDDDD (MM=exponent+50). The routine requires 90 locations and will alter the accumulators, index word 98, and the high-low-equal indicator.

IBM 7070 Library Program Abstracts File no. 8.1.002 Available prior to January 1962

7070 SINE COSINE SUBROUTINE

Contributed By: DS Applied Programming Dept.
IBM Corporation
1271 Avenue of Americas
New York, New York

A. Purpose: This program computes SINE X or COSINE X for $|x| 10^{11}$ radians in floating decimal form.

B. Machine Requirements: This program uses only fixed point operation codes and can be used on all 7070 configurations.

C. General Description: The method consists of a separation into integral and decimal parts, an evaluation of Sin $X = \sum C_{2\ell+1}(X_D)^{2\ell+1}$ and an adjustment of sign for quadrant correction. The maximum error is $\leq 10^{-8}$. Average execute time is 16.8 milliseconds.

D. Capabilities and Limitations: Input must be normalized floating decimal of form MM. DDDDDDDD (MM= exponent + 50). $X \geq 10^{11}$ will cause an error halt. The program requires 70 locations for instructions, constants, and temporary storage. It also requires (and will alter during execution) Accumulators 1, 2, and 3, and Index Word 98.

IBM 7070 Library Program Abstracts File no. 8.1.003 Available prior to January 1962

ARCSINE N

Applied Programming Dept.
IBM

a. Purpose: This program computes the Arcsin N ($N \leq 1$) in floating decimal form.

b. Machine Requirements: The program uses only fixed point operation codes, and can be used on all 7070 configurations.

c. General Description: The Arcsin is approximated by means of the expression

$$\frac{\pi}{2} - \sqrt{1-N}\sum_{i=0}^{7} C_i N^i$$

The maximum error is not greater than $5 \cdot 10^{-8}$. Average execute time (excluding the square root) is 9.7 milliseconds.

d. Capabilities and Limitations: Input must be normalized floating decimal numbers. The program requires 61 locations and will alter the three accumulators, index word 98, and the high-low-equal indicator. There must be a floating decimal square root subroutine available.

IBM 7070 Library Program Abstracts File no. 8.1.004 Available prior to January 1962

Subroutine for IBM 7070

Rolls Royce Ltd.
P. O. Box 31
Derby, England

Range: $|x| < 10$

Entry: X in accumulator 2 to 9 decimal places

a (BLX 51, R308S1
(BLX 51, R308S2

a+1 only exit

Sin/cos x in accumulator 2 to 9 decimal places

9991 set to - 0 -- 0

Space: 63 locations, including R308A - R308A - 10, excluding CØM, CØM + 1

I. W. 's 51, 52 (51 (2, 5), 52 (0, 9))

Method: Hastings, p. 140, with the coefficients C_i multiplied by $\left(\frac{2}{\pi}\right)^i$

$C_1 = 0.99\ 9999\ 9941$ $\quad C_7 = -0.00\ 0198\ 0740$

(Continued on next column)

$C_3 = -0.16\ 6666\ 5661$ $\quad C_9 = 0.00\ 0002\ 6019$

$C_5 = 0.00\ 8333\ 0252$

Error: Max. error is 1 in 8th decimal place.

IBM 7070 Library Program Abstracts File no. 8.1.005 Available prior to January 1962

Subroutine for IBM 7070

Rolls Royce Ltd.
P. O. Box 31
Derby, England

Range: $|x| < 10$

Entry: X in accumulator 2 to 9 decimal places.

a BLX 51, R310S

a+1 $x = n\pi + \frac{\pi}{2}$

a+2 normal exit

Tan x in accumulators 1 and 2 to 9 decimal places.

Space: 59 locations, including R310A - R310A + 7, excluding CØM, CØM+1

I.W.'s 51, 52 (51(2, 5), 52 (0, 9))

S.W. 21

Method: Reduce x to lie in the range $-\frac{\pi}{4} \leq x \leq \frac{\pi}{4}$, and hence use the series for x cot x mentioned in J. Assoc. Comp. Machinery, Vol. 6, No. 1, p. 114.

$$x \cot x = a_0 + a_1 y + a_2 y^2 + a_3 y^3 + a_4 y^4$$

where $y = \frac{(4x)^2}{(\pi)}$

The coefficients thus used are:

$A_0 = 0.99\ 9999\ 9940$ $\quad A_3 = -0.00\ 2095\ 9238$

$A_1 = -0.33\ 3332\ 9740$ $\quad A_4 = -0.00\ 0248\ 2949$

$A_2 = -0.02\ 2226\ 8075$

Error: Max. error is 1 in 8th. decimal place for x in the range $|x| \leq \frac{\pi}{4}$.

IBM 7070 Library Program Abstracts File no. 8.1.006 Available prior to January 1962

Subroutine for IBM 7070

Rolls Royce Ltd.
P. O. Box 31
Derby, England

Range: $|x| \leq 1.0$; $-\frac{\pi}{2} \leq \arcsin x \leq \frac{\pi}{2}$.

Entry; X in accumulator 2 to 9 decimal places.

a BLX 51, R311S.

a+1 Error, $|x| > 1.0$

a+2 Normal exit

Arcsin x in accumulator 2 to 9 decimal places.

9991 set to + 0 ___ 0.

Space: 48 locations, including R311A - R311A + 10, excluding CØM, CØM + 1,

I.W.'s 51, 52 {51 (2, 5), 52 (0, 9)},

S.W. 21

SORT 1

Note that the compare indicators may be reset by this routine.

Method: Hastings; p. 163.

$$\arcsin x = \frac{\pi}{2} - \sqrt{1 - x}\,\psi(x)$$

$$\psi(x) = a_0 + a_1 x + a_2 x^2 + \ldots\ldots\ldots\ldots\ldots\ a_7 x^7$$

$a_0 = -1.570\ 796\ 305$ $\quad a_4 = -0.030\ 891\ 881$

$a_1 = -0.214\ 598\ 802$ $\quad a_5 = -0.017\ 088\ 126$

$a_2 = -0.088\ 978\ 987$ $\quad a_6 = -0.006\ 670\ 090$

$a_3 = -0.050\ 174\ 305$ $\quad a_7 = -0.001\ 262\ 491$

Note that the routine uses the variable $-|x|$, as a result of which the coefficients used differ in sign from those in Hastings.

Error: Max. error is 4 in 8th decimal place.

IBM 7070 Library Program Abstracts — File no. 8.1.007 — Available prior to January 1962

Subroutine for IBM 7070

Rolls Royce Ltd.
P. O. Box 31
Derby, England

Range: $|x| < 10^{12}$; $-\frac{\pi}{2} <$ arctan $x < \frac{\pi}{2}$

Entry: X in accumulators 1, 2 to 9 decimal places.

a BLX 51, R312S
a+1 only exit.

Arctan x in accumulator 2 to 9 decimal places.

9991 set to +0 ——— 0.

Space: 62 locations, including R312A - R312A - 11, excluding CØM, CØM - 1

I. W. 's 51, 52 {51 (2, 5), 52 (0, 9)}

Method: Hastings, p. 137. If $|x| > 1$, take reciprocal.

At most ten significant digits of x are used.

$$\arctan x = \sum_{i=0}^{7} C_{2i+1} x^{2i+1}$$

C_1 = 0. 999 999 333	C_9 = 0. 096 420 044
C_3 = 0. 333 298 561	C_{11} = 0. 055 909 886
C_5 = 0. 199 465 360	C_{13} = 0. 021 861 229
C_7 = 0. 139 085 335	C_{15} = 0. 004 054 058

Error: Max. error is 4 in 8th decimal place.

IBM 7070 Library Program Abstracts — File no. 8.1.008 — Available prior to January 1962

Degrees To Radians Conversion

M. Roberts
AC Spark Plug Div GMC
Milwaukee, Wisconsin

a. Purpose: To convert an angle of the following form:

xxxx° xx' xx.xx" — **seconds**, **minutes**, **degrees**

to radians in normalized floating point form.

b. Machine Requirements: Floating point hardware, 45 core storage words

c. General Description: The routine will convert one or a table of values

d. Capabilities and Limitations: Accumulators and indicators are not saved.

IBM 7070 Library Program Abstracts — File no. 8.1.009 — Available prior to January 1962

7070 - Radians to Degrees Conversion

M. Roberts
AC Spark Plug Div GMC
Milwaukee, Wisconsin

a. Purpose: To convert radians in floating point notation to degrees, minutes, and seconds:

0xxx xx xx.xx — seconds, minutes, degrees

b. Machine Requirements: Floating point hardware, 49 core storage words

c. General Description: The subroutine will convert one or a table of values.

d. Capabilities and Limitations: Angles to be converted must not exceed 17.4532 radious.

IBM 7070 Library Program Abstracts — File no. 8.1.010 — Available prior to January 1962

7070 - Arctangent Subroutine

M. Roberts
AC Spark Plug Div GMC
Milwaukee, Wisconsin

a. Purpose: To find arctan of argument x where X = y/x

b. Machine Requirements: Floating hardware, 77 words storage

c. General Description: Evaluation of the following continued fraction:

$$\arctan x = x \left[B_0 + \cfrac{A_1}{x^2 + B_1 - \cfrac{A_2}{x^2 + B_2 - \cfrac{A_3}{x^2 + B_3}}} \right]$$

d. Capabilities and Limitations: Input must be in normalized floating point notation. Answer may be in either degrees or radions. Signs of y/x will determine the quadrant of the answer.

IBM 7070 Library Program Abstracts — File no. 8.1.011 — Available prior to January 1962

7070 - Sine-Cosine Subroutine

M. Roberts
AC Spark Plug Div GMC
Milwaukee, Wisconsin

a. Purpose: To find sine of an argument x

b. Machine Requirements: Floating hardware, 73 storage words plus one word CCØM, 1 electronic switch

c. General Description: Evaluation of following series

$$\text{Sine } x = x - x^3/3! + x^5/5! - x^7/7! + x^9/9! - x^{11}/11!$$

d. Capabilities and Limitations: Input must be normalized floating point number. Main routine must save CCØM. x is stored as sine x if lx .0015 radions. Entry is permitted in either radions or degree units for x.

IBM 7070 Library Program Abstracts — File no. 8.1.012 — Available prior to January 1962

ARCTANGENT SUBROUTINE

Contributed By:

Author: H. Hyman, Applied Science

Organization: IBM Svenska AB

Gävlegatan 20
Stockholm 6, SWEDEN

a. Purpose: A full precicsion, fixed point subroutine to compute the inverse tangent function, expressed in radians.

b. Machine Requirements: All accumulators, the compare indicators, 1 electronic switch, 2 index words and 90 ordinary storage locations.

c. General Description: The arctangent is approximated by a polynomial of the fourth degree. The constants of the polynomial are stored in a 50 word table. Accuracy: The magnitude of the maximum error is 0.000 000 003. Average execution time: 5.4 milli-seconds.

d. Capabilities and Limitations: The argument X must satisfy:

$$-1. \leq X \leq 1.$$

IBM 7070 Library Program Abstracts — File no. 8.1.013 — Available prior to January 1962

HYPERBOLIC TANGENT SUBROUTINE

Contributed By:

Author: H. Hyman, Applied Science

Organization: IBM Svenska AB

Gävlegatan 20
Stockholm 6, SWEDEN

(Continued on next page)

a. Purpose: A full precision, fixed point subroutine to compute the hyperbolic tangent.

b. Machine Requirements: All accumulators, the compare indicators, 1 electronic switch, 3 index words and 109 ordinary storage locations.

c. General Description: The tanh function is approximated using a tanh expansion formula and a polynomial of the third degree. The choice of constants in this polynomial depends on the argument, and the constants are taken from a 65 word table. Accuracy: The magnitude of the error is always less than 0.000 000 008. Average execution time: 11.0 milliseconds.

d. Capabilities and Limitations: The argument X must statisfy:

$$-10 < X < +10$$

File no. 8.1.014

IBM 7070 Library Program Abstracts

Available prior to January 1962

MODULO 2π CONVERSION SUBROUTINE

Contributed By:

Author: S. Nordin, Applied Science

Organization: IBM Svenska AB

Gävlegatan 20
Stockholm 6, SWEDEN

a. Purpose: A double-precision, fixed point subroutine to convert numbers modulo 2π.

b. Machine Requirements: All accumulators, 2 index words and 25 ordinary storage locations.

c. General Description: If wished, this subroutine may be used to increase the permitted range for the arguments, when using the Sine-Cosine Subroutine and the Tangent-Cotangent Subroutine by the same author.

d. Capabilities and Limitations: The argument X must be expressed in radians and satisfy:

$$-10^{10} < X < 10^{10}$$

File no. 8.1.015

IBM 7070 Library Program Abstracts

Available prior to January 1962

SINE AND COSINE SUBROUTINE

Contributed By:

Author: H. Hyman, Applied Science

Organization: IBM Svenska AB

Gävlegatan 20
Stockholm 6, SWEDEN

a. Purpose: A half-precision, fixed point subroutine to compute the sine or cosine of an angle given in degrees.

b. Machine Requirements: All accumulators, 1 electronic switch, the compare indicators, 2 index words and 92 ordinary storage locations.

c. General Description: The sine or cosine function is approximated by a polynomial of the second degree. The choice of constants in this polynomial depends on the argument value. One of 18 sets of constants is used. Accuracy: 5 decimal places. Average execution time: 2.8 milliseconds.

d. Capabilities and Limitations: The argument X must be of the form $\pm$XXXXXXX.XXX and satisfy:

$$-10000000 < X < 9999910$$

File no. 8.1.016

IBM 7070 Library Program Abstracts

Available prior to January 1962

TANGENT-COTANGENT SUBROUTINE

Contributed By:

Author: S. Nordin, Applied Science

Organization: IBM Svenska AB

(Continued on next column)

Gävlegatan 20
Stockholm 6, SWEDEN

a. Purpose: A full precision, fixed point subroutine to compute the tangent or contangent of an angle given in radians.

b. Machine Requirements: All accumulators, the compare indicators, 2 index words and 92 ordinary storage locations.

