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Special
Information
Systems

Xerox Special Information Systems (XSIS) is specially organized to meet the needs of customers who require uniquely designed, engineered, and integrated information, printing, and publishing systems not available through normal commercial channels.

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- Respond to Federal and commercial customer needs for non-standard information, printing, and publishing systems employing a high mix of Xerox standard products
- Work with other Xerox organizations to meet customer requirements for information, printing, and publishing systems
- Conduct development activities in relevant leading edge technologies

Located in manufacturing and office facilities exceeding 200,000 square feet in Pasadena, California, XSIS is involved in a wide range of programs encompassing such diverse fields as:

- Automated Message Centers
- Scanning, Storing, and Retrieval Systems
- Color Image Processing and Printing Systems
- Computer-Based Publishing and Demand Printing Systems
- Militarized Graphic Plotters
- Security Systems for Currency and Document Protection
- Classified Intelligence Applications

Xerox Special Information Systems
Vista Laboratory
P.O. Box 5608
Pasadena, California 91107-0608
818 - 351 - 2351

XEROX

Dear Sir or Madam,

Please find enclosed the information you requested on our Smalltalk-80 software product line.

If you would like to purchase any of these products, please fill out and sign the enclosed *Software Order Form* and, if applicable, the *Software License Terms and Conditions*.

The *Software License Terms and Conditions* is required for the following packages: SMALLTALK-80 for the Xerox 1109 and Xerox 1186 AI Workstations*. Please note that you must list the package(s) and the serial numbers of the machines on which they will be used. Your signature, title, and date are required on the last page. We cannot ship SMALLTALK-80 without the completed original copy of this agreement.

A *shrink wrap* type of software license is used for the following packages: THE ANALYST, HUMBLE and ASP. This agreement will be attached to the outside of the boxes in which these packages are shipped. Enclosed is a copy for your review.

Please return the completed *Software Order Form*, the *Software License Terms and Conditions* (if applicable), and your purchase order or check to Ms. Leslee Cook, Mail Stop 600, at the above address.

*Note: SMALLTALK-80 is available from XSIS for the Xerox 1109 and Xerox 1186 AI Workstations. Other versions of Smalltalk-80 are available as follows:

Tektronix 4400 Series	Tektronix, Inc.	(800) 547-1512
SUN 2 or 3 Series	ParcPlace Systems	(415) 859-1000
Apple Macintosh Series	APDA	(206) 251-6548
IBM PC AT or Compatible	Softsmarts, Inc.	(415) 327-8100

If you have any questions or require additional information, please contact me at (818) 351-2351, extension 2343. Thank you for your interest.

Very truly yours,

Evelyn Van Orden
Smalltalk-80 Products Manager

Enclosures (4/87)

Smalltalk-80 Software Packages
Domestic Commercial Prices in $US

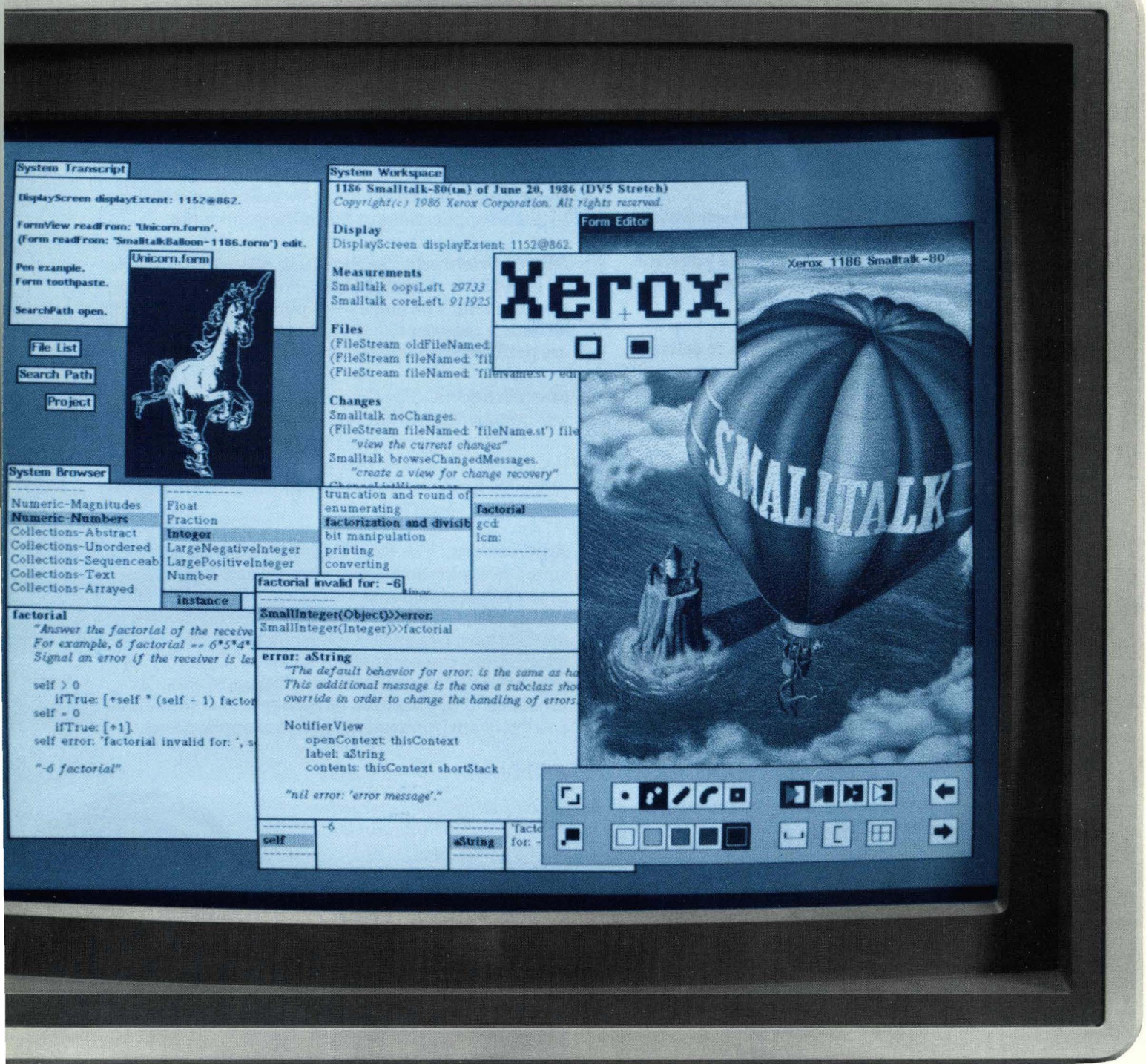| Smalltalk-80 Software Product	Site License [1]	Per Machine License [2]
THE ANALYST V1.1 [3]	5000	1000
HUMBLE W/S V1.1 [3]	1500	500
HUMBLE PC V1.1 [4]		300
ASP V1.1 [5]		500
SMALLTALK-80 DV6 [6]	1000	1000

[1] Site license includes site license and one user installable software installation kit.

[2] Per machine license includes license reproduction fee and one documentation kit per machine.

[3] Available for engineering class workstations that run Smalltalk-80 License Version 2: currently Xerox, Tektronix, and SUN.

[4] Available for personal computer class workstations that run Smalltalk-80 License Version 1 or 2: currently Apple Macintosh and IBM PC AT and compatibles.

[5] Available for any workstation that runs Smalltalk-80 License Version 2: currently Xerox, Tektronix, SUN, and IBM PC AT and compatibles.

[6] Available for the Xerox 1109 and Xerox 1186 AI Workstations. Includes License Version 2 Virtual Image and Virtual Machine.

The Smalltalk-80 System

System Transcript

DisplayScreen displayExtent: 1152@862.

FormView readFrom: 'Unicorn.form'.
(Form readFrom: 'SmalltalkBalloon-1186.form') edit.

Pen example.
Form toothpaste.

SearchPath open.

Unicorn.form

File List

Search Path

Project

System Browser

Numeric-Magnitudes	Float
Numeric-Numbers	Fraction
Collections-Abstract	Integer
Collections-Unordered	LargeNegativeInteger
Collections-Sequenceab	LargePositiveInteger
Collections-Text	Number
Collections-Arrayed	

instance

factorial

"Answer the factorial of the receiver
For example, 6 factorial == 6*5*4*
Signal an error if the receiver is les

self > 0
    ifTrue: [↑self * (self - 1) factor
self = 0
    ifTrue: [↑1].
self error: 'factorial invalid for: ', s

"-6 factorial"

System Workspace

1186 Smalltalk-80(tm) of June 20, 1986 (DV5 Stretch)
Copyright(c) 1986 Xerox Corporation. All rights reserved.

Display
DisplayScreen displayExtent: 1152@862.

Measurements
Smalltalk oopsLeft. 29733
Smalltalk coreLeft. 911925

Files
(FileStream oldFileNamed:
(FileStream fileNamed: 'fil
(FileStream fileNamed: 'fileName.st') edi

Changes
Smalltalk noChanges.
(FileStream fileNamed: 'fileName.st') file
    "view the current changes"
Smalltalk browseChangedMessages.
    "create a view for change recovery"

truncation and round of
enumerating
factorization and divisib
bit manipulation
printing
converting

factorial
gcd:
lcm:

factorial invalid for: -6

SmallInteger(Object)>>error:
SmallInteger(Integer)>>factorial

error: aString
    "The default behavior for error: is the same as ha
    This additional message is the one a subclass sho
    override in order to change the handling of errors.

    NotifierView
        openContext: thisContext
        label: aString
        contents: thisContext shortStack

    "nil error: 'error message'."

self   -6

aString   'facto
for: -

Form Editor

Xerox 1186 Smalltalk-80

Xerox

SMALLTALK

An object-oriented language and programming environment

The Smalltalk-80™ system is a personal, integrated, interactive environment ideally suited to exploratory programming and prototype development. The result of 14 years of research and development at the Xerox Palo Alto Research Center (PARC) and over 6 years of product engineering at Xerox Special Information Systems (XSIS), it has evolved into a state-of-the-art programming environment that uniformly applies an object-oriented point of view to the design and implementation of software systems.

The Smalltalk-80 system takes full advantage of the advanced hardware capabilities of Xerox professional workstations. The graphical user interface, employing a large high-resolution display and three-button mouse, is the most sophisticated available.