c. General Description: The tangent or cotangent function is approximated using tangent expansion formulas and an odd polynomial of the fifth degree. Accuracy: The magnitude of the maximum error is $10^{-9} \cdot \sec^2 X$ for tanX, and $10^{-9} \cdot \operatorname{cosec}^2 X$ for cotX. Average execution time: 8.4 milliseconds.

d. Capabilities and Limitations: The argument X must satisfy:

$$-10 < X < 10$$

File no. 8.1.017

IBM 7070 Library Program Abstracts

Available prior to January 1962

INVERSE TANGENT/COTANGENT SUBROUTINE

Contributed By:

Author: G. J. Elliott, Applied Science

Organization: IBM Svenska AB

Gävlegatan 20
Stockholm 6, SWEDEN

a. Purpose: A full precision, fixed point subroutine to compute the principal value (in radians) of the inverse tangent or cotangent function.

b. Machine Requirements: All accumulators, the compare indicators, 2 electronic switches, 2 index words and 57 ordinary storage locations.

c. General Description: The argument is transformed to satisfy $|X| \leq 1$. Then the Arctangent Subroutine by H. Hyman is used to compute the function. Accuracy: The maximum error is 0.000 000 005. Average execution time: 6-7 milliseconds.

d. Capabilities and Limitations: The argument X must be either zero or satisfy:

$$10^{-(10^{10})} \leq |X| < 10^{(10^{10}-1)}$$

File no. 8.1.018

IBM 7070 Library Program Abstracts

Available prior to January 1962

X^y- SUBROUTINE

Contributed By:

Author: S. Nordin, Applied Science

Organization: IBM Svenska AB

Gävlegatan 20
Stockholm 6, SWEDEN

a. Purpose: A full precision, fixed point subroutine to compute X^y.

b. Machine Requirements: All accumulators and 11 ordinary storage locations.

c. General Description: The program computes X^y by means of the formula $X^y = e^{y \ln X}$ and makes use of two other subroutines by T. Rabe and H. Hyman. Accuracy: The maximum relative error is of the order $3 \cdot 10^{-8}$ $(|y|+0.1)$. Average execution time: 17. milliseconds.

d. Capabilities and Limitations: The arguments X and y must satisfy:

$$10^{-44} < X < 2.688 \cdot 10^{43}$$
$$-100 < y < +100$$

File no. 8.1.019

IBM 7070 Library Program Abstracts

Available prior to January 1962

ARCSINE-ARCCOSINE SUBROUTINE

Contributed By:

Author: S. Nordin, Applied Science

Organization: IBM Svenska AB

Gävlegatan 20
Stockholm 6, SWEDEN

(Continued on next page)

a. Purpose: A full precision, fixed point subroutine to compute the arcsine or arccosine function.

b. Machine Requirements: All accumulators, the compare indicators. 3 index words and 113 ordinary storage locations.

c. General Description: For arguments in the interval $(0.5, 0.9978]$ repeated applications of the formula $\arcsin X = 0.25\pi + 0.5 \cdot \arcsin(2X^2-1)$ will bring the argument to the interval $[0.0, 0.5]$. The latter interval is subdivided into five intervals. In each such interval the arcsine function is approximated by a polynomial of the fifth degree. In the interval $(0.9978, 1.0]$ the function is approximated by $\arcsin X \approx 0.5\pi - \sqrt{1-X}\,[a + b(1-X)]$. Accuracy: The magnitude of the maximum error is $2 \cdot 10^{-9}$. Average execution time: 6.8 milliseconds.

d. Capabilities and Limitations: The routine will give the principal values expressed in radians. The argument X must satisfy $-1 \leq X \leq 1$.

IBM 7070 Library Program Abstracts

File no. 8.1.020
Available prior to January 1962

HYPERBOLIC SINE, COSINE AND COTANGENT SUBROUTINE.

Contributed By:

Author: G. J. Elliott, Applied Science

Organization: IBM Svenska AB

Gävlegatan 20
Stockholm 6, SWEDEN

a. Purpose: A full precision, fixed point subroutine to compute the hyperbolic sine, cosine or cotangent of a number.

b. Machine Requirements: All accumulators, the compare indicators, 2 electronic switches, 2 index words and 101 ordinary storage locations.

c. General Description: This subroutine uses an Exponential Subroutine by T. Rabe. Sinh X and cosh X are computed according to the definition formula. Coth X are also computed in this way for X 0.1 but otherwise coth X are approximated by a polynomial. Accuracy: The maximum error is 8 in the last digit. Average execution time: 14.5 milliseconds.

d. Capabilities and Limitations: The magnitude of the argument must be less than 10^{10}.

IBM 7070 Library Program Abstracts

File no. 8.1.021
Available prior to January 1962

SINE-COSINE SUBROUTINE

Contributed By:

Author: S. Nordin, Applied Science

Organization: IBM Svenska AB

Gävlegatan 20
Stockholm 6, SWEDEN

a. Purpose: A full precision, fixed point subroutine to compute the sine or cosine function.

b. Machine Requirements: All accumulators, the compare indicators, 2 index words and 55 ordinary storage locations.

c. General Description: By the use of well-known trigonometrical identities, the problem may be reduced to that of calculating the functions with arguments in the interval $(0, \pi/4)$. Then the functions are approximated by the polynomials:

$$\sin X \approx a_1X + a_3X^3 + a_5X^5 + a_7X^7 + a_9X^9$$

$$\cos X \approx a_0 + a_2X^2 + a_4X^4 + a_6X^6 + a_8X^8$$

Accuracy: The magnitude of the maximum error is 10^{-9}. Average execution time: 6.4 milliseconds.

d. Capabilities and Limitations: The argument X must be expressed in radians and satisfy $-10 < X < 10$.

IBM 7070 Library Program Abstracts

File no. 8.2.001
Available prior to January 1962

10^X and e^X

Applied Programming Department
IBM

a. Purpose: This program computes 10^X or e^X in floating decimal form, MMDDDDDDDD (MM = exponent + 50) for $-51 < X < 49$ (for 10^X) or $-112.8 < X < 112.8$ (for e^X).

b. Machine Requirements: The program uses only fixed point operation codes, and can be used with all 7070 configurations. Sense mode for sign change and for field overflow must be preset.

c. General Description: X is separated into integral and decimal parts and the decimal part is evaluated by means of the expression

$$\left(\sum_{i=0}^{7} C_i X_d^i\right)^2$$

Maximum error will not exceed $2 \cdot 10^{-8}$. The average execute time is 11 milliseconds.

d. Capabilities and Limitations: Input must be normalized floating decimal. The program requires 65 locations and will alter Accumulators 1, 2, and 3, Index Word 98 and the high-low-equal indicator.

IBM 7070 Library Program Abstracts

File no. 8.2.002
Available prior to January 1962

LOG BASE 10 OR BASE e

Applied Programming Department
IBM

a. Purpose: This program computes log (BASE 10 or BASE e) of X in floating decimal form.

b. Machine Requirements: The program uses only fixed point operations and can be used with any 7070 configuration.

c. General Description: X is treated as the product of a set of numbers whose logs are known and a number between 0 and 0.1 whose log is found by evaluating a relaxed Taylor series. Average execute time is 6.75 ms. for log and 7.75 m.s. for loge. Maximum error is 2×10^{-8}.

d. Capabilities and Limitations: The input must be normalized floating decimal of form MM.DDDDDDDD (MM=exponent + 50). The program requires 54 locations, the three Accumulators and Index Word 98.

IBM 7070 Library Program Abstracts

File no. 8.2.003
Available prior to January 1962

Subroutine e^N for IBM 7070

Rolls Royce Ltd.
P. O. Box 31
Derby, England

Method: Reference: IBM Journal of Research and Development - April 1957

Range: $10 \log_e 10 > x \geqq 9 \log_e 10$.

Entry: x to 8 decimal places in Accumulator 2.

a - BLX 51, R306S

a+1 - ERROR - i. e. out of range

a+2 - Normal return

Exit: e^x to 10 decimal places in Accumulators 1 and 2.

Accuracy: 1 in 10th significant figure.

Timing: Estimated 10.5 milli-seconds.

Locations used: 90 AND CØM

Switches Used: NONE.

Index locations used: 51, 52, 53.

IBM 7070 Library Program Abstracts — File no. 8.2.004 — Available prior to January 1962

Subroutine $Log_e x$ for IBM 7070

Rolls Royce Ltd.
P. O. Box 31
Derby, England

This subroutine computes $\log_e x$ for a single-precision fixed point argument.

Restrictions: $\text{Log}_e x$ is computed for $x > 0$. For $x \leq 0$ control is returned to a+ 1 in the calling sequence.

Usage: Calling sequence.

x in accumulators 1, 2 to 10 decimal places

```
 LOC
a    BLX 51, R307S
a+1  Error return
a+2  Normal return
```

On exit $\log_e x$ is in accumulator 2 to 8 decimal places.

Coding: 47 locations are used. Index accumulators used are:-

51 (0, 9)
52 (2, 5)
53 (2, 5)
54 (0, 9)

Timing:- approx.

Method: $\text{LOG}_e X = \text{LOG}_e (1+y) + (10-n)\,\text{LOG}_e 10 - m \log_e 2$

Where n - number of shifts to left justify x in accumulator 1.
n - number of times doubling is needed to bring shifted x into the form 1 + y to 10 decimal places.

$$\text{LOG}_e (1+y) = \sum_{i=1}^{8} a_i x^i$$

Where $a_1 = +.9999964239$
$a_2 = -.4998741238$
$a_3 = +.3317990258$
$a_4 = -.2407338084$
$a_5 = +.1676540711$
$a_6 = -.0953293897$
$a_7 = +.0360884937$
$a_8 = -.0064535442$

Accuracy: Max. error is 3 in the 8th decimal place.

IBM 7070 Library Program Abstracts — File no. 8.2.005 — Available prior to January 1962

7070 - Logarithm Subroutine

M. Roberts
AC Spark Plug Div GMC
Milwaukee, Wisconsin

a. Purpose: To find the logarithm of argument x (ln x or log x)

b. Machine Requirements: Floating point hardware, 82 words core storage

c. General Description: Evaluation of the following series:

$$\ln x = 2 \sum y^i / i \text{ where } i = 1, 3, 5 \ldots$$
$$\text{for } x < \sqrt{10},\ y = x-1/x+1$$
$$\text{for } x > \sqrt{10},\ y = x-\sqrt{10}/x+\sqrt{10}$$

d. Capabilities and Limitations: Input must be normalized floating point no.

IBM 7070 Library Program Abstracts — File no. 8.2.006 — Available prior to January 1962

7070 - Exponential Subroutine

M. Roberts
AC Spark Plug Div GMC
Milwaukee, Wisconsin

a. Purpose: To find exponential of argument x (e^x or 10^x)

b. Machine Requirements: Floating hardware, 50 core locations

c. General Description: Evaluation of following series:

$$10^x = (1 + a_1 x + a_2 x^2 + a_3 x^3 \ldots + a_7 x^7)^2 \quad 0 \leq x \leq 1$$

d. Capabilities and Limitations: Input must be in normalized floating point notations. Accumulators and H, L, E indicators are not saved.

IBM 7070 Library Program Abstracts — File no. 8.2.007 — Available prior to January 1962

EXPONENTIAL SUBROUTINE

Contributed By:

Author: T. Rabe, Applied Science

Organization: IBM Svenska AB

Gävlegatan 20
Stockholm 6, SWEDEN

a. Purpose: A full precision, fixed point subroutine to compute the exponential function.

b. Machine Requirements: All accumulators, the compare indicators, the overflow indicator for accumulator 2, 2 index words and 102 ordinary storage locations.

c. General Description: The exponential function is approximated by a polynomial of the fourth degree. The maximum error is 3 in the last digit. Average execution time is 8.4 milliseconds.

d. Capabilitites and Limitations: The magnitude of the argument must be less than 10^{10}.

IBM 7070 Library Program Abstracts — File no. 8.2.008 — Available prior to January 1962

NATURAL LOGARITHM SUBROUTINE

Contributed By:

Author: H. Hyman, Applied Science

Organization: IBM Svenska AB

Gävlegatan 20
Stockholm 6, SWEDEN

a. Purpose: A full precision, fixed point subroutine to compute the logarithm.

b. Machine Requirements: All accumulators, the overflow indicator for accumulator 2, 3 index words and 115 ordinary storage locations.

c. General Description: The logarithm is approximated by a polynomial of the third degree. The constants of this polynomial depend on the argument and are stored in a 64 word table. Accuracy: The magnitude of the maximum error is 0.000 000 03. Average execution time: 7.1 milliseconds.

d. Capabilities and Limitations: The argument X of lnX must satisfy:

$$10^{-44} < X < 2.688 \cdot 10^{43}$$

IBM 7070 Library Program Abstracts — File no. 8.3.001 — Available prior to January 1962

SQUARE ROOT X

Applied Programming Dept.
IBM

a. Purpose: This program computes the square root of $x \geq 0$ in floating decimal form.

b. Machine Requirements: This program uses only fixed point operation codes, and can be used on all 7070 configurations.

c. General Description: The method consists of a linear approximation followed by two iterations of Newtons formula (modified). The maximum error is -1 in the eighth place of the digitand. Average execute time is 10.3 milliseconds.

d. Capabilities and Limitations: Input must be normalized floating decimal numbers of the form MMDDDDDDDD (MM = exponent + 50). An attempt to take the square root of a negative number will produce an error halt. The program requires 42 locations for instructions, constants, and temporary storage. It also requires (and will alter during execution) Accumulators 1, 2, and 3, and Index Word 98.

IBM 7070 Library Program Abstracts

File no. 8.3.002
Available prior to January 1962

Square Root, Topler Method

Rolls Royce Ltd.
P.O. Box 31
Derby, England

Purpose: This subroutine computes square root x to a controlled accuracy for a single precision fixed point argument.

Range: $0 \leq x < 1$.

Usage: Input: x to 10 decimal places in 9992.

(A) If maximum accuracy is required:-

Calling sequence: a BLX 51, R304[illegible]
a+1 error return, $x < 0$
a+2 normal return.

(B) If less accuracy is required, enter 000n in I.W. 52 (6,9), where n is the number of decimal places of accuracy required, $0 < n < 8$.

Calling sequence: a BLX 51, S304S2
a+1 error return, $x < 0$

a+2 normal return.

Output: $\sqrt{x}$ to 10 decimal places in 9992
+ 0 in 9991.

Space: 25 locations. Index words 51 (2, 5), 52 (2, 9).

Method: The Töpler process of successive subtraction of odd numbers. This is based on the fact that,

$$\sum_{i=1}^{n} (2i - 1) = n^2$$

and is the method normally used in desk machine computation.

Accuracy: When used with maximum accuracy, the maximum error is 5 in the 9th decimal place.

Timing: Average execution time is approx. .7 + 1.3n ms.
For maximum accuracy (n = 8), the time is approx. 11.1 ms.

IBM 7070 Library Program Abstracts

File no. 8.3.003
Available prior to January 1962

7070 - N^{th} ROOT OF X

Rolls Royce, Ltd.
P. O. Box 31
Derby, England

Purpose: This subroutine computes n^{th} root x for a single precision fixed point argument.

Range: $0 \leq x < 1$, $n < 9999$.

Usage: Input : x to 10 decimal places in 9992.

$\frac{1}{n}$ to 10 decimal places in 9993.

Output: $\sqrt[n]{x}$ to 10 decimal places in 9992.

+0 in 9991.

Calling sequence: a BLX 51, R305S

a+1 error return, $x<0$

a+2 normal return

Space: 32 locations excluding CØM - CØM + 3
Index words 51 (2, 5), 52 (0, 9).

Method: Newton's iteration process: -

$$y_{i+1} - y_i = \frac{1}{n} \left(\frac{x}{y_i^{n-1}} - y_i \right)$$

with y_o = .9999999999.

Accuracy: As accurate as oscillations allow. With reasonable combinations of n and x i. e., n small and x near normalised, maximum error is about 5 in the 10^{th} decimal place.

Timing: Average execution time is approx.

3.6 + m (1.2n + 2.4) ms

where m is the number of iterations.

IBM 7070 Library Program Abstracts

File no. 8.3.004

Subroutine for IBM 7070

Rolls Royce Ltd.
P.O. Box 31
Derby, England

Purpose: This subroutine computes square root x for a single precision fixed point argument.

Range: $0 \leq x < 1$

Usage: Input: x to 10 decimal places in 9992.
Output: $\sqrt{x}$ to 10 decimal places in 9992.
+ 0 in 9991.

Calling sequence: a BLX 51, R309S
a+1 error return, $x < 0$
a+2 normal return

Space: 50 locations including R39A - R39A + 5, and excluding CØM, CØM + 1. Index words 51 (2, 5), 52(2,5), 53 (2, 5)
Electronic switches 21, 22
Note that the compare indicators may be reset by this routine.

Method: A predicition of $\sqrt{x}$ correct to .0034 using -

$$\sqrt{x} \doteq .176661 + 1.523546x - .938906x^2, \quad .1 \leq x \leq .5$$
$$\sqrt{x} \doteq .3151385 + .8856812x - .2013536x^2, \quad .5 \leq x \leq 1$$

followed by two applications of Newton's iteration method;-

$$y_{i+1} = 1/2 \left(y_i + x/y_i \right)$$

Accuracy: Maximum error is 5 in the 10th. decimal place

Timing: Average execution time is approx. 12.7 ms.

IBM 7070 Library Program Abstracts

File no. 8.3.005
Available prior to January 1962

7070 - Cube Root Subroutine

R. Culp
AC Spark Plug Div GMC
Milwaukee, Wisconsin

a. Purpose: To compute the cube root of a real number in floating point form.

b. Machine Requirements: Floating hardware, 40 core storage words

c. General Description: Bailey iteration

$$x_{i+1} = \frac{x_i \left(x_i^3 + 2N\right)}{2x_i^3 + N}$$

d. Capabilities and Limitations: Input must be in normalized floating point form.

IBM 7070 Library Program Abstracts

File no. 8.3.006
Available prior to January 1962

Double Precision Square Root Subroutine

A. Dickerman
AC Spark Plug Div GMC
Milwaukee, Wisconsin

a. Purpose: To extract the square root of a 16 digit floating point number.

b. Machine Requirements: Floating hardware, 171 core locations.

c. General Description: Iterate:

$$\sqrt{x} = \frac{Y + 3A}{3Y + A}$$

d. Capabilities and Limitations: Input must be normalized floating point. Maximum error is 1 in the 16th place.

IBM 7070 Library Program Abstracts

File no. 8.3.007
Available prior to January 1962

Square Root Subroutine

M. Roberts
AC Spark Plug Div GMC
Milwaukee, Wisconsin

a. Purpose: To find square root of argument A

b. Machine Requirements: Floating hardware, 45 words storage

c. General Description: Iterate:

$$\sqrt{A} = \left(\frac{Y + 3A}{3Y + A}\right)$$ where initial approximation is

$x = 1 + .2A$
$Y = x^2$

d. Capabilities and Limitations: Input must be normalized floating point. Maximum error is 1 in eighth place.

IBM 7070 Library Program Abstracts

File no. 8.3.008
Available prior to January 1962

SQUARE ROOT SUBROUTINE

Contributed By:

Author: T. Rabe, Applied Science

Organization: IBM Svenska AB

Gävlegatan 20
Stockholm 6, SWEDEN

a. Purpose: A half-precision, fixed point subroutine to compute the square root.

b. Machine Requirements: All accumulators, the compare indicators, 2 index words and 115 ordinary storage locations.

c. General Description: The square root is approximated by a polynomial of the second degree. The choice of constants in this polynomial depends on the first two digits in the argument. One of 32 sets of constants is used. Accuracy: 5 digits. Average execution time: 2.15 milliseconds.

d. Capabilities and Limitations: The program will accept any positive argument where the first two digits are not both zeroes. The program will also accept the arguments +0 and -0.

IBM 7070 Library Program Abstracts

File no. 8.3.009
Available prior to January 1962

SQUARE ROOT SUBROUTINE

Contributed By:

Author: G. J. Elliott, Applied Science

Organization: IBM Svenska AB

Gävlegatan 20
Stockholm 6, SWEDEN

a. Purpose: A full precision, fixed point subroutine to compute the positive square root of a number.

b. Machine Requirements: All accumulators, the compare indicators, 2 index words and 46 ordinary storage locations.

c. General Description: The subroutine obtains a first approximation using the half-precision Square Root Subroutine by T. Rabe. Then one application of the Newtonian formula gives ten digits accuracy. Average execution time: 6.9 milliseconds.

d. Capabilities and Limitations: Negative arguments will cause a programmed stop.

IBM 7070 Library Program Abstracts

File no. 8.3.010
Available prior to January 1962

SQUARE ROOT SUBROUTINE

Contributed By:

Author: S. Nordin, Applied Science

Organization: IBM Svenska AB

Gävlegatan 20
Stockholm 6, SWEDEN

a. Purpose: An 8-digit precision, fixed point subroutine to compute the square root of the absolute value of a number.

b. Machine Requirements: All accumulators, 2 index words and 14 ordinary storage locations.

c. General Description: The "odd-integer method" is used. Accuracy: Eight digits. Average execution time: 11 milliseconds. This space-saving but fairly time-consuming routine is included in the Arcsine-Arccosine Subroutine by the same author.

d. Capabilities and Limitations: Does not apply.

IBM 7070 Library Program Abstracts

File no. 8.4.001
Available prior to January 1962

Double Precision Floating Divide

R. Haertle, M. Roberts
AC Spark Plug Div GMC
Milwaukee, Wisconsin

a. Purpose: Divide a 16 digit floating point number by a 16 digit floating point number to obtain a 16 digit floating point quotient.

b. Machine Requirements: Floating hardware, 30 core storage words

c. General Description: $\frac{A_1 + A_2}{B_1 + B_2} = \frac{A_1 + A_2}{B_1} - \frac{A_1 + A_2}{B_1} \times \frac{B_2}{B_1}$

d. Capabilities and Limitations: The AC Spark Plug double precision floating add and multiply routines must be assembled with this routine.

IBM 7070 Library Program Abstracts

File no. 8.4.002
Available prior to January 1962

Double Precision Floating Multiply

R. Haertle, M. Roberts
AC Spark Plug Div GMC
Milwaukee, Wisconsin

a. Purpose: Multiply two 16 digit floating point numbers.

b. Machine Requirements: Floating hardware, 35core storage words

c. General Description: $(A_1 + A_2) \times (B_1 + B_2) = (A_1B_1 + A_1B_2 + A_2B_1 + B_2A_2)$

d. Capabilities and Limitations: A 16 digit product is developed. The AC Spark Plug double precision add subroutine must be used with this subroutine.

IBM 7070 Library Program Abstracts

File no. 8.4.003
Available prior to January 1962

Double Precision Floating Add

R. Haertle, M. Roberts
AC Spark Plug Div GMC
Milwaukee, Wisconsin

(Continued on next page)

a. Purpose: Add two 16-digit floating numbers

b. Machine Requirements: Floating hardware, 22 core storage words

c. General Description: The subroutine utilizes the double precision add code with logic necessary to accomplish the algebraic summation of two double precision numbers.

d. Capabilities and Limitations: Input must be in normalized floating point form (The low order word of the double precision number must have a characteristic of eight less the high order word of that double precision number).

File no. 8.6.001

IBM 7070 Library Program Abstracts Available prior to January 1962

Interpolation Subroutine

Rolls Royce Ltd.
P.O. Box 31
Derby, England

Purpose: To find an interpolate using 2, 3 or 4 points.

Method: 2, 3 or 4 point Aitken.

Entry: x in 9992 with the same alignment as x_i's.

The number of points to be used, n, in the non-indexing portion of index word 52.

x_i's in symbolic locations CØM + 1 . . . . CØM + n

y_i's in symbolic locations CØM + n + 1 . . . . CØM + 2n

a BLX 51, R301S

a + 1 return

y will be placed in 9992 with the same alignment at the y_i's.

Space: 22 locations and CØM to CØM + 10 index words. 51. (2, 5), 52, 53.

Timing: .5 + 4.5 n (n - 1) milliseconds approx.

File no. 8.6.002

IBM 7070 Library Program Abstracts Available prior to January 1962

Table Interpolation

M. Roberts
AC Spark Plug Div GMC
Milwaukee, Wisconsin

a. Purpose: Given x and a table of x_i and n associated dependent functions, $y_n = f_n(x)$, to interpolate to the desired order for the y's specified in the subroutine linkage.

b. Machine Requirements: Floating hardware, 88 words of storage plus table area.

c. General Description: A search is performed with the argument x to locate the best available $k_x + 1$ x-coordinates. Interpolation of order k_x is then performed by passing a polynomial of degree k_x through $K_x + 1$ points. The Aitken form of the polynomial is used. When x lies outside the range of the table, extrapolation is performed.

d. Capabilities and Limitations: Input must be in normalized floating form.

File no. 8.9.001

IBM 7070 Library Program Abstracts Available prior to January 1962

FLOATER, a subroutine to convert numbers from fixed to floating decimal form.

Contributed By:

Author: H. Hyman, Applied Science

Organization: IBM Svenska AB

Gävlegatan 20
Stockholm 6, SWEDEN

a. Purpose: See title.

b. Machine Requirements: All accumulators, the compare indicators, index word # 98, 2 other index words, 16 ordinary storage locations and a storage area for the block to be converted.

(Continued on next column)

c. General Description: A sequential block of fixed decimal numbers will be replaced by their corresponding floating decimal numbers. Average execution time: 0.58 milliseconds per word to be floated.

d. Capabilities and Limitations: Alphameric words will not be floated, but ignored. If a characteristic greater than 99 is developed, it will be treated modulo 100. If a negative characteristic is developed, the floating decimal number will be set to zero.

File no. 8.9.002

IBM 7070 Library Program Abstracts Available prior to January 1962

FIXER, a subroutine to convert numbers from floating to fixed decimal form.

Contributed By:

Author: H. Hyman, Applied Science

Organization: IBM Svenska AB

Gävlegatan 20
Stockholm 6, SWEDEN

a. Purpose: See title.

b. Machine Requirements: All accumulators, the compare indicators, index word # 98, 1 other index word, 25 ordinary storage locations and a storage area for the block to be converted.

c. General Description: A sequential block of floating decimal numbers will be replaced by their corresponding fixed decimal numbers. Average execution time: 0.8 milliseconds per number to be converted.

d. Capabilities and Limitations: Alphameric words will not be converted, but ignored. If a fixed decimal number, greater in magnitude than 9999999999, is tried to be developed, it will be considered to be ± 9999999999.

File no. 9.1.001

IBM 7070 Library Program Abstracts Available prior to January 1962

7070 POLYNOMIAL ROOT EXTRACTION (TIREX)

Contributed by: George E. Priest
Texas Instruments
Technical Computations
P. O. Box 5474
Dallas 22, Texas

a. Purpose: This routine is designed to solve for all zeros (roots) of a polynomial in one unknown with real coefficients.

b. Machine Requirements:

As the source deck stands it calls for one card reader (alpha) and one magnetic tape on unit 14. This may be easily altered in the source program. The routine requires 399 storage locations when assembled plus package deck and square root subroutine.

c. General Description:

The program employs a variation of Bairstow's method as the solution technique. This method is not subject to breakdown when there are multiple roots.

d. Capabilities and Limitations:

The routine is designed for polynomial with only real coefficients, however it solves for both real and complex roots.

File no. 10.1.001

IBM 7070 Library Program Abstracts Available prior to January 1962

Double Precision Matrix Multiplication

A. Dickerman
AC Spark Plug Div GMC
Milwaukee, Wisconsin

a. Purpose: To multiply two matrices with any number of rows and columns within the limitations of core storage.

b. Machine Requirements: Floating hardware, 97 storage words plus AC Spark Plug double precision add and multiply subroutines. The user must also reserve the area of the two matrices as well as the product matrix.

c. General Description: Standard matrix multiplication

d. Capabilities and Limitations: Input in normalized floating form. Indicators and accumulators are not saved.