Every component in the Smalltalk-80 system is accessible to the user and is presented in a meaningful way for observation and manipulation. The powerful interactive programming tools allow complex system changes to be made within a few seconds.

Effective management of complexity is a key contribution of the Smalltalk-80 approach to software.

Personal, graphical, integrated, interactive, uniform, extensible, object-oriented

The Smalltalk-80 system supports multiple, overlapping windows for text and graphics editing, browsing, programming, compiling, testing, debugging, inspecting, accessing files, and running user-defined applications.

Personal. The Smalltalk-80 system is personal because the user can tailor it to individual preferences and requirements without interfering with other users. Performance is maximized by utilizing the entire resources of the workstation.

Graphical. The graphical window-based user interface, pioneered at Xerox PARC in the early 1970's, creates a visual language for every system component and presents it in a meaningful format on the large, high-resolution display.

Integrated. The environment provides integrated programming facilities that greatly enhance productivity, allowing programmers to explore new ideas quickly and receive immediate feedback.

Interactive. The environment takes full advantage of the large high-resolution bitmapped display and three-button optical mouse that are standard components of Xerox professional workstations. These interactive devices allow the user to move freely among a variety of programming activities and applications.

Uniform. Uniformity is one of the most important features that distinguishes the Smalltalk-80 system from traditional programming systems. The language is based on a few object-oriented concepts that are applied uniformly throughout the system: object, message, class, subclass, instance, and method. The environment's window facilities consistently adhere to a small number of user interface conventions that are quickly learned and easily used by casual and experienced users alike.

Extensible. The Smalltalk-80 system is fully extensible because enhancements can easily be developed and integrated. The language can be extended to support new syntax and functions. The environment can be extended by modifying existing tools and applications or by defining new ones.

Object-Oriented. The Smalltalk-80 system is the *de facto* industry standard object-oriented programming environment. The language is purely object-oriented; all data is represented as objects and all computations are performed by sending messages to objects.

Specifications. The Smalltalk-80 system contains 250 system classes that provide a library of over 4,500 functions with 1.5 million bytes of commented source text available on-line. Extended precision integers up to 65,000 digits in length and full IEEE floating point format are supported.

Applications. The Smalltalk-80 system is ideally suited to exploratory programming, software prototyping, simulation, modeling, AI research, and the rapid development of sophisticated interactive applications. Design and implementation of applications can occur simultaneously, encouraging experimentation and creative solutions to complex problems. The Smalltalk-80 system is also suitable as a delivery environment for end-user applications.

Publications

Smalltalk-80: The Interactive Programming Environment,
A. Goldberg, 1983,
Addison-Wesley.

Smalltalk-80: The Language and Its Implementation,
A. Goldberg & D. Robson,
1984, Addison-Wesley.

Smalltalk-80: Bits of History, Words of Advice, edited by
G. Krasner, 1984,
Addison-Wesley.

XEROX

The Analyst Workstation System

AnalystLogo.image- + 1

The Analyst

Information Centers

Map-atlas hierarch connections

| demo | Idle-cursors | Map-atlas | Private |
| Scavenge | Current-Work | Kids-Center | Make New Center |

Weather Animation

Trucks

Map Animation databases

Balloon.form

test text

Meet record

Morgan-128.image

Map-atlas

Maps

World (5 min)

Continental US Map

Zoom Map

Europe (1 min)

NorthAfrica (1 min)

1186 Smalltalk-80

Continental US Map

The Analyst

The Analyst: A Smalltalk-80 Information Analys
Introduction
System Concepts
Data Organization
Application Packages
   Information Center
      Text
      Document Layout
      Images
      Maps
      Business Graphics
      Outlines
      Spreadsheets
      Databases
   Auto Books

The Analyst Workstation System is an integrated set of special application packages implemented in the **Xerox Smalltalk-80 System**. Professional analysts, programmers and casual users benefit from the flexible working environment that can be customized as needed. At the same time, *The Analyst* forms the foundation for the development of additional sophisticated integrated applications. *The Analyst* system was designed to meet the need for an intelligent, interactive, graphics-oriented front end to the real world of continually changing task

Demo's Info Center
XPers

The available Item Reference is:
Meet record

Charts
Databases
Idle Forms
The new project
Maps (XPers)
Outlines
Pictures
Reports
Spreadsheets

XPers

Demo's Pictures Folder

The available Item Reference is:
Meet record

Carol at Her Workstation
Los Angeles Basin
Peppers
The Smalltalk Balloon
Spreadsheet Picture
airport
docks
harbor
rails

cation packages
The Analyst
Center, Text
out, Report
mages, Business
Outlines,
ting, Clocks,

Los Angeles

Dallas

Washington DC
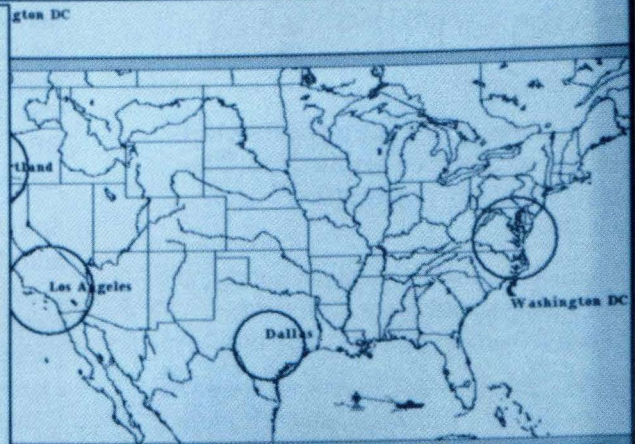
| Activity | Brush | Color | Grid | Mode |
| line | | | (off) | under |

An integrated information analysis environment

The Analyst™ Workstation System is an integrated set of special application packages implemented in the Xerox Smalltalk-80™ environment that provides a wide range of information analysis capabilities. These packages are used by professional analysts as tools in a working environment that can be customized to individual needs, as well as by programmers as a foundation for the development of sophisticated interactive applications.

The Analyst is derived from a series of integrated analyst software packages developed in the Smalltalk-80 environment during the past 6 years at Xerox Special Information Systems (XSIS). It is designed to fulfill requirements for an intelligent, interactive, graphics-oriented environment for manipulating text, graphics, maps, and image data.

The Analyst is commercially available in the form of commented Smalltalk-80 source code that can be integrated into any Smalltalk-80 system.

The Analyst Information Center

At the hub of The Analyst is the Information Center, an integrated information management system that organizes all resources and tools for both novice and experienced users. Reports consisting of formatted text, spreadsheets, charts, graphs, maps, and illustrations are easily created, printed, and stored with the Information Center.

Data Security. Windows reflect the highest security level of all information contained within them. The Analyst helps insure that any organization's data remains where it should.

Maps and Images. The Analyst displays, zooms, and annotates scanned images and maps. Maps are generated on demand from an optional map database.

Business Graphics. Pie, bar, line charts, clustered or stacked bar charts, and x-y scatter or linear fit plots can be generated. Charts can be created interactively or automatically from data stored in personal databases.

Personal Databases. Personal databases with fixed-length fields and records can be created and updated. These databases can store a wide variety of information, including textual and numeric data, geographic data for display on maps, temporal data for animation, and business or technical data for charting. A powerful user interface allows sorting, report generation, and queries without knowledge of the query language. The user can link records to more extensive data sets in any information center. Complete record-by-record data security information is also retained.

The Analyst Spreadsheets. Spreadsheets can be created with an arbitrary number of cells. Cells can contain virtually any Smalltalk-80 object, from simple numbers to charts, graphs, vectors, and matrices. Spreadsheets can be linked together to form powerful distributed spreadsheets. Entire personal databases can be kept in cells, allowing the user to both query and analyze them from within a spreadsheet.

The Analyst Outlines. The Analyst supports creation, editing, and manipulation of outlines. Ideas and concepts can be copied from one outline to another. Outlines can be used to create structured documents which can be printed and formatted in a variety of ways. Outlines can automatically eliminate items that are flagged as being sensitive to a particular audience.

Report Generator. Reports, documents, and memos can be generated by combining text, graphics, maps, and images in an editable WYSIWYG window, from information stored in any information center.
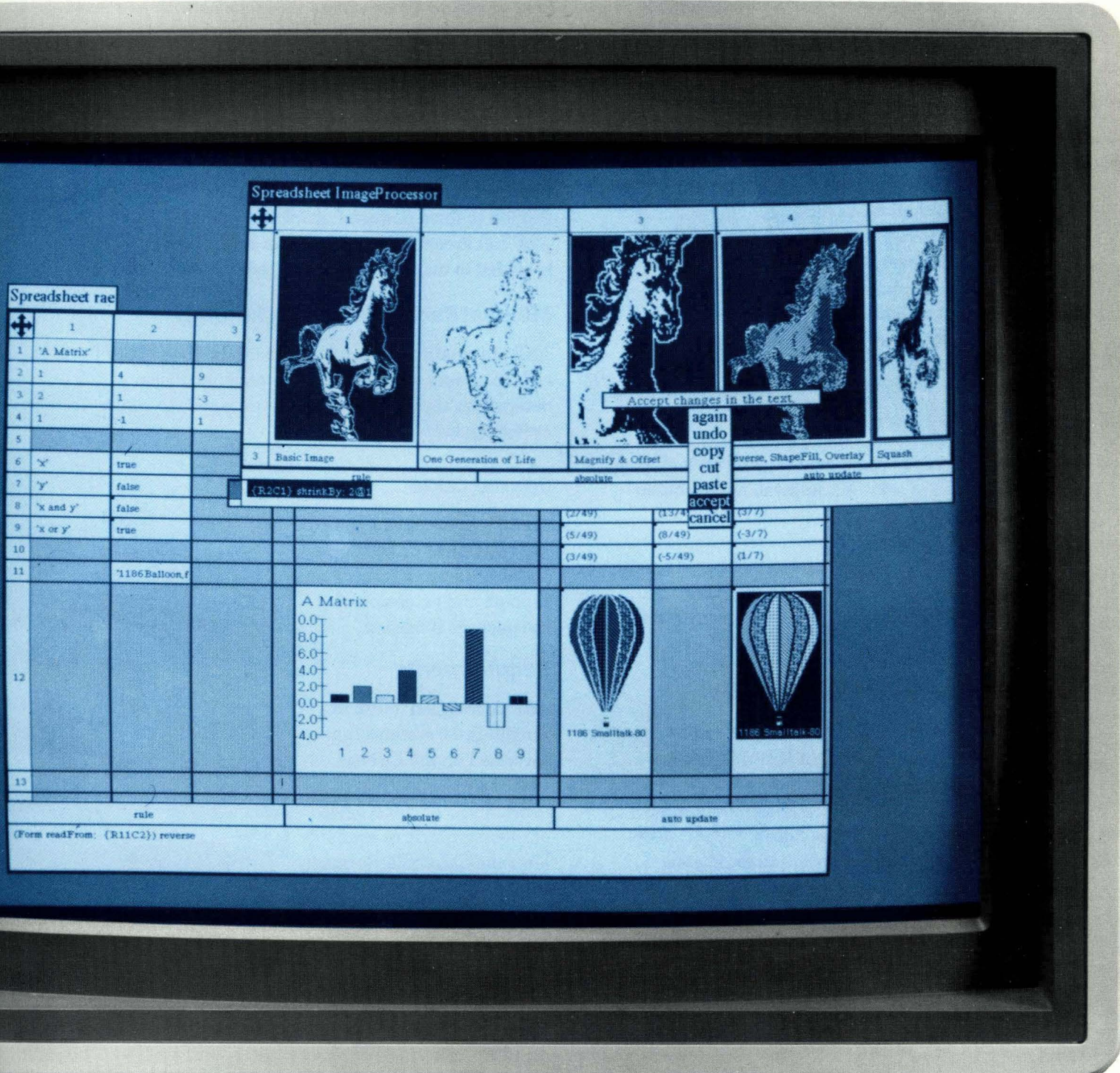
Communications. Powerful RS232C and Ethernet communications packages are included in The Analyst. RS232C windows can emulate intelligent text and graphics terminals. Graphics terminal emulators can capture command streams for later analysis. All terminal emulators are integrated with The Analyst's multi-window editing environment. Ethernet packages allow communication with all XNS printers and servers.