IBM 7070 Library Program Abstracts File no. 10.1.002 Available prior to January 1962

7070 MATRIX INVERSION AND SIMULTANEOUS EQUATIONS

CONTRIBUTED BY: W. W. Marks and Gordon Smith
IBM Corporation
Los Angeles Wilshire

PURPOSE: To invert a given matrix and/or to solve a system of simultaneous linear equations. To perform matrix operations as subroutines.

MACHINE REQUIREMENTS: A 5K or 10K 7070 with floating point hardware.

GENERAL DESCRIPTION: An elimination method with interchange of columns to bring the largest element in the row into the diagonal.

CAPABILITIES AND LIMITATIONS: A matrix of approximately 97 x 97 can be inverted on a 10K machine and a 67 x 67 on a 5K machine. The matrix package occupies 691 locations.

IBM 7070 Library Program Abstracts File no. 10.1.003 Available prior to January 1962

SINGLE PRECISION MATRIX INVERSION

Contributed By:

Author: H. Hyman, Applied Science

Organization: IBM Svenska AB

Gävlegatan 20
Stockholm 6, SWEDEN

a. Purpose: A single precision, floating point program for a 7070 without floating decimal hardware to invert a matrix and solve systems of linear equations.

b. Machine Requirements: All accumulators, the compare indicators, the priority mask register, 1 electronic switch, 12 index words, storage locations # 97, # 99, # 100, # 103 - # 279, 296 ordinary storage locations, a storage area for the augmented matrix and one or two tape units.

c. General Description: The program uses the pivotal elimination method of Jordan, and will automatically select a non-zero pivot element. The program may also be used to solve an arbitrary number of systems of equations, where the coefficients of the unknowns are given by the matrix to be inverted. Average execution time is approximately $3.2\ n^2$ (n+b) milliseconds, where n is the order of the matrix and b the number of systems.

d. Capabilities and Limitations: Let n be the order of the matrix and b the number of systems of equations. The restrictions are then as follows:

a. 5,000 word machine: $n < 67$ $n(n+b) < 4380$

b. 10,000 word machine: $n < 97$ $n(n+b) < 9370$

IBM 7070 Library Program Abstracts File no. 10.4.001 Available prior to January 1962

Solution of Simultaneous Linear Equations

M. Roberts
AC Spark Plug Div GMC
Milwaukee, Wisconsin

a. Purpose: To find x1, x2, ... x_n of the following equation set:

$$\begin{array}{cccc} a_{11}\,a_{12}\cdots & a_{1n} & x1 & c1 \\ a_{21} & . & x2 & c2 \\ . & . & . & . \\ . & . & . & . \\ . & . & . & . \\ . & . & . & . \\ a_{n1}\cdots\cdots & a_{nn} & x_n & c_n \end{array}$$

b. Machine Requirements: Floating hardware, approximately 200 words plus the matrix area are the storage requirements

c General Description: Crout's Reduction

d. Capabilities and Limitations: Input must be in normalized floating form. Accumulators and indicators are not saved.

IBM 7070 Library Program Abstracts File no. 10.4.002 Available prior to January 1962

7070 SLEP, SOLVE SIMULTANEOUS LINEAR EQUATIONS WITH PIVOTING

Contributed By: Robert Judson
The B. F. Goodrich Co.
Akron 18, Ohio

A. Purpose: Solve N simultaneous linear equations with one right hand column vector (one set of constant terms). Includes pivoting so that equations may be arranged in any order and may have zeros on diagonal.

B. Object Routine Machine Requirements: Floating point hardware.

C. (Note: Can be furnished for non-floating point hardware if desired). Working storage is $(N+1)^2$ locations for N equations. Location PV must not be disturbed.

C. Method: Elimination to echelon form followed by back solution.

D. Source Language: Autocoder

E. Source Language Entry: BLX LINK, SOLVE with equations stored sequentially by rows. a_{11} is in location PV+1 and n in accumulator No. 1, right justified. Solution will be in same locations as original right hand vector. (i.e. X_1 in PV+N+1, X_2 in PV+2(N+1) etc.).

IBM 7070 Library Program Abstracts File no. 11.3.001 Available prior to January 1962

7070 STEPWISE MUTIPLE REGRESSION ANALYSIS, MR1

Contributed By

Author: Gary Lotto

Organization: University of Pittsburgh

Computation and Data Processing Center
University of Pittsburgh
Pittsburgh 13, Pennsylvania

a. Purpose: This program will report the results of a multiple regression analysis for up to 130 variables. Independent variables are introduced one at a time in the order that they contribute to regression on the dependent variable.

b. Machine Requirements: The program is written for 10K machine with floating point hardware. It may be modified for fixed point hardware, a 5K machine, etc. Storage used is a function of the number of variables included. Output is printed or punched. Input is on cards or tape.

c. General Description: During each step, a variable is included or deleted, and the correlation matrix either "reduced" or "increased" from the effects of this operation, in such a way that the same logarithm may be used on successive steps to provide coefficients and significance tests. The routine will perform each step in a 130 variable problem in about 14 seconds, exclusive of output. Output may be included or partially or completely supressed, as desired, and will make the time highly variable between steps.

d. Capabilities and Limitations: The program will handle up to 130 variables (approximately 85 variables on a 5K machine). The operator may, by manual intervention, prohibit certain independent variables from entering into regression, force inclusion or deletion of certain variables, change the dependent variable, or change the significance levels for inclusion or deletion at any time.

IBM 7070 Library Program Abstracts File no. 11.3.002 Available prior to January 1962

7070 MULTIPLE LINEAR REGRESSION BY THE STEPWISE METHOD

CONTRIBUTED BY: R. E. Boss
Systems Engineer, Los Angeles Wilshire
December, 1960

SPECIFICATIONS: This program provides means, standard deviations and simple correlation coefficients for up to 40 variables. This is the limiting number of this version, however, it can be extended by modifying the FORTRAN dimension statement and recompiling.

(Continued on next page)

The program also provides the standard error of the estimate of the dependent variable, and a multiple correlation coefficient. Each linear regression equation expresses a single "dependent" variable as a function of up to 39 "independent" variables. The standard error of each regression coefficient is computed.

Variables may be transformed if so desired.

The transformed observed data values are listed on the output tape as they are read and converted. All variables transformed are indicated in the output with the type of transformation specified. The following transformations are available:

Log X_i	(Code 1)
$(X_i + a)^p$	(Code 2)
Square Root X_i	(Code 3)
Natural log X_i	(Code 4)
$(X_i - 1) * (X_j)^p$	(Code 5)

Any weight can be applied to any observation if so desired. If no specific weight is given, the observation is assumed to have unit weight.

IBM 7070 Library Program Abstracts

File no. 11.3.003
Available prior to January 1962

7070 Intercorrelation Matrix, CORR1

Contributed By

Author: Gary Lotto

Organization: University of Pittsburgh
Computation and Data Processing Center
University of Pittsburgh
Pittsburgh 13, Pennsylvania

a. Purpose: This program will report the vector of means and standard deviations, the number of cases, and the symmetric matrix of correlations between every variable and every other of a set of up to 130 variables.

b. Machine Requirements: The program is written for a 10K machine with floating point hardware and 1 tape unit. It may easily be modified to use a 5K machine, and/or no floating point hardware (by subrountine simulation) with a subsequent reduction in the maximum number of variables that may be handled and with a possible reduction in the speed of a part of the program. The amount of storage used is a function of the number of variables included. Input is on tape. Output is printed or punched.

c. General Description: Cumulation of sums, sums of squares, and sums of cross products proceeds in fixed point arithmetic at a speed relative to the number of variables specified, and to the number of digits in the average observation of input data. For 4 digits, 130 variables are processed at approximately 7 1/2 seconds per case. The time is approximately proportional to V^2 (V= the number of variables), and about 10 per cent is saved per digit fewer than 4.

The transfer routine occurs once per run, and is approximately 1 1/2 minutes for 130 variables.

The printout occurs at maximum print speed, and prints 23 columns of the matrix at a time. The column vectors of means and standard deviation is also printed. All output is to 3 decimal places.

d. Capabilities and Limitations: The program will handle up to 130 variables (approx. 85 variables on a 5K machine) with the restriction that the maximum sum of squares (treating the data as whole numbers) must be less than 10^{10}. The matrix is left in storage for further analysis, if desired (see, for example, MR1).

IBM 7070 Library Program Abstracts

File no. 11.3.004
Available prior to January 1962

7070 INTERCORRELATION MATRIX - CORR2 - FOR CARD INPUT

Contributed By

Author: Gary Lotto

Organization: University of Pittsburgh

Computation and Data Processing Center
University of Pittsburgh
Pittsburgh 13, Pennsylvania

a. Purpose: This program will report the vector of means and standard deviations, the number of cases, and the symmetric matrix of correlations between every variable and every other of a set of up to 130 variables.

(Continued on next column)

b. Machine Requirements: The program is written for a 10K machine with floating point hardware. It may easily be modified to use a 5K machine, and/or no floating point hardware (by subroutine simulation) with a subsequent reduction in the maximum number of variables that may be handled and with a possible reduction in the speed of a part of the program. The amount of storage used is a function of the number of variables included. Input is on cards. Output is on the printer or on cards.

c. General Description: Cumulation of sums, sums of squares, and sums of cross products proceeds in fixed point arithmetic at a speed relative to the number of variables specified, and to the number of digits in the average observation of input data. For 4 digits, 130 variables are processed at approximately 7 1/2 seconds per case. The time is approximately proportional to V^2 (V= the number of variables), and about 10 per cent is saved per digit fewer than 4.

The transfer routine occurs once per run, and is approximately 1 1/2 minutes for 130 variables.

The printout occurs at maximum print speed, and prints 23 columns of the matrix at a time. The column vectors of means and standard deviations is also printed. All output is to 3 decimal places.

d. Capabilities and Limitations: The program will handle up to 130 variables (approx. 85 variables on a 5K machine) with the restriction that the maximum sum of squares (treating the data as whole numbers) must be less than 10^{10}. The matrix is left in storage for further analysis, if desired.

IBM 7070 Library Program Abstracts

File no. 11.3.005
Available prior to January 1962

7070 - Principal Axis Factor Analysis

Contributed By

Author: A. W. Bendig

Organization: Psychology Department

University of Pittsburgh

a. Purpose: To compute the eigenvalues and eigenvectors of a square symmetric matrix of size V.

b. Range: $2 \leq V \leq 130$

c. Machine Requirements: 10K core, Floating point hardware, Card reader, On-line printer.

d. General Description: The vectors of the right orthonormal (eigenvector) and the element of the basic structure delta matrix (square roots of the eigenvalues) are computed by an iterative powering process until the V pairs of eigenvector elements obtained on two successive iterations differ by less than a programmed tolerance value. When the eigenvector elements are stabilized, the vector is multiplied by the delta element to produce the factor coefficients or loadings, and the eigenvalue, eigenvector, and factor loadings are sent to the output routines.

IBM 7070 Library Program Abstracts

File no. 11.3.006
Available prior to January 1962

Stepwise Multiple Linear Regression Analysis on the IBM 7070

Contributed By

Author: Donald G. Wyman

Organization: IBM Corporation

401 Grand Avenue
Oakland 10, California

a. Purpose: To solve for the coefficients in a regression equation using an analysis of variance to select only the variables which meet a prescribed significance test.

b. Machine Requirements: (Include machine components special features storage requirements, control panels -- standard or special)

5000 words of storage, 3 tapes and card reader or 4 tapes. (1 less tape if residuals are not claculated).

c. General Description: (Mathematical method, accuracy, speed, if appropriate)
Mathematical method as outlined by M. A. Efroymsen, Mathematical Methods for Digital Computers, ed. A. Ralston and H. Wilf. Coded in basic Fortran using floating point subroutines.

d. Capabilities and Limitations: The program has been written as two independent phases. Phase 1 reads and transforms input and forms simple correlations for up to 72 variables. Phase 2 solves for the coefficients, either directly or stepwise, from any system of equations formed as a subset of the 72 variables to a maximum of 55 independent and one dependent.

IBM 7070 Library Program Abstracts

File no. 11.3.007
Available prior to January 1962

Multiple Correlation and Regression Analysis by the Stepwise Method.[1]

Contributed By:

Author: R. E. Boss

Organization: IBM Corporation

Systems Engineer-Scientific
Los Angeles, Wilshire Office

a. Purpose: The program provides means, standard deviations and simple correlation coefficients for all variables.

The Stepwise Method provides a final regression equation containing only those independent variables indicated to be significant.

Intermediate results include those variables in the regression, and the variable added to the equation to improve the "goodness of fit" at each step.

Other results include the standard error of each regression coefficient and the error of estimate of the dependent variable, a multiple correlation coefficient, and a comparison of actual data and predicted values. Variable transformations are available.

b. Equipment Specifications: (a) 5,000 or 10,000 word 7070
(b) On-line card reader
(c) Minimum of three tapes

c. Source Language: FORTRAN

d. Timing: $(n+2)^2(m+n)$ additions and multiplications and $(n+2)^2(n/2)$ divisions

e. Accuracy: Single precision floating point.

[1] M. A. Efrovmson. Esso Research and Engineering Company.

IBM 7070 Library Program Abstracts

File no. 11.3.008
Available prior to January 1962

7070 - Normalized Varimax Factor Rotation

Contributed By:

Author: A. W. Bendig

Organization: Psychology Department
University of Pittsburgh
Pittsburgh 13, Pennsylvania

a. Purpose: To rotate the factor loadings of V variables on F factors to orthogonal simple structure.

b. Range: $2 \leq V \leq 130$, $2 \leq F \leq 20$

c. Machine Requirements: 10K core, Floating point hardware, Card reader, On-line printer.

d. General Description: Pairs of factors are rotated by an iterative process until all pairs are stabilized within a tolerance value. The normalized varimax criterion value, the rotated factor loadings, and the transformation matrix is the output.

IBM 7070 Library Program Abstracts

File no. 11.7.001
Available prior to January 1962

Random Numbers and Random Normal Deviates Generator

A. Dickerman
AC Spark Plug Div GMC
Milwaukee, Wisconsin

(Continued on next column)

a. Purpose: See title.

b. Machine Requirements: Floating hardware, 69 core storage words.

c. General Description: A set of 16 random numbers between 0 and 1 are in storage: $xj = x_o + xj-1$ (MOD)1 J=17 The first and last numbers of the set are added always moving x1 to x_o position and the new number becomes x1 + 15. Accumulator overflow is ignored. Random normal deviates are obtained by direct process. Given two random numbers U1, U2

$$x_1 = (2 \log_e U_1)\ 1/2 \sin 2\pi U_2$$
$$x_2 = (2 \log_e U_1)\ 1/2 \cos 2\pi U_2$$

d. Capabilities and Limitations: The AC Spark Plug log and sine routines must be used with this subroutine.

IBM 7070 Library Program Abstracts

File no. 11.7.002
Available prior to January 1962

RANDOM NUMBER GENERATOR SUBROUTINE

Contributed By:

Author: K. Angström, Applied Science

Organization: IBM Svenska AB

Gävlegatan 20
Stockholm 6, SWEDEN

a. Purpose: A subroutine to generate random numbers, either uniformly or normally distributed, in fixed or floating form.

b. Machine Requirements: All accumulators, 4 index words, 96 ordinary locations and floating decimal device (if floating decimal numbers are to be generated).

c. General Description: The generator must be initially loaded with 16 ten-digit random numbers (X_i), uniformly distributed. The program generates a new number using the formula $X_i = X_{i-1} + X_{i-16}$. To generate a normally distributed random number the central limit theorem is applied. Thus three ten-digit uniformly distributed random numbers are generated. The sum of the 20 digits in the first two of these numbers followed by random decimals consisting of the last seven digits in the third number is considered as a normally distributed random number. The mean and the standard deviation may be specified by the user of this subroutine. Execution time: 0.7 - 7.5 milliseconds.

d. Capabilities and Limitations: Does not apply.

IBM 7070 Library Program Abstracts

File no. 12.1.001
Available prior to January 1962

The Inventory Management Simulator-7070 Full Fortran Version

Contributed By:

Author: C. J. Welker

Organization: IBM Corporation

618 S. Michigan Avenue
Chicago, Illinois

a. Purpose: This program allows the user to test inventory replenishment rules and demand forecasting techniques; the objective is to prove the validity of methods which can then be installed in the inventory operation system.

b. Machine Requirements: (Include machine components, special features, storage requirements, control panels-standard or special).
10K core memory, card reader, from one to five tape drives (dependent upon subprogram configuration used).

c. General Description: (Mathematical method, accuracy, speed, if appropriate) Mathematical method, simulation accuracy: not applicable. Speed: Running times vary considerably depending upon the subprogram configuration used. However, eighty to one-hundred demand transactions per minute can serve as a reasonable estimate.

d. Capabilities and Limitations: The subprogram package allows this program to be adapted to many inventory situations. In addition the program structure is such that the user can readily incorporate his own subprogram variations; thereby tailoring the simulator to meet his requirements.

IBM 7070 Library Program Abstracts — File no. 12.9.001 — Available prior to January 1962

7070 - Transportation Problem (Dennis Technique)

Robert Judson
The B. F. Goodrich Company
Dept. 0073 - Bldg. 24-C
Akron 18, Ohio

a. Purpose: To solve fairly large transportation problems in reasonably short times using magnetic tape to store Supply, Demand and Cost Data. Also to permit suppression of any desired shipping paths, even to the extent of suppressing an entire row (which essentially becomes an artificial vector).

b. Machine Requirements: 3 tape units and 5K memory. To solve any problem between 50 x 500 and 275 x 275. Program will be furnished in Symbolic Autocoder form so that it can be readily modified for a 10K or larger memory.

c. Timing: 118 x 12 Approx. 70 seconds with 1/3 costs excluded
12 x 118 Approx. 90 " " " "

c. General Description: Reference: Jack B. Dennis "A High Speed Computer Technique for the Transportation Problem" J. of the ACM, Vol. 5, No. 2, April 1958.

Program is in two parts. Cost tape to Matrix tape (BFG No. 79102) and Main Program (BFG No. 79101) so as to facilitate adaptation by users with card oriented equipment.

IBM 7070 Library Program Abstracts — File no. 12.9.002 — Available prior to January 1962

7070 Management Decision-Making Exercise

Contributed By:

Author:	John A. Flint	H. James Farver
Organization:	IBM Corporation Peoria, Illinois	IBM Corporation Peoria, Illinois

a. Purpose: Using the 7070, the operation of five firms manufacturing similar low profit products in a highly competitive industry is simulated. Management "teams" are given an opportunity to make decisions and to see the results of these decisions almost immediately.

b. Machine Requirements:
1 7500 Card Reader
1-4 729-II or IV Tapes (Channel 1 only)
10 K Storage
Peripheral printer (720 or 1401)

c. General Description: The exercise has been modeled after the business strategy game constructed by Richard Bellman, Franco Ricciordi, and others for the American Management Association in 1957. While the general form of this exercise resembles the AMA game, there are a number of innovations which have been introduced to add realism and difficulties to the strategy problems encountered.

The basic decision problem involved in the exercise is that of deciding on courses of action with only a vague knowledge of the outcome of such actions. The results of decisions made by each management team depends not only on their own decisions, but also on the decisions made by the competitive teams.

The result is a realistic simulation of every-day business operation with the flavor and incentive necessary for an interesting "Management Decision" exercise.

d. Capabilities and Limitations: Not applicable.

7090 1094BESYS3 AVAILABLE PRIOR TO JANUARY 1962

ONE PHASE MONITOR SYSTEM.
A MONITOR PROGRAM COMPOSED OF SIX /6/ MAJOR PROGRAMS.
REQUIRES A TWO CHANNEL 32K MACHINE, 7090 OR 709 WITH DATA
CHANNEL TRAPS. NORMAL OPERATION USES NINE TAPES.
SUBMITTAL IS CONTAINED ON FIVE /5/ TAPES, A HIGH DENSITY
BINARY SYSTEM TAPE, TWO SYMBOLIC TAPES, AND TWO LISTING TAPES
CORR 1152

7090 1095WHHCL AVAILABLE PRIOR TO JANUARY 1962

ENTHALPY AND ENTROPY OF COMPRESSED LIQUID
COMPUTES ENTHALPY AND ENTROPY OF COMPRESSED LIQUID AS
FUNCTIONS OF PRESSURE AND TEMPERATURE

7090 1095WHHSL AVAILABLE PRIOR TO JANUARY 1962

ENTHALPY OF SATURATED LIQUID
COMPUTES ENTHALPY OF SAT. LIQ. AS FUNCTION OF TEMPERATURE

7090 1095WHHSS AVAILABLE PRIOR TO JANUARY 1962

ENTHALPY ENTROPY SPECIFIC VOLUME OF SUPERHEATED STEAM
COMPUTES ENTHALPY, ENTROPY, AND SPECIFIC VOLUME OF
SUPERHEATED STEAM AS FUNCTIONS OF PRESSURE AND TEMP.

7090 1095WHHSV AVAILABLE PRIOR TO JANUARY 1962

ENTHALPY ENTROPY SPECIFIC VOLUME OF SATURATED VAPOR
COMPUTES ENTHALPY, ENTROPY, SPECIFIC VOLUME, AND TEMPERATURE
OF SATURATED VAPOR AS FUNCTIONS OF PRESSURE

7090 1095WHISD AVAILABLE PRIOR TO JANUARY 1962

ISENTROPIC PRESSURE CHANGE SUBROUTINE
DETERMINES THE REMAINING VARIABLES /QUALITIES, SPECIFIC
VOLUMES, ENTHALPIES, ENTROPY, AND TEMPERATURES/ AT THE
EXTREMETIES OF AN ISENTROPIC PROCESS GIVEN THE INLET AND
EXIT PRESSURES AND EITHER INLET TEMPERATURE OR INLET
ENTHALPY. OPERATES IN SUPERHEATED AND WET STEAM REGIONS OR
IN THE COMPRESSED LIQUID REGION.

7090 1095WHVISL AVAILABLE PRIOR TO JANUARY 1962

VISCOSITY OF LIQUID WATER
COMPUTES VISCOSITY OF LIQUID. CORR. 1225

7090 1095WHVISV AVAILABLE PRIOR TO JANUARY 1962

VISCOSITY OF STEAM
COMPUTES VISCOSITY OF STEAM AS FUNCTION OF PRES. AND TEMP.

7090 1095WHVSL AVAILABLE PRIOR TO JANUARY 1962

SPECIFIC VOLUME OF SATURATED LIQUID
COMPUTES SPEC. VOL. OF SAT. LIQ. AS FUNCTION OF TEMPERATURE

7090 1095WH58E AVAILABLE PRIOR TO JANUARY 1962

MINIMUM ERROR ROUTINE FOR STEAM TABLE DISTRIBUTION
ERROR FACILITY FOR WH STEAM TABLES

7090 1095WH0058 AVAILABLE PRIOR TO JANUARY 1962

THERMODYNAMIC PROPERTIES OF WATER AND STEAM
A COLLECTION OF FORTRAN TOPE SUBROUTINES TO ALLOW THE
COMPUTATION OF VARIOUS THERMODYNAMIC PROPERTIES /ENTROPY,
ENTHALPY, TEMPERATURET PRESSURET SPECIFIC VOLUME, QUALITY,
AND VISCOSITY/ OF STEAM AND WATER ON THE 709 OR 7090.

7090 1113APMTTR AVAILABLE PRIOR TO JANUARY 1962

MULTIPLE TAPE TEST ROUTINE
THIS SELF LOADING ROUTINE CAN TEST UP TO 20 BLANK TAPES
AT ONE TIME USING EITHER OR BOTH CHANNEL A AND CHANNEL B.

7090 1115GPFMSD AVAILABLE PRIOR TO JANUARY 1962

OFFLINE EDIT FOR FORTRAN MONITOR WITH SOURCE LANG DEBUG
THIS CORRECTION PROVIDES A NEW OFF LINE EDITOR FOR THE
PREVIOUSLY DISTRIBUTED DEBUG PACKAGE OF THE FORTRAN
COMMITTEE. THE EDITOR WAS PREPARED BY REPLACING THE IBM
COLUMN EDITOR RECORDS 6,6A,7,7A,8,42A,43,43A,CHAIN,/STH/,
/IOH/ WITH THE DEBUG PACKAGE CORR. 1245

7090 1095WHLDIR AVAILABLE PRIOR TO JANUARY 1962

LAGRANGIAN INTERPOLATION FOR STEAM TABLES
FOURTH ORDER SINGLE OR DOUBLE EQUAL INCREMENT INTERPOLATION

7090 1095WHPSL AVAILABLE PRIOR TO JANUARY 1962

PRESSURE OF SATURATED LIQUID
COMPUTES PRES. OF SAT. LIQ. AS FUNCTION OF TEMPERATURE

7090 1095WHSSI AVAILABLE PRIOR TO JANUARY 1962

ENTHALPY OR ENTROPY IN LIQUID SUPERHEAT OR WET REGIONS
COMPUTES ENTROPY OR ENTHALPY AND TEMPERATURE AS FUNCTIONS
OF PRESSURE AND EITHER ENTHALPY OR ENTROPY. IN ADDITION,
SPECIFIC VOLUME AND QUALITY ARE CALCULATED IN THE WET AND
SUPERHEATED STEAM REGIONS

7090 1095WHSSL AVAILABLE PRIOR TO JANUARY 1962

ENTROPY OF SATURATED LIQUID
COMPUTES ENTROPY OF SAT. LIQ. AS FUNCTION OF TEMPERATURE

7090 1095WHTSH AVAILABLE PRIOR TO JANUARY 1962

TEMPERATURE OF SATURATED LIQUID FROM ENTHALPY
COMPUTES TEMP. OF SAT. LIQ. AS FUNCTION OF ENTHALPY

7090 1095WHTSL AVAILABLE PRIOR TO JANUARY 1962

TEMPERATURE OF SATURATED LIQUID
COMPUTES TEMP.OF SAT. LIQ. AS FUNCTION OF PRESSURE

7090 1095WHVCL AVAILABLE PRIOR TO JANUARY 1962

SPECIFIC VOLUME OF COMPRESSED LIQUID
COMPUTES SPEC. VOL. OF COMP. LIQ. AS FUNCTION OF PRES. & TEMP

7090 1122NRNPRE AVAILABLE PRIOR TO JANUARY 1962

FORTRAN DOUBLE PRECISION ARITHMETIC PACKAGE
ENABLES A FORTRAN PROGRAMMER TO COMPUTE USING DOUBLE
PRECISION ARITHMETIC. /A DOUBLE PRECISION NUMBER CONSISTS OF
ONE WORD FOR THE EXPONENT AND TWO WORDS FOR THE FRACTION./
INCLUDES DOUBLE-SINGLE CONVERSION ROUTINES, AND DOUBLE PREC.
ELEMENTARY FUNCTION ROUTINES

7090 1123WPS002 AVAILABLE PRIOR TO JANUARY 1962

DUMMY FRONT END CARD FOR 09-7090T C&ANNEL A
PROTECTS THE FRONT OF A SELF-LOADING 709-7090 BINARY CARD
DECK FROM DAMAGE IN CASE OF CARD JAMS ON LOADING, AT THE
SAME TIME LEAVING THE MACHINE CONDITION UNDISTURBED EXCEPT
FOR THE FIRST THREE CORE LOCATIONS. LOADED BY LOAD CARD
BUTTON. EXECUTES LOAD CARD BUTTON FOR NEXT CARD.

7090 1124MLHPRS AVAILABLE PRIOR TO JANUARY 1962

POLYNOMIAL ROOT FINDER ROUTINES
FORTRAN SUBROUTINE TO FIND THE COMPLEX ROOTS OF A POLYNOMIAL
WITH REAL COEFFICIENTS. THE METHOD OF MULLER IS USED. THIS
METHOD FINDS MULTIPLE ROOTS.