Specifications. The Analyst Workstation System adds 200 new classes to the Smalltalk-80 system, providing 6,500 new functions with about 2 million bytes of commented source text. An on-line User Guide provides instructions specific to particular tasks and a Demo Center provides examples of windows and tools. Concise on-line instructions, along with meaningful menus and graphics, allow users to make efficient use of the system.

Applications. The Analyst is ideally suited as a personalized working environment for professional analysts. It can also be exploited as a foundation upon which sophisticated new interactive applications can be developed to enhance the Xerox Smalltalk-80 system.
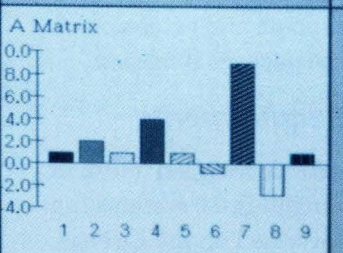
ASP – The Analytic Spreadsheet Package

An advanced object-oriented spreadsheet package for the Smalltalk-80 system

ASP™ is an analytic spreadsheet package that provides access to the full power of the Smalltalk-80™ programming environment. Developed by Xerox Special Information Systems (XSIS) as part of The Analyst™ Workstation System, ASP is now available as a separate package for the Smalltalk-80 environment.

Unlike other spreadsheet packages, ASP is designed for the analysis of more than just numbers and labels. Vectors, points, collections of data, text, charts, files, and images are just a few types of objects that ASP can manipulate and display.

While ASP provides a large array of predefined functions, it is also extensible. By adding new methods to the Smalltalk-80 environment, ASP can be instantly expanded to match user needs, without requiring extensive knowledge of either ASP or the Smalltalk-80 system.

Graphical User Interface

ASP spreadsheets can be created interactively with an arbitrary number of cells. A graphical, mouse-based user interface is provided for selecting cells, rows, columns, or rectangular sections; for entering values and rules into cells; for adjusting the width and height of rows and columns; for scrolling to arbitrary rectangular regions; and for performing many other spreadsheet functions.

Flexible Data Types and Formulas

Virtually any type of Smalltalk-80 object can be displayed and manipulated in an ASP cell. Most Smalltalk-80 language constructs are available in ASP formulas. This includes the use of temporary variables for storage of interim values. Spreadsheets have been developed that interface to databases, perform image processing, conjugate regular verbs, and many other advanced functions. Truly unprecedented power is available to those whose analysis tasks reach beyond simple numeric processing into the realms of symbols and data structures.

Special Data Types

Several special types of data are included with ASP to allow the manipulation of matrix objects and business graphics (pie, bar, and line charts) within cells. Simple accessing protocols make it easy to deal with these complex objects.

Interlinking

Spreadsheets can be linked together in a hierarchical fashion to form powerful distributed spreadsheets. ASP can access information from any spreadsheet that is loaded in main memory or stored on a local disk.

Minimal Recalculation Technology

ASP automatically calculates the minimal number of cells to update when a change is made. ASP also determines the sequence of updates to cells to assure correct answers.

Source Code

Complete source code for ASP is included with the package, allowing local programming support and extension of the package if needed.

Requirements

ASP is designed to run in Smalltalk-80 systems that are based on the License Version 2 Virtual Image. A minimum of 500 Kbytes of memory must be available after the Smalltalk-80 image is loaded.

HUMBLE
Expert System Shell

HUMBLE.logo

HUMBLE

SmalltalkBalloon

HUMBLE Knowledge Bases

ROX
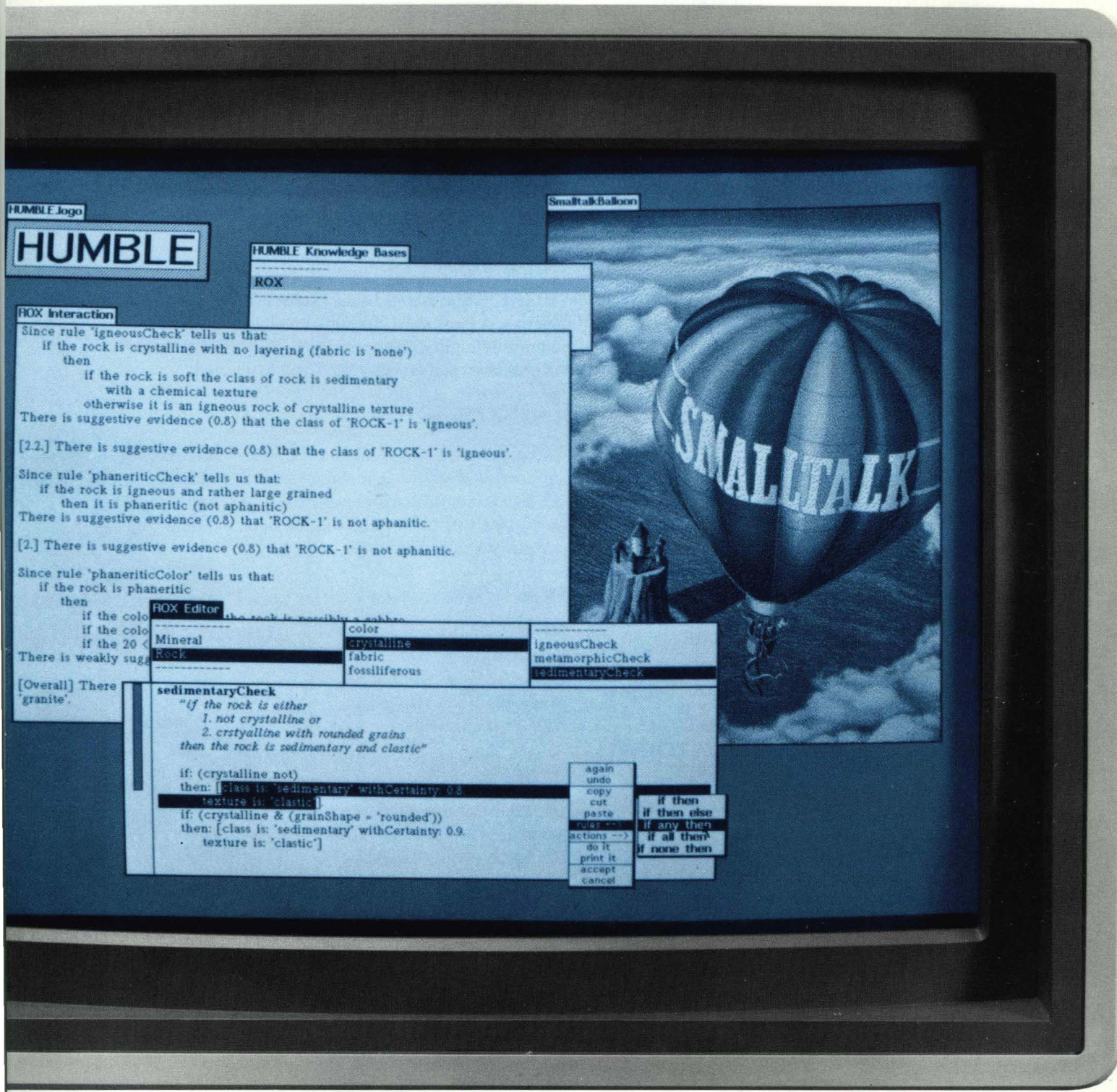
ROX Interaction

Since rule 'igneousCheck' tells us that:
   if the rock is crystalline with no layering (fabric is 'none')
   then
      if the rock is soft the class of rock is sedimentary
         with a chemical texture
      otherwise it is an igneous rock of crystalline texture
There is suggestive evidence (0.8) that the class of 'ROCK-1' is 'igneous'.

[2.2.] There is suggestive evidence (0.8) that the class of 'ROCK-1' is 'igneous'.

Since rule 'phaneriticCheck' tells us that:
   if the rock is igneous and rather large grained
   then it is phaneritic (not aphanitic)
There is suggestive evidence (0.8) that 'ROCK-1' is not aphanitic.

[2.] There is suggestive evidence (0.8) that 'ROCK-1' is not aphanitic.

Since rule 'phaneriticColor' tells us that:
   if the rock is phaneritic
   then
      if the colo the rock is possibly a gabbro
      if the colo
      if the 20 <
There is weakly sugg

[Overall] There
'granite'.