7090 1125MLCLIZ AVAILABLE PRIOR TO JANUARY 1962

INVERSE LAPLACE TRANSFORM, INVERT
THIS SUBROUTINE INVERTS A QUOTIENT OF RELATIVELY PRIME
POLYNOMIALS WITH REAL AND CONSTANT COEFFICIENTS INTO THE
REAL-TIME DOMAIN ACCORDING TO HEAVISIDE S PARTIAL FRACTION
EXPANSION THEOREMS. EITHER THE GENERAL REAL-TIME SOLUTION OR
THE REAL-TIME SOLUTION VALUATED AT DESIGNATED TIME POINTS
MAY BE OBTAINED FROM THIS SUBROUTINE

7090 1130RLA14A AVAILABLE PRIOR TO JANUARY 1962

SMASHT
A TWO PASS COMPILER LOADING PROGRAM DESIGNED TO REPLACE THE
COMPILER-MODIFY AND LOAD PARTS OF THE SOS SYSTEM AND TO
WORK IN CONJUNCTION WITH THE REMAINDER OF THE
SOS SYSTEM.

IBM 7090 PROGRAM LIBRARY ABSTRACT

7090 1131AS0124 AVAILABLE PRIOR TO JANUARY 1962

ADMINT ADAMS INTEGRATION OF DIFFERENTIAL EQUATIONS
INTEGRATES A SYSTEM OF N SIMULTANEOUS FIRST ORDER DIFF. EQUATIONS. SUBROUTINE EAS FIVE SEPARATE ENTRIES. REQUIRES 279 CELLS.

7090 1132MAGINT AVAILABLE PRIOR TO JANUARY 1962

GENERALIZED INTEGRATION SUBROUTINE
A SET OF SIMULTANEOUS ORDINARY DIFFERENTIAL EQUATIONS IS SOLVED USING EITHER RUNGE-KUTTA OR ONE OF SEVERAL SETS OF PREDICTOR-CORRECTOR FORMULAS. PREDICTOR-CORRECTOR FORMULAS ARE STARTED WITH RUNGE-KUTTA POINTS. A VARIABLE INTEGRATION INTERVAL WITH ERROR CONTROL CAN BE USED OPTIONALLY WITH PREDICTOR-CORRECTOR FORMULAS. USES 473 LOCATIONS.

7090 1138RWINP5 AVAILABLE PRIOR TO JANUARY 1962

DECIMAL, OCTAL, BCD LOADER
ALLOWS SELECTIVE INPUT WITH A SINGLE CALL STATEMENT, AND ALLOWS FOR CHANGES IN VALUES WHICH WERE NOT ORIGINALLY DESIGNATED AS INPUT. REQUIRES 672 WORDS OF STORAGE WITH ALL TEMPORARIES SELF-CONTAINED.

7090 1145ERTSDA AVAILABLE PRIOR TO JANUARY 1962

TIME SERIES DECOMPOSITION AND ADJUSTMENT
FORTRAN PROGRAM TO ADJUST SEASONAL AND IRREGULAR TIME SERIES TO A FORM THAT SHOWS PRIMARILY THE TREND-CYCLICAL MOVEMENTS. SEASONAL FACTORS, IRREGULAR FLUCTUATIONS AND MANY SUMMARY MEASURES USEFUL IN TIME SERIES ANALYSIS ARE COMPUTED IN THE PROCESS. BASICALLY ADAPTATION OF TENNESSEE VALLEY AUTHORITY PROGRAM /TV TSDA/ TO 8K 704. PROGRAM ALSO EXTENDED TO PERMIT /1/ ADJUSTING FOR DELIVERY DAYS AND /2/ FITTING LEAST SQUARES TREND LINE AS FORECASTING AID. CORR./1176

7090 1146AMPLOT AVAILABLE PRIOR TO JANUARY 1962

GENERALIZED PLOT ROUTINE
THIS ROUTINE IS USED TO GENERATE AND LABEL GRAPHS FOR THE SC 4020 MICROFILM RECORDER. COMMANDS ARE WRITTEN ON TAPE. THE ROUTINE WILL PERFORM THE SCALING REQUIRED AND PLOT SETS OF POINTS WHOSE COORDINATES ARE GIVEN IN FLOATING POINT FORM. GRID LINES MAY BE SPECIFIED TOGETHER WITH A FORMAT TO CONTROL THEIR LABELLING. IT IS POSSIBLE TO PRINT HORIZONTAL AND VERTICAL TITLES. USES 1806 STORAGES.

IBM 7090 PROGRAM LIBRARY ABSTRACT

7090 1149AS0123 AVAILABLE PRIOR TO JANUARY 1962

LARGE DOUBLE PRECISION SIMULTANEOUS EQUATION SOLVER AND DETERMINANT EVALUATORCGAUSSIAN ELIMINATION USED TO SOLVE THE SIMC E-UATIONSCINPUT AND OUTPUT ARE SINGLE PRECISION. SUBROUTINE EAS TEREE ENTRIES. CORR./1180

7090 1150RLRATF AVAILABLE PRIOR TO JANUARY 1962

TAYLOR SERIES RATIONAL FUNCTION CURVE FITTING
FINDS THE COEFFICIENT OF A RATIONAL FUNCTION BY THE TAYLOR SERIES METHOD. CORR.1214

7090 1158ORCPS1 AVAILABLE PRIOR TO JANUARY 1962

CRITICAL PATH AND RESOURCE SUMMARY CALCULATION
CALCULATES CRITICAL PATH PARAMETERS FOR EACH JOB AND THE SUM OF EACH RESOURCE IN USE AT ANY TIME, DURING THE SPAN OF A GIVEN PROJECT OF N JOBS. 6 TAPES REQUIRED.

7090 1169RCRTRC AVAILABLE PRIOR TO JANUARY 1962

ROOT TRACING
ENABLES ONE TO LOCATE THE ZEROES OF NON-LINEAR FUNCTIONS, THE LOCUS OF COMPLEX ROOTS OF A CHARACTERISTIC EQUATION WITH A REAL PARAMETER, AND TO FIND THE LOCUS OF AN N-DIMENSIONAL VECTOR, USING SUBROUTINES DIF AND ODE.

7090 1175WDSTOP AVAILABLE PRIOR TO JANUARY 1962

UNLOAD ALL TAPES
ONE-CARD SELF-LOADING PROGRAM ACERTAINS WHICH TAPE UNITS ARE IN READY STATUS, THEN ISSUES REWIND-AND-UNLOAD INSTRUCTIONS FOR THOSE TAPE UNITS

7090 1177URGAMA AVAILABLE PRIOR TO JANUARY 1962

NORMALIZED INCOMPLETE GAMMA FUNCTION WITH POISSON TERM
GIVEN A AND X, POSITIVE-REAL OR ZERO, THIS SUBROUTINE WILL COMPUTE THE NORMALIZED INCOMPLETE GAMMA FUNCTION

GAM/A,X/-GAMMA/A,X//GAMMA/A,0/, WHERE GAMMA/A,X/ IS DEFINED AS THE INTEGRAL FROM X TO INFINITY OF EXP/-U/ TIMES U TO THE /A-1/TH POWER DU. SUBROUTINE ALSO EVALUATES THE POISSON TERM AND EXTENDS THE UPWARD RANGE OF SDA 516 ABOVE 100. ACCURACY IS USUALLY BETTER THAN 0.000001 . TIMING IS OPTIMIZED BY CHOICE OF METHOD AS A FUNCTION OF REGION. AVER. ABOUT 15 M.S. GAMA CAN ALSO GIVE PROBABILITIES FOR CHI-SQUARE DISTRIBUTION.

7090 1182DVCIR AVAILABLE PRIOR TO JANUARY 1962

CIRCULAR AND ELLIPTICAL COVERAGE FUNCTION
COMPUTES THE OFFSET CIRCLE PROBABILITY FUNCTION-HERE CALLED THE CIRCULAR COVERAGE FCN., P/R,D/ - OR THE FCN. V/K,C/, WHICH REPRESENTS THAT PORTION OF AN ELLIPTICAL DISTRIBUTION OVER A CIRCLE CENTERED AT THE ORIGIN. ACCURACY- PROBABILITIES CORRECT TO 6 DECIMAL PLACES. AVERAGE TIME - 6 MILLESECONDS PER CASE.

7090 1194ERMPR3 AVAILABLE PRIOR TO JANUARY 1962

STEPWISE MULT. REGRESSION WITH VARIABLE TRANSFORMATIONS
TRANSFORMS RAW INPUT DATA AND PERFORMS A STEPWISE MULTIPLE REGRESSION UPON THE TRANSFORMED DATA. THE TRANSFORMED DATA CONSISTS OF M SETS CONTAINING N INDEPENDENT VARIABLES AND ONE DEPENDENT VARIABLE. A WEIGHTING FACTOR CAN BE ASSOCIATED WITH EACH SET OF DATA. A SUBSET OF REGRESSION COEFFICIENTS FOR K VARIABLES, K LESS THAN OR EQUAL TO N, WILL BE OBTAINED WHICH ARE SIGNIFICANT AT A GIVEN LEVEL OF SIGNIFICANCE.
SIMILAR TO ER MPR2, DIST. 47 . ALLOWS MAX. OF 130 REGRESSION VARIABLES. REQUIRES 32K CORE AND 3 TAPES.

7090 1195IKLP90 AVAILABLE PRIOR TO JANUARY 1962

7090 LINEAR PROGRAMMING SYSTEM - SUCESSOR TO SCROL
LP/90 IS A COMPLETE PROGRAMMING AND OPERATING SYSTEM INCLUDING A SYSTEM ASSEMBLER. ALL I/O STANDARDIZED AND CENTRALIZED --OVER 30 AGENDA ITEMS, ELABORATE DATA INPUT AND OUTPUT. ROWS AS WELL AS COLUMNS MAY HAVE MNEMONIC NAMES.
--VERY FAST DUE TO IMPROVED I/O AND ALGORITHMIC TECHNIQUES. FEATURES DOUBLE PRECISION. HANDLES 1024 ROWS. BUILT-IN PROVISIONS SIMPLIFY DEBUGGING MACHINE, PROGRAMMING AND FORMULATION ERRORS. CORR. DIST.1213

7090 1196LLIPLV AVAILABLE PRIOR TO JANUARY 1962

LINCOLN IPLV INTERPRETIVE SYSTEM - 709,7090
TO EXECUTE PROGRAMS WRITTEN IN IPLV AS DESCRIBED IN RAND CORP PAPERS, P-1929,P1897,P1918,1960. THE SYSTEM CONTAINS AN ASSEMBLER, INTERPRETER, TRACE, AND DUMP. SEE LONG DESCRIPTION OF HOW TO RUN SYSTEM. TAPE DENSITIES MUST BE SET EXTERNALLY ON THE 7090. ASSEMBLY OF SAP DECK PRODUCES SYMBOL TABLE, BINARY DECK, 2 WRITE TAPE CARDS, CALL & FIX, RESUME, TR TO START CARD. BINARY DECK MUST FOLLOW UPPER BINARY OCTAL LOADER. CORR. 1223

IBM 7090 PROGRAM LIBRARY ABSTRACT

7090 1197LLBAM AVAILABLE PRIOR TO JANUARY 1962

BOOLEAN ALGEBRA MINIMIZER
FINDS THE TWO-LEVEL MINIMUM SUM OF PRODUCTS OR PRODUCT OF SUMS FORM FOR SETS OF SIMULTANEOUS BOULEAN EQUATIONS. HAS THE CAPABILITY OF MINIMIZING UP TO 36 SIMULTANEOUS BOOLEAN EQUATIONS, EACH OF WHICH CONTAINS UP TO 36 INDEPENDENT VARIABLES.

7090 1199PEIBLD AVAILABLE PRIOR TO JANUARY 1962

TO ASSIGN TAPE UNIT USAGE OTHER THAN THAT WHICH IS STANDARD IN IB SOS

7090 1204MACURE AVAILABLE PRIOR TO JANUARY 1962

N DIMENSIONAL TABLE LOOK UP
GIVEN THE ARGUMENTS X/1/, X/2/,...., X/N/ COMPUTE Y - F/X/1/, X/2/,...., X/N// BY LINEAR INTERPOLATION FROM A TABLE OF XS. IF DESIRED, THIS PROGRAM WILL ALSO EXTRAPOLATE ON THE UPPER AND LOWER LIMIT.

7090 1205NUDEQ AVAILABLE PRIOR TO JANUARY 1962

ORDINARY DIFF. EQUNS.SOLUTION /RUNGE-KUTTA/
TO INTEGRATE STEPWISE,A SET OF N SIMULTANEOUS FIRST ORDER DIFFERENTIAL EQUATIONS USING GILL,S VARIATION OF THE RUNGE-KUTTA METHOD.

7090 1206NULEQ AVAILABLE PRIOR TO JANUARY 1962

LINEAR EQUATIONS SOLUTION FAP CODED 7090
THIS PROGRAM SOLVES THE MATRIX EQUATION AX-B WITH AN OPTION ALSO TO EVALUATE THE DETERMINANT OF A. THE GAUSS ELIMINATION METHOD IS USED. THE MATRICES ARE NORMALIZED ROW-WISE,THE A MATRIX IS REDUCED TO TRIANGULAR FORM AND X/I,K/ IS COMPUTED. B IS TRANSFORMED INTO X AND LEAVES PRODUCT OF THE DIAGONAL ELEMENTS AS THE DETERMINANT OF A.

IBM 7090 PROGRAM LIBRARY ABSTRACT
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7090 1211IQMDLD AVAILABLE PRIOR TO JANUARY 1962

IQ MOD LOADER
EDITS AN A5 SOS PUNCH SQUOZE TAPE AND A MOD PACKAGE OF CONTROL CARDS AND MODIFICATIONS TO PRODUCE AN A3 SOS PROGRAM INPUT TAPE. ELIMINATES PUNCHING SQUOZE DECKS AND CARD TO TAPE OPERATIONS IN PRODUCING AN A3 SOS PROGRAM INPUT TAPE.

7090 1212MFAOVC AVAILABLE PRIOR TO JANUARY 1962

ANALYSIS OF VARIANCE OR COVARIANCE
COMPUTATIONS FOR ORTHOGONAL OR NON-ORTHOGONAL DATA AND FOR ANY STATISTICAL DESIGN.