ROX Editor

Mineral
Rock

color
crystalline
fabric
fossiliferous

igneousCheck
metamorphicCheck
sedimentaryCheck

sedimentaryCheck
  "if the rock is either
    1. not crystalline or
    2. crstyalline with rounded grains
  then the rock is sedimentary and clastic"

  if: (crystalline not)
  then: [class is: 'sedimentary' withCertainty: 0.8
    texture is: 'clastic'].
  if: (crystalline & (grainShape = 'rounded'))
  then: [class is: 'sedimentary' withCertainty: 0.9.
    texture is: 'clastic']

again
undo
copy
cut
paste
rules -->
actions -->
do it
print it
accept
cancel

if then
if then else
if any then
if all then
if none then

SMALLTALK

An advanced Smalltalk-80 based expert system tool

HUMBLE™ is an advanced expert system building tool which runs entirely within the Smalltalk-80™ environment. Users add rules and data definitions to create expert systems for specific problems. Developed by Xerox Special Information Systems (XSIS), HUMBLE meets the needs of many diverse applications because it is easily modified and extended by the user.

Complete source code is provided with the package. Input and output can be redirected to a user generated interface package, if desired. The certainty model which HUMBLE uses to make decisions can be altered.

Forward and Backward Chaining

Both forward and backward chaining are possible within a single HUMBLE knowledge base. Backward chaining is automatic during execution, while forward chaining can be specified at any point during rule execution.

Multiple Knowledge Bases

HUMBLE supports the existence of several knowledge bases simultaneously. A complete programmer's interface allows any Smalltalk-80 application to interface with HUMBLE knowledge bases.

Multiple Execution Contexts

HUMBLE supports the concept of multiple execution contexts, allowing the same rules to be applied to several similar objects within a knowledge base.

Understandable Rule Language

The rule language in HUMBLE is exceptionally easy to read and write. It also contains an *escape* to standard Smalltalk-80 code, should an application require functions not built into the rule language.

Advanced Editor/Browser

The knowledge base editor provided with HUMBLE resembles the Smalltalk-80 code Browser. It is mouse driven, and includes automatic cross referencing features. It provides all of the organizational advantages of rule sets, without the restrictions.

Redirectable Input and Output

Output from a HUMBLE knowledge base can be directed to any Smalltalk-80 Stream object. Input can be obtained from standard or user implemented objects. Trace and debugging facilities, also redirectable, are provided.

Reasoning under Uncertainty

HUMBLE uses the standard MYCIN certainty model. However, for users who require alternate approaches, the certainty model is designed to be easily altered to suit the needs of particular applications. A simple subclass which responds to eight messages is all that is required to entirely replace the certainty model. In fact, different knowledge bases may have entirely separate certainty models.

Explanation

HUMBLE knowledge bases explain their reasoning in English. A backward chaining mechanism in the explanation facility gives complete, concise explanations. Alternatives can be examined and explained.

Source Code

Complete source code for the HUMBLE shell and its supporting windows is included with the package. Modifications and additions are encouraged, particularly in the areas designed to be modular: the certainty model and input/output.

High Performance

HUMBLE's processing speed is very quick: 125 rules per second on a Xerox 1132 processor. Further, execution rate does not degrade when the size of the rule set increases.
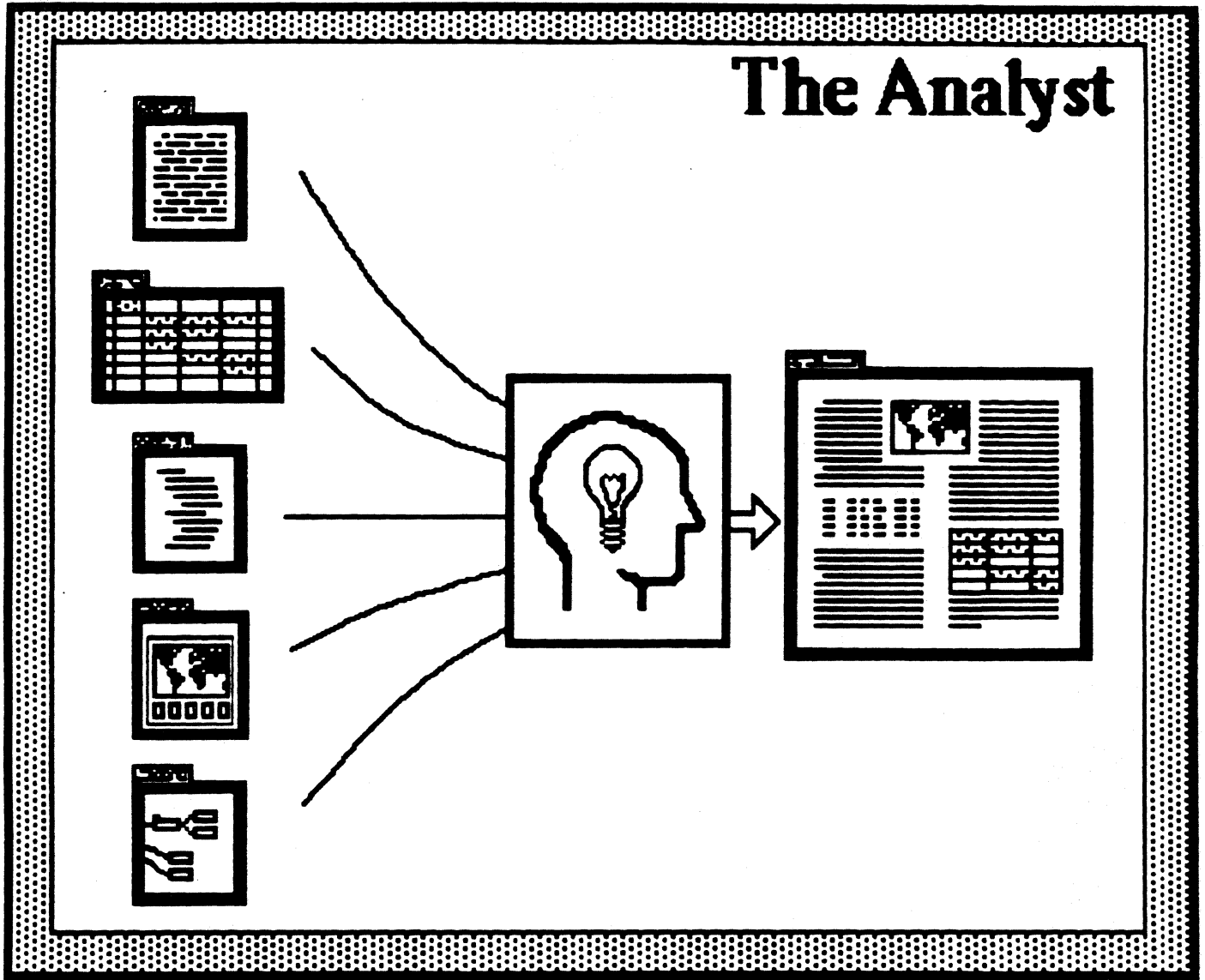
Requirements

HUMBLE is designed to run in Smalltalk-80 systems that are based on any License Version virtual image. A minimum of 200 Kbytes of memory must be available after the Smalltalk-80 image is loaded.

The Analyst
A Smalltalk – 80 Information Analysis Tool

The Analyst
# A Smalltalk − 80 Information Analysis Tool

Introduction

The Analyst workstation sytem is an integrated set of special application packages implemented in the Xerox Smalltalk − 80 system. Professional analysts, programmers and casual users benefit from the flexible working environment that can be customized as needed. At the same time, The Analyst forms the foundation for the development of additional sophisticated integrated applications. The Analyst system was designed to meet the need for an intelligent, interactive, graphics − oriented front end to the real world of continually changing task requirements.
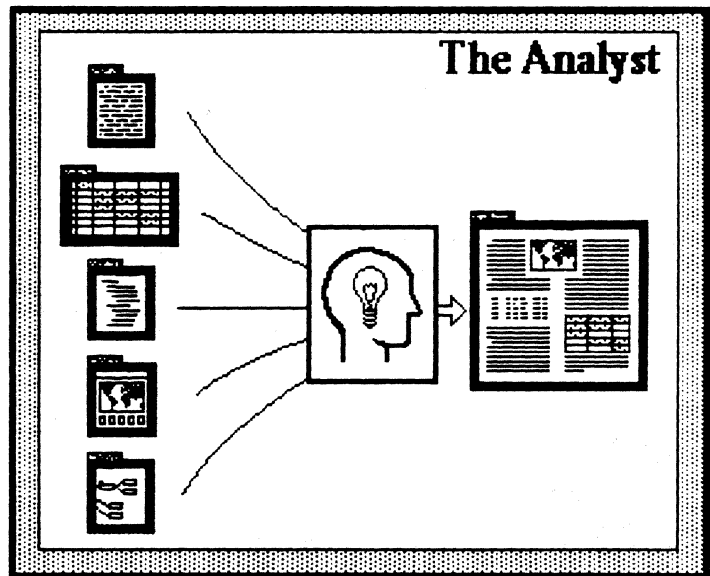
Window − based application packages currently integrated in The Analyst include the Information Center, Text Editing, Document Layout, Report Generation, Maps and Images, Business Graphics, Spreadsheets, Outlines, Personal Databases, Printing, Clocks, Calendars, On − line Atlas, Auto Books, Expert Systems, and Terminal Emulation. A complete and flexible system of security level designations is also included.

System Concepts

The Analyst system addresses the management of information and the production of finished reports based on that information. A primary goal of The Analyst development project was to create a system readily accessible to the average (particularly non — computer savvy) user, providing a personal, integrated, and extensible environment employing a uniform graphical interface. Uniformity of application interfaces allows the user direct access to each task without the additional chore of learning a multitude of different interfaces. At every step, the user is presented a list of alternate actions in pop — up menus and dialog boxes, eliminating the necessity of learning a command language. Every feature in the system has been designed with an eye toward making it easy for the user.
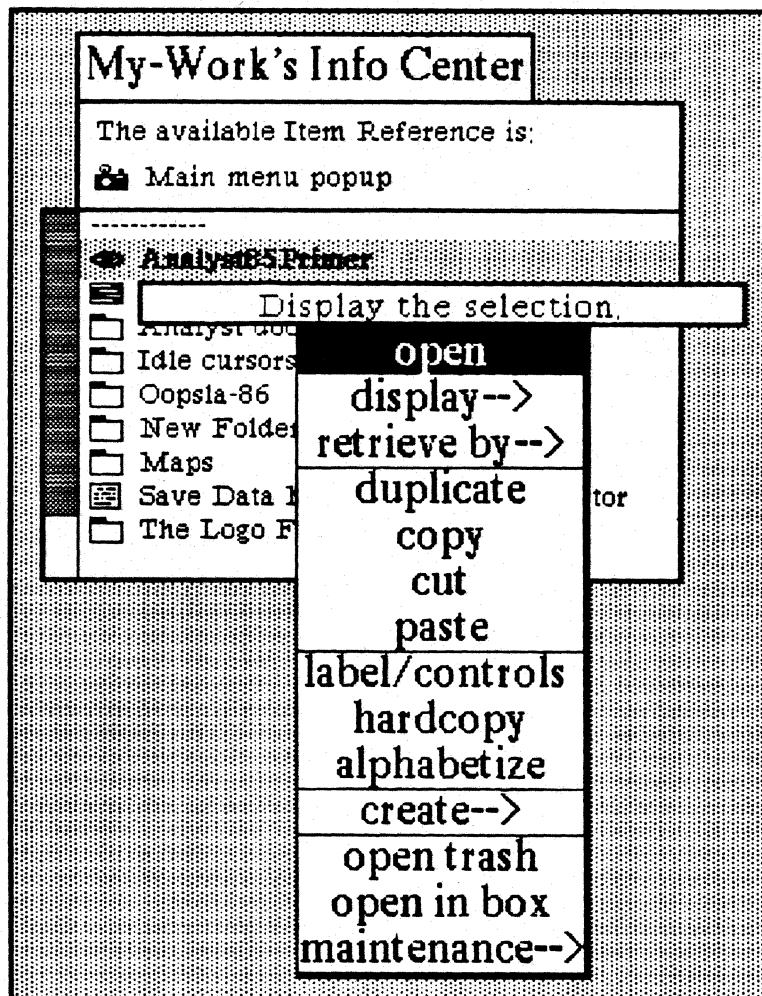
Data Organization

The Analyst organizes data in a method designed to be both intuitive and flexible. The system is easy and natural to use for anyone familiar with the operation of the standard office filing system, as its design and terminology are based on those very concepts. Just as the usual filing scheme in an office consists of a hierarchy of filing cabinets, drawers, and folders, The Analyst organizes large collections of data into information centers that are further organized into smaller collections called folders, which in turn contain items and other folders.
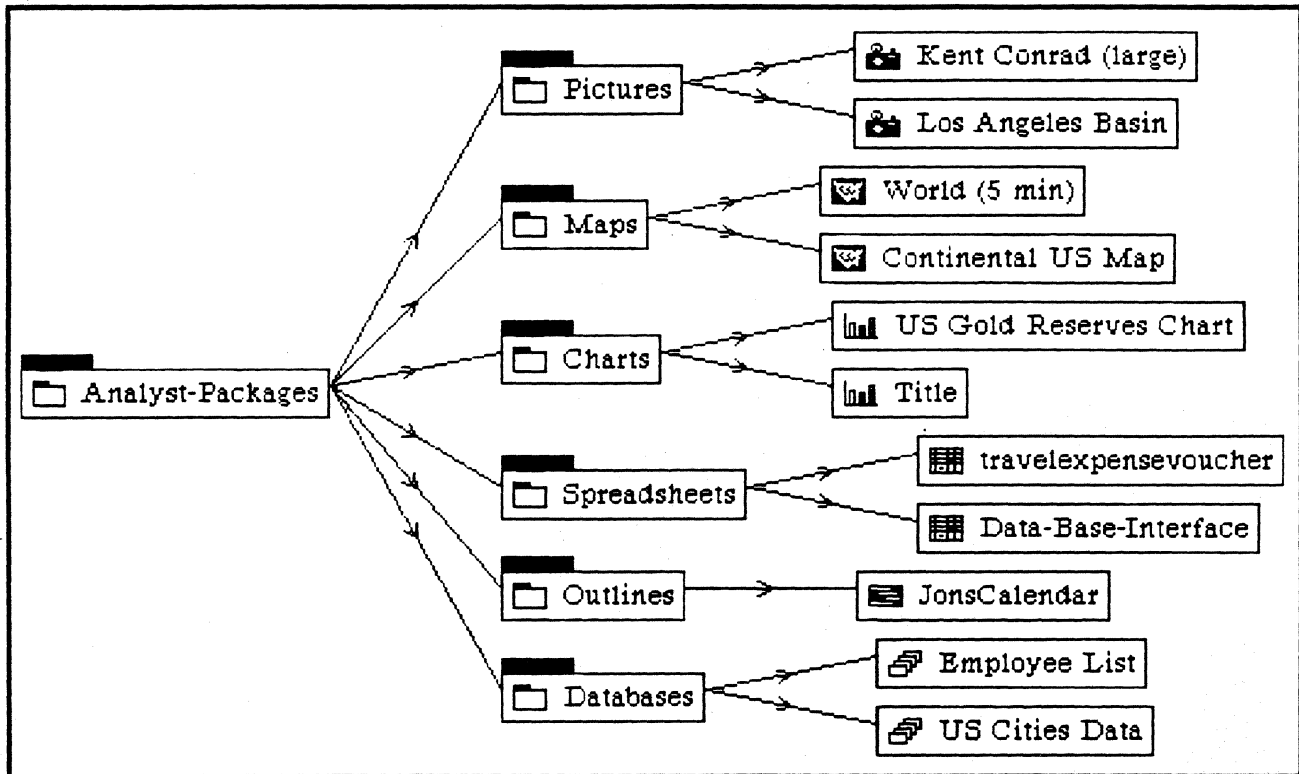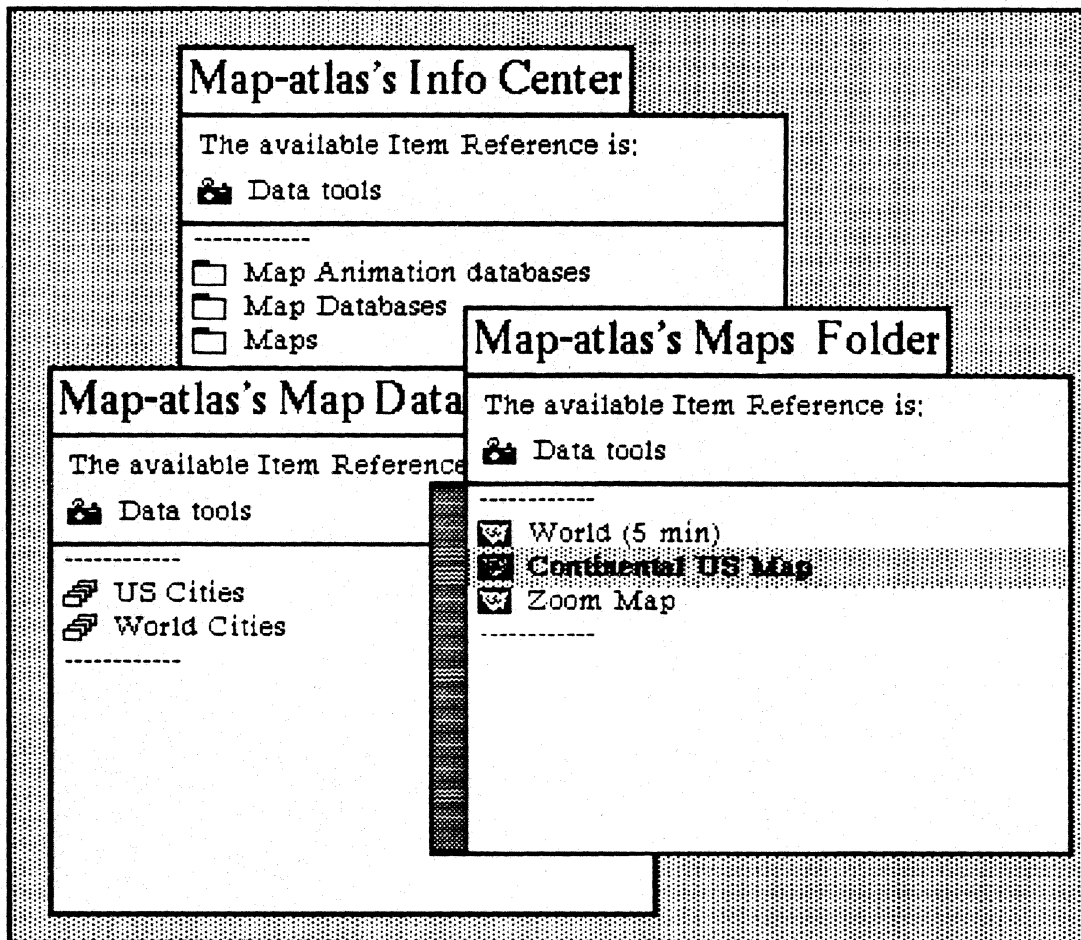

Application Packages

Application packages integrated in The Analyst system are window — based and employ a uniform user interface. Packages currently supported are the Information Center, Text Editing, Document Layout, Report Generation, Images, Maps, Business Graphics, Outlines, Spreadsheets, Personal Databases, On — line Atlas, Expert Systems, and text and graphic Terminal Emulation.
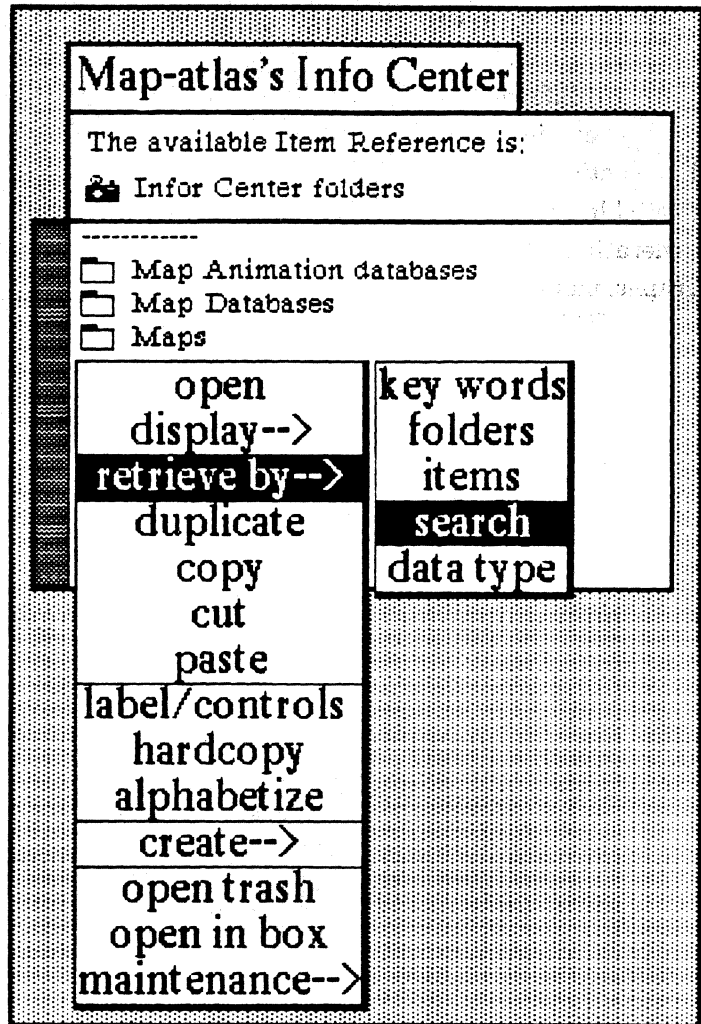
Information Center