7090 1217NUTRAK AVAILABLE PRIOR TO JANUARY 1962

ERROR DETECTION SUBROUTINE
THIS ROUTINE WILL TRACE BACK THROUGH THE SEQUENCE OF SUBROUTINE CALLS AND OUTPUT SELECTED ARGUMENTS MAKING USE OF THE STANDARD ERROR FEATURE IN FORTRAN AND FAP.

7090 1218NUSNUP AVAILABLE PRIOR TO JANUARY 1962

7090 INPUT/OUTPUT PACKAGE
TO PROVIDE THE FAP CODER WITH A MEANS OF UTILIZING FORTRAN INPUT/OUTPUT ROUTINES IN A FAP PROGRAM TO PERFORM THE FOLLOWING FUNCTIONS....
READ INPUT TAPE, WRITE OUTPUT TAPE, READ CARDS, PUNCH CARDS,PRINT,READ BINARY TAPE,WRITE BINARY TAPE, BACKSPACE TAPE, WRITE AN END OF FILE, REWIND TAPE.

7090 1228NOEI AVAILABLE PRIOR TO JANUARY 1962

EXPONENTIAL INTEGRAL.
FORTRAN PROGRAM COMPUTES EXPONENTIAL INTEGRAL TO WITHIN ERROR, FLGEI, DEFINED BEFORE EACH USE. IF UNSUCCESSFUL IN ACHIEVING SPECIFIED ERROR, A PRINT OUT OCCURS SHOWING SIZE OF LAST TERM OF SERIES APPROXIMATION.

IBM 7090 PROGRAM LIBRARY ABSTRACT
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7090 1229IQCSOS AVAILABLE PRIOR TO JANUARY 1962

SOS PROGRAM LOADER. CALLS IN A SELECTED SOS PROGRAM FROM A MASTER SQUOZE TAPE, MODIFIES PROGRAM VIA &&9D 95 459 /IF DESIRED/ AND TRANSFERS THE SELECTED PROGRAM TO SYSPIT/A3/ . ALTER CARDS MAY BE INCLUDED ON MASTER TAPE. ANY ALTERS IN CARD READER WILL BE INSERTED IMMEDIATELY PRIOR TO ENDMOD. SENSE SWITCH 6 IS USED TO OBLITERATE GO CARD FOLLOWING SQUOZE /FOR PUNCH SQUOZE ONLY/. LOAD TAPE IS SIMULATED AT END OF THIS LOADER PROGRAM. EITHER A GO OR PS CARD FOLLOWING JOB CARD IN READER DETERMINES ACTION.

7090 1230EOGAS4 AVAILABLE PRIOR TO JANUARY 1962

4-POINT GAUSSIAN INTEGRATION SUBROUTINE
A FORTRAN FUNCTION TYPE SUBROUTINE USED AS GAS4/FCN,A,B/ TO EVALUATE A 4-POINT GAUSS-LEGENDRE APPROXIMATION TO THE INTEGRAL FROM A TO B OF FCN, WHICH IS A FORTRAN FUNCTION-TYPE SUBROUTINE.

7090 1235RWDICO AVAILABLE PRIOR TO JANUARY 1962

DIFFERENTIATION OR INTERPOLATION
THE FORMULA FOR NUMERICAL INTERPOLATION OR DIFFERENTIATION OF A GENERAL TABLE CAN BE REPRESENTED AS THE SUM OF TERMS CONSISTING OF A COEFFICIENT TIMES A TABLE ENTRY. THIS SUBROUTINE PRODUCES THE COEFFICIENTS FOR AN N POINT FORMULA FOR INTERPOLATION OR FOR ANY DEGREE DIFFERENTIATION,INDEPENDENT OF THE TABLE OR TABLES OF ORDINATES WITH WHICH IT MAY BE USED. ON ENTRY TO THE SUBROUTINE, ALL THAT IS NEEDED IS THE TABLE OF ABSCISSAE AND THE POINT OF EVALUATION. 247 CELLS OF PROG. AND CONSTANTS

7090 1236IBCURV AVAILABLE PRIOR TO JANUARY 1962

PROGRAM CURVES .
THIS PROGRAM GIVES COORDINATES OF POINTS ON A CURVE DEFINED BY AN EQUATION OF THE FORM F/X,Y,ZK/-O WHERE ZK ARE THE PARAMETERS ENTERING THE FUNCTION,/K-1,2,3,4/. OUTPUT IS IN LIST FORM AS WELL AS SUITABLE FOR PLOTTING.

IBM 7090 PROGRAM LIBRARY ABSTRACT
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7090 1238ORTOSS AVAILABLE PRIOR TO JANUARY 1962

TRANSIENT OR STEADY STATE TEMPERATURES
A 3-DIMENSIONAL HEAT TRANSFER CODE. WILL FIND TIME DEPENDENT TEMPERATURE DISTRIBUTION IN NONHOMOGENEOUS IRREGULAR BODIES. TREATS SURFACE-TO-SURFACE AND SURFACE-TO-BOUNDARY RADIATION.

7090 1239BEPIP AVAILABLE PRIOR TO JANUARY 1962

BELL LABS PERMUTATION INDEX PROGRAM
PRODUCES FROM INPUT BIBLIOGRAPHIC DATA A FOUR-PART DOCUMENT INDEX. THE PRINCIPAL PART IS A PERMUTED TITLE INDEX WITH A 120-CHARACTER LINE. ALSO OUTPUT ON THE SAME TAPE AS THE PERMUTED INDEX IS A COMPLETE BIBLIOGRAPHY OF THE INPUT DATA. THE OTHER TWO INDEXES ARE OUTPUT AS A MIXED CARD FILE OF /1/ AUTHORS AND /2/ PROJECT NUMBERS. EXCEPT FOR THE BE SYS INPUT, OUTPUT AND TAPE CONTROL ROUTINES, THIS IS AN INDEPENDENT PROGRAM.

7090 1240ERBR01 AVAILABLE PRIOR TO JANUARY 1962

CRYSTALLOGRAP&IC PROGRAM
THIS USES THE DIAGONAL TERMS OF THE REGRESSION MATRIX ONLY. IT IS BASED ON NUXR5, WHICH IS USED ON THE 704. THE PROGRAM ALLOWS SPACE FOR ABOUT 100 ATOMS IN THW ASOMMETRIC UNIT AND AN UNLIMITED NUMBER OF REFLECTIONS. IT IS SUITABLE FOR USE WITH ANY OF THE 230 SPACEGROUPS, AND HANKLES X-RAY AS WELL AS NEUTRON DIFFRACTION DATA. IT IS INTENDED FOR USE WIT& T&E IB FORTRAN MONITOR.

7090 1241MADSM1 AVAILABLE PRIOR TO JANUARY 1962

MADSM1 CURVE SMOOTHING ROUTINE
THIS POINT SMOOTHING ROUTINE USES A METHOD OF AVERAGING THREE PARABOLAS. FOR EACH SMOOTHED POINT, THE NINE CLOSEST GIVEN POINTS ARE OBTAINED. EACH PARABOLA THEN IS CONSTRUCTED THROUGH THREE OF THESE POINTS.

IBM 7090 PROGRAM LIBRARY ABSTRACT
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7090 1242SIPYFT AVAILABLE PRIOR TO JANUARY 1962

POLYNOMIAL FIT
A LEAST SQUARES FIT OF A POLYNOMIAL EQUATION, Y-P/X/, OF DEGREE LESS THAN OR EQUAL TO 15 TO A GIVEN SET OF DATA POINTS /X I, Y I/ FOR BOTH THE EQUAL AND UNEQUAL WEIGHT CASES

7090 1243SILSQR AVAILABLE PRIOR TO JANUARY 1962

LEAST SQUARES
LEAST SQUARES SOLUTION TO NORMAL EQUATIONS WITH NUMBER OF

7090 1248MDSCD AVAILABLE PRIOR TO JANUARY 1962

SMOOTHED ORDINATE AND DERIVATIVE
THE SMOOTHED VALUES OF THE DEPENDENT VARIABLE, THE FIRST DERIVATIVE, OR BOTH ARE COMPUTED AT EQUAL INTERVALS OF THE INDEPENDENT VARIABLE FROM LEAST SQUARES PARABOLAS FITTED TO SUCCESSIVE
LEAST SQUARES PARABOLAS FITTED TO SUCCESSIVE

AETRA — 7090 Nuclear Code

(1) Code Originated by:
Atomics International
Division of North American Aviation, Inc.

(2) Computer: (Language)
7090 (FORTRAN)

(3) Description of Code: (Indicated status, if known)
To adjust cross-section data based on data from a critical experiment involving fission foils and oscillator measurements. In use, available.

(4) References:
"FORTRAN Nuclear Codes"

AIMFIRE — 7090 Nuclear Code

(1) Code Originated by:
Atomics International

(2) Computer:
7090 (FORTRAN)

(3) Description of Code:
The basic purpose of this code is to compare the costs of various fuel cycles. AIMFIRE uses non-spatial two-group theory to predict k_{eff} as a function of burnup. Options are available by which changes in certain heterogeneous effects with burnup can be taken into account. The code contains a library of fast and thermal microscopic cross-sections, decay constants, and fission yields for 40 isotopes. The present version is designed to investigate uranium fuel systems.

(5) Approximate Performance:
About 2 seconds per cycle, each cycle divided into three parts.

(6) References:
1. R. A. Blaine, "AIMFIRE, A Fuel Economics Code", NAA-SR-6706 (1961).

(7) Material Available:
1. NAA-SR-6706.
2. FORTRAN source deck.

Note: The information given above was abstracted from NAA-SR-6706.

AIM-6 — 7090 Nuclear Code

(1) Code Originated by:
Atomics International

(2) Computer:
7090 (FORTRAN, FAP)

(3) Description of Code:
AIM-6 is a one-dimensional diffusion theory code with options similar to those of FOG, except for the buckling iteration program. A library of microscopic cross section data is utilized to form the macroscopic cross sections. In addition to the searches available to FOG, a concentration search on one or two elements is permitted. An extensive data edit is available.

(4) Restrictions or Limitations:
There must be no more than 101 spaces nor more than 18 energy groups. Only downscattering is permitted, but can be from a given group to any lower group.

(5) Approximate Performance:
For a 16 group, 101 mesh point problem, 3 minutes would be a typical time for a single problem, although times may be as low as 30 seconds.

(6) Reference:
1. H. P. Flatt, D. C. Baller, "The AIM-6 Code", NAA Program Description, January, 1961.

(7) Material Available:
1. NAA Program Description.
2. FORTRAN-FAP source deck.

AIREK-II — 7090 Nuclear Code

(1) Code Originated by:
Atomics International

(2) Computer:
7090 (FORTRAN)

(3) Description of Code:
The AIREK code is designed to solve the reactor kinetics equations with respect to time. The mathematical method used is that developed by E. R. Cohen ("Some Topics in Reactor Kinetics" - Sec. Geneva Conf., p. 629, 1958).

(4) Restrictions or Limitations:
The maximum number of differential equations that can be solved simultaneously is 50. Within this limitation, there may be i delayed neutron groups, $o < i \leq 25$, and n other linear feedback equations, $o \leq n \leq 49-i$.

(6) References:
1. A. Schwartz, "Generalized Reactor Kinetics Code AIREK-II", NAA-SR-MEMO 4980 (1959).

(7) Material Available:
1. NAA-SR-MEMO 4980 and Addendum.
2. FORTRAN source deck.

Note: The information given above was abstracted from NAA-SR-MEMO 4980.

CLOUD — 7090 Nuclear Code

(1) Code Originated by:
Atomics International

(2) Computer:
7090 (FORTRAN)

(3) Description of Code:
The CLOUD code calculates the external gamma-ray dose rate and total integrated dose resulting from the continuous release of radioactive materials to the atmosphere. Meteorological parameters such as wind velocity, lateral and vertical diffusion parameters, stability parameters and the presence of physical boundaries such as a ground surface and a temperature inversion layer, are considered. Decay of the source material is described either by the use of a simple parent-daughter decay scheme or by a Way-Wigner type relationship.

(4) Restrictions or Limitations:
A 32K memory is required.

(6) Reference:
1. D. S. Duncan, "CLOUD, An IBM 709 Program for Computing Gamma-Ray Dose Rate from a Radioactive Cloud", NAA-SR-MEMO 4822, 1959.

(7) Material Available:
1. NAA-SR-MEMO 4822.
2. FORTRAN source deck.

7090 Nuclear Code

Nuclear Code

1. Name of Code: EQUIPOISE - 3: A Two-Dimensional, Two-Group, Neutron Diffusion Code for the IBM 7090 Computer.

2. Computer: IBM 7090

3. ABSTRACT:

Equipoise - 3 is an IBM-7090 FORTRAN programmed code for the solution of two-group, two-dimensional, neutron diffusion equations. A maximum of 2100 mesh points may be used, and the code will solve problems in either rectangular or cylindrical geometry. Logarithmic derivative boundary conditions are allowed, and removal of neutrons from both groups is permitted.

FOG 7090 Nuclear Code

(1) Code Originated by:
Atomics International

(2) Computer:
7090 (FORTRAN)

(3) Description of Code:
The FOG codes are one-dimensional neutron diffusion theory codes. The difference equations used are designed in conserve neutrons in cylindrical and spherical geometry. The principal options available include calculation of the adjoint flux, five different criticality searches, and choice of one of nine possible sets of boundary conditions (including energy-dependent extrapolation lengths). In addition, an automatic calculation of extrapolation parameters is permitted, and there is available a buckling iteration program for a fully-reflected, right circular cylinder.

(4) Restrictions or Limitations:
Only macroscopic input data is permitted. From one to four energy groups are permitted, and up to 239 mesh points and 40 regions. Scattering is permitted only to the next lower group.

(5) Approximate Performance:
Varies widely, but execution time may generally be expected to be less than 30 seconds.

(6) Reference:
1. H. P. Flatt, "The FOG One-Dimensional Diffusion Equation Codes", NAA-SR-6104, 1961.

(7) Material Available:
1. NAA-SR-6104.
2. FORTRAN source deck.