The Information Center is the hub of The Analyst system. It is an *information management* device that places innumerable resources within easy reach of even the most inexperienced user. An Information Center consists of a user constructed hierarchy of folders and data items. With the tools available in an Information Center, the user can do everything from creating a one – line memo to generating a comprehensive document that includes sophisticated formatted text, spreadsheets, graphs, maps, and illustrations.

```
Map-atlas's Info Center
The available Item Reference is:
🎥 Data tools
------------
☐ Map Animation databases
☐ Map Databases
☐ Maps

        Map-atlas's Maps  Folder
        The available Item Reference is:
        🎥 Data tools
        ------------
        📷 World (5 min)
        📷 Continental US Map
        📷 Zoom Map
        ------------

Map-atlas's Map Data
The available Item Reference
🎥 Data tools
------------
🗐 US Cities
🗐 World Cities
------------
```

The Information Center is the ideal "gopher", complete with cross – references, item references, keywords, annotations, and other methods of finding and retrieving just the right folder or individual item the user might need. While the overall structure of an Information Center is represented as a hierarchy of folders, the user can add other relational connections of his own creation, i.e. source connections, note connections, or reference connections. He also has access to resources such as maps, charts, photographs, and any other relevant material he may have saved for future use. In addition, there are tools available to create charts, outlines, spreadsheets, databases, and maps.

Another special and personal feature of the Information Center is its flexibility. It is as individual as each user: available tools can be utilized according to an individual user's work habits; the user does not have to adjust to a rigid system. The user is provided with everything needed to organize and use information in whatever style best suits him/her. The user can retrieve, manipulate, and create items in a manner very close to old—fashioned, hands—on, pen and paper directness, while at the same time utilizing the speed, accuracy, flexibility, and power of the latest technology.

Map-atlas's Info Center

The available Item Reference is:

Infor Center folders

Map Animation databases
Map Databases
Maps

open display-->	key words
retrieve by-->	folders
duplicate	items
copy	search
cut	data type
paste	

label/controls
hardcopy
alphabetize

create-->

open trash
open in box
maintenance-->

Text

The text editing windows in The Analyst allow the creation and editing of formatted text. The ability to quickly and easily create a document such as a memo, report, or summary is an integral part of The Analyst software.

All text entry and editing is done in the *text pane* of a window. Within the text, the user may choose a variety of fonts and styles; annotate passages; copy—cut—paste anything from single words to entire text sections, from any text pane on the screen; and even compute numbers. All these capabilities are available in any text pane of any window.

Document Layout

The Preview window is The Analyst system's document preparation and page layout tool. It allows the user to compose documents that contain both text and graphics. It is also used to perform certain editing functions that cannot be done in a regular text window, such as creating multiple column formats, justifying text, changing margin settings, varying line spacing, locating page breaks, and accurately setting tabs.

The Preview window allows text to flow around pictures. When the user places a picture (drawing, image, map, chart, graph, etc.) onto a page in the Preview window and composes that page, the text will position itself around or at the side(s) of the image. The text and graphics seen in the Preview window are exactly the way they will appear when printed (popularly known as *WYSIWYG*, or *what — you — see — is — what — you — get*). Thus, the user can be sure that his screen layouts of text and images will be accurate and realistic.

Images

The Image Editor allows the user to create bitmap illustrations for the enhancement of otherwise conventional text reports. These illustrations may be created from scratch, derived from digitally scanned images, or input from the Chart Editor (a business graphics package). The editing tool within the Image Editor allows application of iconic or textual annotations to the illustration, drawing attention to specific areas of interest on the presentation.

A composite picture may be created by a simple cut and paste of other pictures. The completed work may be filed away in an Information Center to be recalled when needed.

Maps

The Map Editor provides the capability of displaying or creating bitmap images generated from a digital geographic database, which then can be edited and annotated. Maps are generated on demand from a map database that has been stored on the local disk or in a remote mass storage device, such as a file server. The Map Editor provides the capability to expand (zoom) areas within the displayed area and to annotate the map with data from other databases.
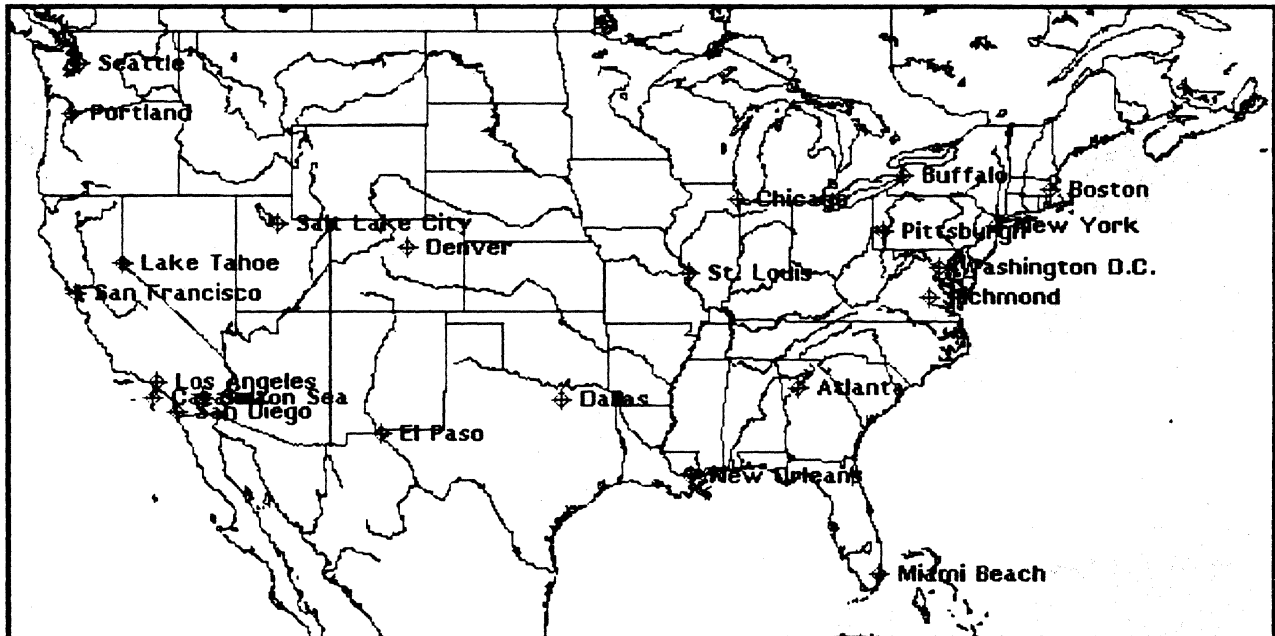
Map databases can be files of cities, harbors, depots, or anything else the user finds useful as annotations for maps. Such databases may be queried by pointing to any of the displayed points on the map; the full database record corresponding to the selected point is displayed for the user. Information Centers may be searched in the same manner by directing the query to the Information Center rather than to the database.

Business Graphics

The Chart Editor is a graphics tool produces different types of charts from user supplied or database data. The user has a choice of producing pie, bar, or line charts, clustered and stacked bar charts, x—y scatter, or linear fit plots. Data points for a chart may be derived from a database or specified interactively by the user. The chart may be quickly replotted in several different chart types so that the user can choose the best presentation of the data.


U.S. Gold Reserves
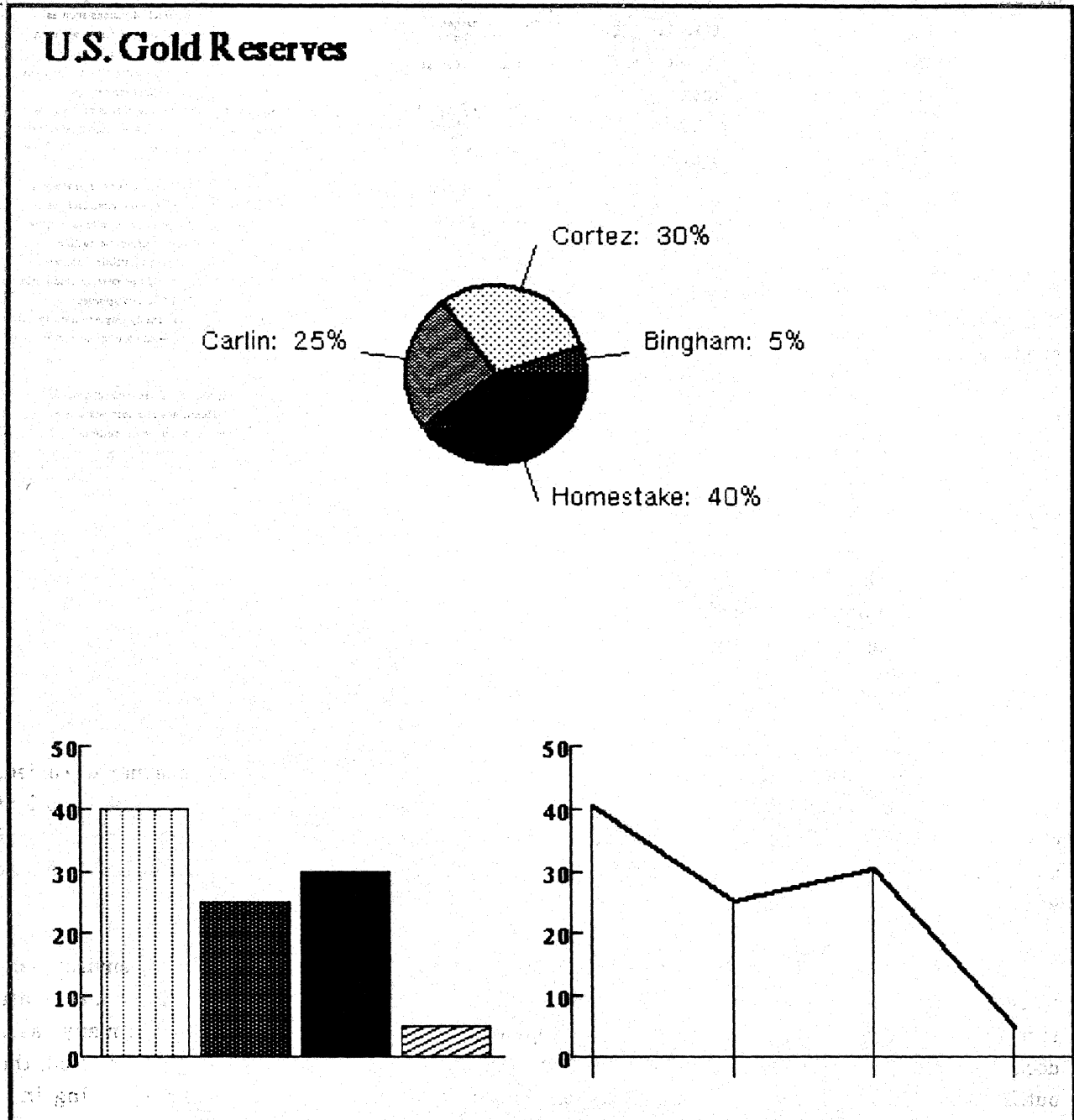
Outlines

The Outline package gives the user a structured framework on which to construct documents. Most documents are arranged in a hierarchy. There are overall divisions such as chapters, smaller divisions often called sections, subsections, and so on. In many cases, these sections are somewhat independent of one another. The Outline package uses this framework to provide a document structure that is both easily understood and flexible, allowing clarity and the ability to rearrange sections.

Many people have been taught to produce a document by creating an outline first, and then filling in the sections with appropriate text. This paper, in fact, was created using the outline approach. The purpose of an outlining program is to simplify and enhance this process by electronic means. To further facilitate this approach, a number of features are usually implemented to aid in viewing, rearranging, and editing the outline and its contents.

The Analyst Outline package fully supports this approach. Headlines and sections may be copied, cut, and pasted between outlines or within an outline. Sections can be hidden while not being worked on. Outlines can be concatenated together. Text can be edited within the outline window or in spawned windows. Inline computation of values is possible within the editor window, just as in the standard text window.

This package also supports some rather unusual features. First, as is fitting in any environment where data security is important, The Analyst allows each section of the outline to have a separate security level. These are of interest when hardcopy of the document is desired, since in many cases documents have specific requirements on maximum security level. When hardcopy is produced, the outline package automatically edits out sections too sensitive to be included, often resulting in a tremendous time saving for the user.
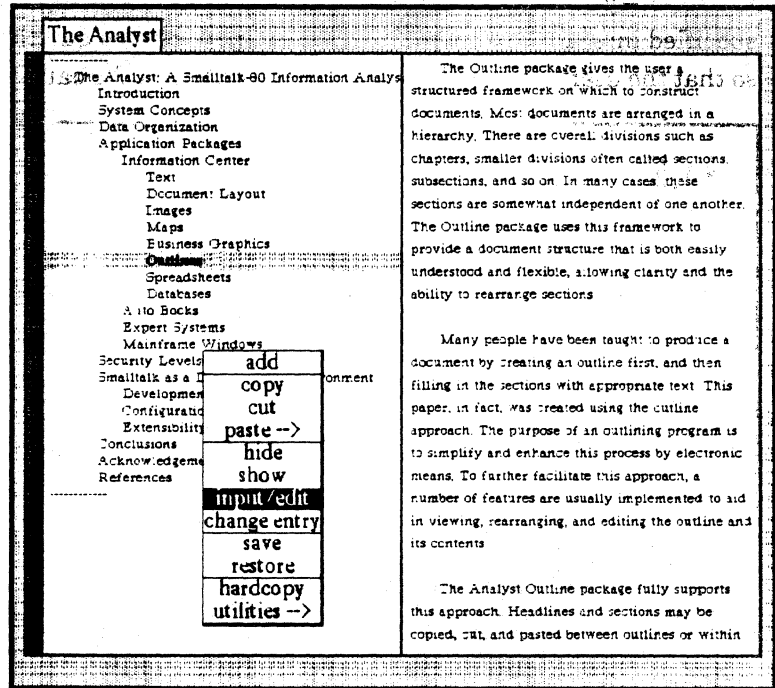
Spreadsheets

A Spreadsheet is a modeling device or tool that lets you explore "what — if" scenarios. It is arranged as a a two — dimensional array of cells indexed by row and column. Cells contain values that can be computed dynamically from user — specified rules that may reference values from other cells. Spreadsheets in The Analyst can, in addition, be linked together to form powerful distributed spreadsheets.

Each cell of a Spreadsheet can hold any Smalltalk — 80 object. Images, databases, pop — up menus, files, and many other Smalltalk — 80 objects can be used. New functionality added to the Smalltalk — 80 system is automatically accessible by Spreadsheets without modification to the Spreadsheet application software.

Spreadsheet rae	1	2	3	4	5	6	7	
1	'A Matrix'					'n'	'n factorial'	
2	1	4	9			12	479001600	
3	2	1	-3					
4	8	-1	1					
5					'The Inverse of the Matrix'			
6	'x'	true			Matrix (			
7	'y'	false					'Inverse Display'	
8	'x and y'	false					(1/98)	(13/1...
9	'x or y'	true					(13/98)	(71/1...
10							(5/98)	(-33/1...
11		'FancierBalloo						
12								
	rule		absolute			auto update		

BarChart new title: {R-11C-4} labels: #('1' '2' '3' '4' '5' '6' '7' '8' '9') data: {R-10C-4 R-8C-2}
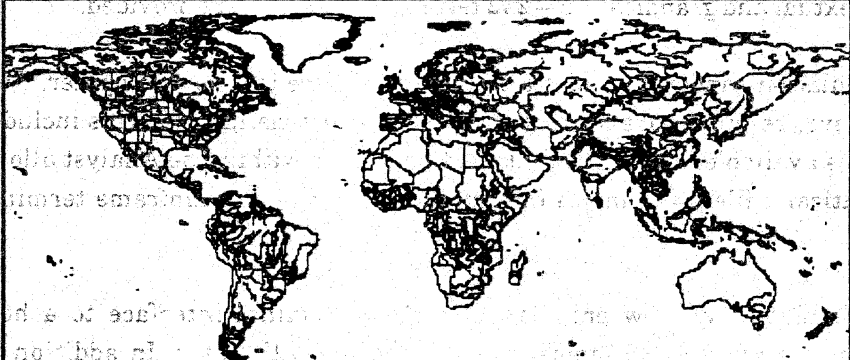
Databases

The Analyst Database package is a powerful personal data management tool by which the user can rapidly review data, make many kinds of additions or changes to it, create new data items, and manipulate the data according to user—specific needs. Database information is integrated with other application packages via the Information Center, so that extracted data can be sent to a Chart Editor or accessed in a Spreadsheet. Cartographic information can be stored in a database and accessed by the Map Editor. Individual records may be independently assigned security levels.

The basic functions in the Database package are data entry, data manipulation, and data output. Data entry can start from a blank record whose fields are to be filled in from scratch by the user, or from an existing record that may be used as a template for entering the next one. A menu—driven query function assists the user in the creation of a syntactically correct query, eliminating the need for the user to learn the query language. This capability allows the user to concentate on the question behind the query without worrying about syntax. Data output functions allow the user to sort a list of records identified by a query, and then produce a report that can be immediately hardcopied. Selected records may also be sent directly to the Chart Editor to produce line, bar, or pie charts.

```
┌─────────────────────────────────────────────────────────────────┐
│  US Cities                                                        │
│ ┌──────────────┬──────────────┬─────────────────────────────────┐│
│ │ FIELDS       │ HITS         │ ()                              ││
│ │ -----------  │ -----------  │                                 ││
│ │              │              │ Label:  Salt Lake City          ││
│ │ Label        │ Boston       │ Icon:   J                       ││
│ │ Icon         │ Buffalo      │                                 ││
│ │ lat          │ Chicago      │ lat:    40.75                   ││
│ │ lon          │ New York     │ lon:    248.134                 ││
│ │ key          │ Pittsburgh   │                                 ││
│ │ -----------  │ Portland     │ key:    SaltLakeCity            ││
│ │              │ Salt Lake City│                                ││
│ │              │ Seattle      │                                 ││
│ │              │ -----------  │                                 ││
│ │              │ 8 hits       │                                 ││
│ │              │ running from │                                 ││
│ ├──────────────┴──────────────┼─────────────────────────────────┤│
│ │ QUERIES                     │ REPORTS                         ││
│ │ -----------                 │ -----------                     ││
│ │ lat > 40                    │ -----------                     ││
│ │ -----------                 │                                 ││
│ └─────────────────────────────┴─────────────────────────────────┘│
└─────────────────────────────────────────────────────────────────┘
```

Auto Books

Auto Books allow the user quick access to large reference documents. The example currently in use in The Analyst is a World Atlas. This tool provides a graphical interface (a world map) to quickly select the area of interest in the world. A list of accessible countries allows the user to select the desired country. The information for each country is displayed in outline format facilitating rapid browsing of the contents of the Atlas.

World Atlas

Brunei

Land
Water
People
Government
Economy
Communications
Defense Forces

Population
Nationality
Ethnic divisions
Religion
Language
Literacy
Labor force
Organized labor

Population: 209,000 (July 1983), average annual growth rate 4.0%

Nationality: noun-Bruneian(s); adjective-Bruneian

Ethnic divisions: 65% Malay, 24% Chinese, 11% other

Religion: 60% Muslim (Islam official religion); 8% Christian; 32% other (Buddhist and animist)

Language: Malay and English official, Chinese

Literacy: 45%

Labor force: 32,155; 33.8% trade, transport, and services; 32.8% industry, manufacturing, and construction; 30.5% agriculture; 2.9% other

Organized labor: 3.4% of labor force

Expert Systems

HUMBLE, an expert system shell written in the Smalltalk — 80 system, is another package available to add to The Analyst. Used in an integrated manner with the other packages in the system, it makes expert systems available to the working analyst in the same environment as his/her other tools.