FORM 7090 Nuclear Code

(1) Code Originated by:
Atomics International

(2) Computer:
7090 (FORTRAN)

(3) Description of Code:
The FORM, or FORTRAN-MUFT, code is a fourier transform slowing-down code quite similar to the MUFT-4 code, but containing some additional options, including the option of changing cross sections in the 54 group library at execution time. Library editing routines are included as auxilary codes.

(4) Restrictions:
A 32K memory and 2 tape units are required.

(5) Approximate Performance:
About 5-6 seconds.

(6) References:
1. D. J. McGoff, "FORM, A Fourier Transform Fast Spectrum Code for the IBM-709", NAA-SR-MEMO 5766 (1960).

(7) Material Available:
1. NAA-SR-MEMO 5766.
2. FORTRAN source deck.

Note: The information given above was abstracted from NAA-SR-MEMO 5766.

FORTRAN SNG 7090 Nuclear Code

(1) Code Originated by:
Atomics International

(2) Computer:
7090 (FORTRAN)

(3) Description of Code:
This code is a revision of an earlier code written by Argonne National Laboratory (Ref. 480/AMD107 by J. E. Denes). The principal changes that were made were to eliminate use of drums and any on-line printing, as well as to increase the size of the dimension statements. In addition to the regular flux calculations in plane, spherical, and cylindrical geometry, various criticality searches are permitted.

(Continued on next column)

(4) Restrictions or Limitations:
A 32K memory is required. Up to 100 space intervals and 20 energy groups may be used.

(6) References:
1. B. Carlson, "The S_n Method and the SNG and SNK Codes", LA T-1-159, 1958.
2. B. J. Lemke, "FORTRAN SNG Code", NAA Program Description, 1959.

(7) Material Available:
1. NAA Program Description.
2. FORTRAN source deck.

FUGUE 7090 Nuclear Code

(1) Code Originated by:
Atomics International

(2) Computer:
7090 (FORTRAN)

(3) Description of Code:
The FUGUE code computer steady-state wall and bulk fluid temperature, void fraction, and local pressure in liquid-cooled closed channels in which the heating rate is specified. The required relationships are expressed in general, non-dimensional form and combined in an internally consistent manner to allow predictions for a variety of coolants and specified operating conditions.

(5) Approximate Performance:
A maximal problem requires about 1 minute on the 7090.

(6) References:
1. H. J. Richardson, "FUGUE", NAA Program Description, 1960.
2. R. C. Noyes, F. Bergonzoli, J. E. Gingrich, "FUGUE, A Non-Dimensional Method for Digital Computer Calculation of Steady State Temperature, Pressure, and Void Fraction in Pipe Flow With or Without Boiling", NAA-SR-5958, 1961.

(7) Material Available:
1. NAA Program Description.
2. FORTRAN source deck.

GAM-I 7090 Nuclear Code

(1) Code Originated by:
General Dynamics Corporation
General Atomic Division

(2) Computer: (Language)
7090 (FORTRAN)

(3) Description of Code: (Indication of status, if known)
Calculates few- and multi-group cross-sections using the P_1 equations. A full scattering matrix is included for both P_0 and P_1 scattering terms. Resonance absorption is treated by the methods developed by L. W. Nordheim.

(4) References:
G. D. Joanou, J. S. Dudek, "GAM-I: A Constant P_1 Multigroup Code for the Calculation of Fast Neutron Spectra and Multigroup Constants", GA-1850, 1961.

GRACE-I 7090 Nuclear Code

(1) Code Originated by:
Atomics International

(2) Computer:
7090 (FORTRAN)

(3) Description of Code:
GRACE-I is a multigroup, multiregion, gamma-ray attenuation code designed primarily for computing gamma-ray heating and gamma-ray dose rates in multiregion finite or semi-infinite slab shields. A different buildup factor may be specified for each source region considered.

(4) Restrictions or Limitations:
If a 704 is used, at least an 8K memory is required. As many as 30 regions, 10 mesh points per region, 20 gamma-ray energy groups, 10 shield materials, and 5 material buildup factors may be included in a single calculation.

(Continued on next page)

(5) Approximate Performance:
A sample problem involving 1 source region, 9 mesh points and 1 energy group required .65 minutes on the 709.

(6) Reference:
1. D. S. Duncan, A. B. Speir, "GRACE I, An IBM 704-709 Program Designed for Computing Gamma-Ray Attenuation and Heating in Reactor Shields", NAA-SR-3719, 1959.

(7) Material Available:
1. NAA-SR-3719 (A listing of the FORTRAN source program is in this document).
2. FORTRAN source deck.

GRACE-II — 7090 Nuclear Code

(1) Code Originated by:
Atomics International

(2) Computer:
7090 (FORTRAN)

(3) Description of Code:
GRACE-II is a multigroup, multiregion, gamma-ray attenuation code which computes the total dose rate or heat generation rate from either a spherical or a cylindrical source. The source, which may be located in either the central region of the system or in a concentric shell region surrounding it, may be uniform, exponential, or have a polynomial variation in the radial direction. In the case of cylindrical geometry, it may also have a polynomial variation in the axial direction.

(4) Restrictions or Limitations:
If used on the 704, at least a 16K memory is required. As many as 22 regions, 10 mesh points per region, 20 gamma-ray energy groups, 20 shield materials, and 20 material buildup factors may be included in a single calculation.

(5) Approximate Performance:
A sample problem required 3.64 minutes on the 709.

(6) Reference:
1. D. S. Duncan, A. B. Speir, "GRACE-II, An IBM 709 Program for Computing Gamma-Ray Attenuation and Heating in Cylindrical and Spherical Geometries", NAA-SR-MEMO 4649, 1959.

(7) Material Available:
1. NAA-SR-MEMO 4649.
2. FORTRAN source deck.

PDQ 2-90 — 7090 Nuclear Code

(1) Code Originated by:
International Business Machines Corporation

(2) Computer: (Language)
7090 (SAP)

(3) Description of Code: (Indication of status, if known)
Revision of PDQ-2 which eliminates need for use of computibility package. Handles up to 5000-5500 mesh points.

PERT — 7090 Nuclear Code

(1) Code Originated by:
Atomics International

(2) Computer:
7090 (FORTRAN)

(3) Description of Code:
The PERT code is a perturbation theory code designed for use with the AIM-5, AIM-6, and FOG codes. Punched card output from these codes is used as input to the PERT code. Using cross section data, fluxes, and adjoint fluxes, the relation change in k_{eff} may be calculated. Cross sections may be weighted with the adjoint flux and/or flux. The neutron lifetime for the delay groups may also be calculated.

(4) Restrictions or Limitations:
A linear perturbation theory is used for the calculations of the relative change in k_{eff}.

(Continued on next column)

(5) Approximate Performance:
Generally less than 30 seconds for an 18 group problem.

(6) Reference:
1. H. P. Flatt, "PERT", NAA Program Description, January, 1961.

(7) Material Available:
1. NAA Program Description.
2. FORTRAN source deck.

PREP — NORC Nuclear Code

(1) Code Originated by:
Westinghouse - Bettis Plant

(2) Computer:
NORC

(3) Description of Code:
Elastic scattering transfer cross-sections are calculated using mass no., lethargy spectrum, and Legendre expansion cofficients for differential elastic scattering cross-sections. The computed cross-sections for a given element are placed on a library tape upon which as many as 30 elements may be accumulated.

(4) Restrictions or Limitations:
A maximum of 99 groups and 30 elements are allowed.

(5) Approximate Performance:
1 hour.

(6) References:
Summary, September, 1958.

SAIL — 7090 Nuclear Code

(1) Code Originated by.
Atomics International

(2) Computer:
7090 (FORTRAN)

(3) Description of Code:
The monoenergetic neutron transport equation is solved using the discrete S_n method for a one-dimensional plane cell. Various cell properties are computed. Emphasis is placed upon ease in running multiple cases, and, in case of lack of convergence within the specified number of iterations, upon restarting a problem at a later date.

(4) Restrictions or Limitations:
The code is limited to a single energy group, 100 regions, 100 intervals, and plane geometry. The order of approximation must be 2, 4, 6, or 8.

(5) Approximate Performance.
The running time is generally less than one minute. A sample S_4 problem involving 7 mesh points required 21 seconds, including loading the program into memory.

(6) References:
1. B. J. Lemke, "SAIL", NAA Program Description, February, 1961.
2. B. Carlson, "Numerical Solution of Transient and Steady-State Neutron Transport Problems", LA-2260 (1960).

(7) Material Available:
1. NAA Program Description.
2. FORTRAN source deck.

SIZZLE — 7090 Nuclear Code

(1) Code Originated by:
Atomics International
Division of North American Aviation, Inc.

(2) Computer: (Language)
7090 FORTRAN

(3) Description of Code: (Indication of status, if known)
One-space dimension, 18 group diffusion theory calculation. After calculation at t=0, number of groups may be reduced to 1 to 6 groups. First version of code was primarily intended for fast reactor calculations, but later versions have appeared for thermal calculations. In production, available.

(4) References:
"FORTRAN Nuclear Codes"

S_4 CYLINDRICAL GEOMETRY CELL CODE

7090 Nuclear Code

(1) Code Originated by:
Atomics International

(2) Computer:
7090 (FORTRAN)

(3) Description of Code:
This code solves the one-dimensional monoenergetic Boltzmann equation in cylindrical geometry, using the S_4 approximation. In addition to the flux distribution, cell-averaged parameters are computed. An input gues to the flux may be used or a diffusion calculation may be performed to provide an initial guess. In addition, when running multiple cases, the converged flux from the previous case may be used.

(4) Restrictions or Limitations:
The present restrictions are 100 regions and 400 intervals. With these dimensions, a 32K memory is required.

(5) Approximate Performance:
About 15 seconds for a 50 mesh point problem.

(6) References:
1. J. S. Temple, "S_4 CYLINDRICAL GEOMETRY CELL CODE", AMTD-104, 1961.

(7) Material Available:
1. AMTD-104.
2. FORTRAN source deck.

TEMPEST

7090 Nuclear Code

(1) Code Originated by:
Atomics International
Division of North American Aviation, Inc.

(2) Computer: (Language)
7090 (FORTRAN)

(3) Description of Code: (Indicated status, if known)
Thermal cross-section, Wigner-Wilkins or Wigner equations. In use, available.

(4) References:
"FORTRAN Nuclear Codes"

TEMPEST-II

7090 Nuclear Code

(1) Code Originated by:
Atomics International

(2) Computer:
7090 (FORTRAN)

(3) Description of Code:
TEMPEST-II is a neutron thermalization code based upon the Wigner-Wilkins approximation for light moderators and the Wilkins approximation for heavy moderators. A Maxwellian distribution may also be used. The model used may be selected as a function of energy. The second-order differential equations are integrated directly rather than transforming to the Riccati equation. The code provides microscopic and macroscopic cross-section averages over the thermal neutron spectrum.

(4) Restrictions or Limitations:
A 32K memory is required.

(5) Approximate Performance:
About 15-20 seconds.

(6) References:
1. R. H. Shudde, "TEMPEST-II", NAA Program Description, 1961.

(7) Material Available:
1. NAA Program Description.
2. FORTRAN source deck.

7090 Nuclear Code

Nuclear Code

1. Name of Code: TWENTY GRAND: The Twenty Grand Program for the Numerical Solution of Few-Group Neutron Diffusion Equations In Two Dimensions.

2. Computer: IBM 7090

3. ABSTRACT:

The Twenty Grand program for the IBM 7090 is capable of solving neutron diffusion problems in cylindrical or slab geometry for one to six groups. Up to 3000 mesh points may be used. Neutron transfer from any group to any other group is permitted. Leakage in the third dimension in X-Y geometry may be treated by a buckling which can vary with region and group. Three types of symmetry conditions may be handled automatically. The zero flux, zero derivative, and logarithmic boundary conditions are available.

7090 Nuclear Code

Nuclear Code

1. Name of Code: WHIRLAWAY - A Three - Dimensional, Two Group Neutron Diffusion Code for the IBM 7090 Computer.

2. Computer: IBM 7090

3. ABSTRACT:

By making certain changes in two of the chain links of the Whirlaway code, it may be used to calculate the flux distribution with a fixed source in one region. The eigenvalue is kept at unity. While regions with flux-dependent sources are permitted, they must not be adjacent to the one fixed-source region. Corrected values for the sample problem given in ORNL-3150 are also included.

2DXY

7090 Nuclear Code

(1) Code Originated by:
Aerojet-General Nucleonics

(2) Computer:
7090 (FLOCO-II-D)

(3) Description of Code:
The 2DXY program solves the homogeneous or inhomogeneous multi-group transport equation in xy geometry. Vacuum, surface source, or reflecting boundary conditions are available as options. In the homogeneous case the user may request the computation of reactivity, period, critical concentrations of some composition or the critical thickness of a zone. The S_n approximation is used.

(4) Restrictions or Limitations:
Scattering must be isotropic.

(5) Approximate Performance:
One and one-half hours for 6 group, 1000 mesh points on the 7090 (using the binary editor).

(6) References:
1. J. Bengston, S. T. Perkins, T. W. Sheheen, and D. W. Thompson, "2DXY - A Two-Dimensional Cartesian Coordinate S_n Transport Calculation", AGN-TM-329, 1961.
2. B. Carlson, C. Lee, and J. Worlton, "The DSN and TDC Neutron Transport Codes", LAMS-2346, 1961.
3. S. T. Perkins, T. W. Sheheen, D. W. Thompson, "2DXY", Computer Code Abstract No. 18, Nuclear Science and Engineering, 10, p. 408, 1961.

(7) Material Available:
1. Binary Editor Deck (7090).
2. FLOCO II F Binary Deck (7090).
3. 2DXY Deck (7090).
4. Sample Problem Input Deck (7090).
5. AGN TM-392.

Notes: 1. The above information was taken from Reference 3.
2. This code was contributed through the Argonne Code Center. The binary editor program referred to above is essentially a compatibility package for the 7090.

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IBM

International Business Machines Corporation
Data Processing Division
112 East Post Road, White Plains, New York