Mainframe Windows

Within The Analyst both textual and graphical RS—232 terminal emulation are provided.

The Textual Terminal Emulation window provides a terminal interface to a host computer. This window provides access to whatever resources are present on the user's host mainframe. This includes access to whatever mail system is available. The level of integration of tools within The Analyst allows the user to capture and automatically file away in his Information Centers any mainframe terminal exchange.

The Graphics Terminal Emulation window provides a graphics terminal interface to a host computer. This makes all of the mainframe's graphical tools accessible to the user. In addition to capturing and saving mainframe drawn graphics as bitmaps, the graphic vectors can be captured and saved in Map format for later enhancement by the user with the Map Editor.

Security Levels

The Analyst system's Data Security facility helps insure that any organization's data remains where it belongs. Since all data windows always display the current security level of any data being reviewed, accidental dissemination of private information becomes impossible.

Items that comprise a typical Information Center, such as reports, folders, illustrations, etc., may be given a security level either when they are first created or at any time after that. In addition, the security level can be upgraded, downgraded, or removed. The Information Center folders in which private files are stored will always reflect the highest security level represented by their contents. Even more detailed information control is provided for Outlines and Databases where individual entries may be assigned different secutity levels.

Change Classification

accept	cancel	bailOut

Classification	███	Int.	XPers	XPriv	XReg

The Security scheme used by The Analyst is externally specified and may be altered to meet new requirements without modification to system software. Changes to the Security scheme in use will be noted by the system and existing data will be automatically updated to use the new scheme. Security levels are tracked as data is copied from one window to another as a standard feature of The Analyst. Data windows reflect the highest security level for the information they display.

Extensibility

New applications can be readily inserted into the framework of The Analyst. A fully defined and documented programmer's interface is designed to aid other implementers in extending and customizing The Analyst's capabilities for suit specific requirements. The programming tools available in the Smalltalk — 80 environment provide the programmer complete access to all of the source code in the sytem, making available a wealth of past programming experience. The interface to the application packages in The Analyst are available to be browsed, exploitated, and emulated. A programmer can combine existing features, from the Smalltalk — 80 system and from The Analyst application packages, into new applications.

Smalltalk as a Development Environment

The personal integrated, interactive programming environment provided in the Smalltalk -- 80 system provides ready access to existing system facilities, including source code, making a wealth of past programming experience available to the programmer. The powerful interactive programming tools allow the programmer to rapidly make complex system changes, while being completely aware of the affect these changes have on the total system.

HUMBLE Knowledge Bases

ROX

ROX Editor

Mineral

~~Rock~~

----

fossiliferous
grainShape
grainSize
gritty
~~~~
porphyritic
soft
texture

met
pha
~~~~
phan
phan
phan
phan
phan

ROX Interaction

ROCK-1

ROCK-1

    It is certain that 'ROCK-1' is not fossiliferous.

    It is certain that 'ROCK-1' is not porphyritic.

    It is certain that 'ROCK-1' is crystalline.

    It is certain that the grainShape of 'ROCK-1' is 'angular'.

    It is certain that 'ROCK-1' is not soft.

    It is certain that the texture of 'ROCK-1' is 'crystalline'.

    There is suggestive evidence (0.8) that the class of 'ROCK-1' is 'igneous'.

    The attributes of 'ROCK-1' have not been set.

    There is suggestive evidence (0.8) that 'ROCK-1' is not aphanitic.

    It is uncertain whether 'ROCK-1' is gritty.

    It is certain that 'ROCK-1' is not calcareous.

    It is certain that the grainSize of 'ROCK-1' is 2.

---

phaneriticColor

    "if the rock is phaneritic

        then

            if the color >=50 then the rock is possibly a gabb

            if the color < 20 then the rock is possibly a grani

            if the 20 <= color < 50 then the rock may be a dio

if: {aphanitic} not

then: [

    if: {color} >= 50

    then: [{name} is: 'gabbro' withCertainty: 0.4]

    if: {color} < 20

    then: [{name} is: 'granite' withCertainty: 0.4]

    if: {color} >= 20 & ({color} < 50)

    then: [{name} is: 'diorite' withCertainty: 0.4]]

HUMBLE

HUMBLE: A Smalltalk – 80 Expert System Shell

HUMBLE is an expert system shell written in the Smalltalk – 80 programming environment. It provides a number of advanced tools to those wishing to do expert system development in Smalltalk. HUMBLE will run in any Smalltalk Licensed Version, including those available on Xerox. Tektronix, Apple, IBM machines. Knowledge bases are source code compatible on any of the above machines.

Features

HUMBLE contains a wide array of desirable features. It is a true expert system tool, not merely a simple decision tree or table. Considerable effort has been expended to assure ease of use and understanding.

In technical jargon, HUMBLE is a goal – directed multiple – context expert system shell, with reasoning under uncertainty.

What that means is that HUMBLE can:

1. Interpret user supplied rules to make conclusions.
2. Fire rules on its own initiative, in response to questions asked of it.
3. Apply the same rules to a number of similar but independent entities.
4. Handle uncertain data, in a predictable and reasonable manner.

Each of these points, as well as the user interface, is discussed more fully in the following sections.

Interface

The basic HUMBLE system contains three standard windows which form the interface between the user and the knowledge base. All three windows use the standard Smalltalk Model – View – Controller window scheme, to assure wide compatibility with existing Smalltalk images.

The system level interface to HUMBLE is a window called the *Manager*. The Manager provides the user with a list of all knowledge bases presently loaded into Smalltalk. By making selections and giving commands in the Manager, the user can load and unload, edit, interact with, and control the outputs from any of his knowledge bases.
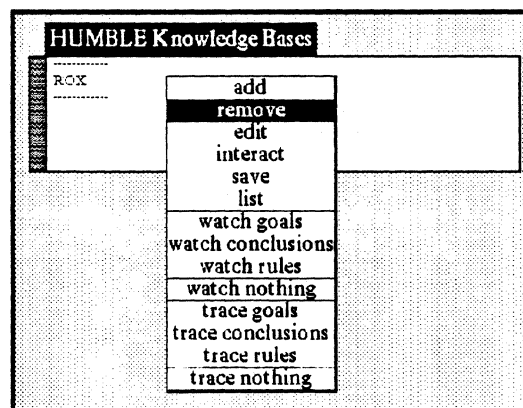
The second window, the *Editor*, is a browser for entering rules and entity definitions. This browser provides easy and structured access to the expert system being built. The user can browse and edit any part of the static knowledge of the system from this single window. It is completely mouse driven, and exceptionally easy to use. The browser takes care of organizing the knowledge base, assisting with the generation and maintenance of the rules, and building the knowledge structure. Outwardly, this window resembles a simplified Smalltalk code browser.
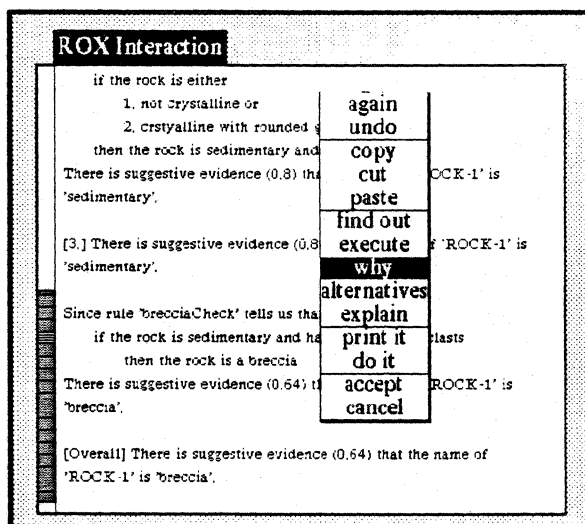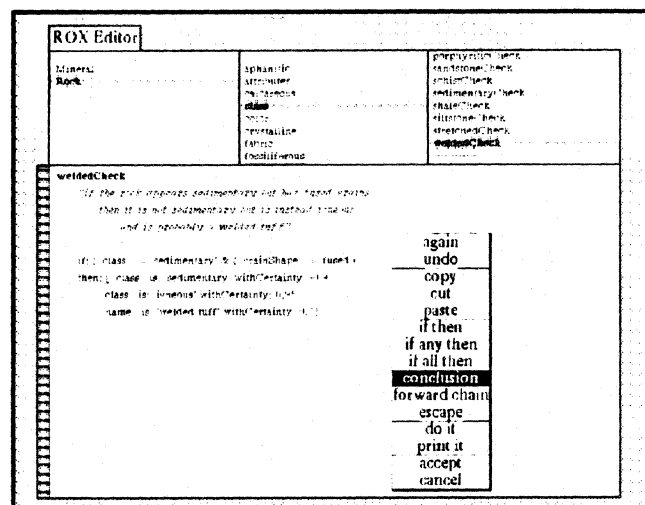
The dynamic knowledge, or temporary information, is accessed through a consultation window, called the *Listener*. This window provides the user with an interactive transcript which includes mouse driven explanation facilities. In this window the user gives the system goals and data and receives conclusions and explanation.

Inferencing Method

HUMBLE uses goal directed reasoning as its main inference tool. In other words, when the system is given a goal, it will use the information implied in its rules to decide how to satisfy it.

The main method by which HUMBLE attempts to satisfy its goals is through the use of rules. Each rule is a specification of some conclusion that can be drawn if certain conditions are met. A simple rule might be something like 'If the animal barks, is a mammal, and is named 'Fido' then the animal is a dog'. HUMBLE rules are more precise, but the idea remains the same.

HUMBLE uses its rules to find the answers to questions it is asked. Given a goal, it will attempt to satisfy the conditions of some rule that makes a conclusion about the goal. In the example above, if the system is asked to find out what type of animal is being considered, it would notice that if the proper conditions are met it could say that the animal is a dog. Therefore, it would try to find out if the animal barks, whether it is a mammal, and what its name is. Each of these becomes a new goal, which might require that more rules be fired. Eventually, the system would get to a stage where it would ask the user for information, which would then be used to make the appropriate conclusions. This goal directed approach is also commonly called backward chaining.

HUMBLE is also capable of forward chaining. Essentially, any HUMBLE rule may cause another rule to be executed as part of its action clause. This adds both expressiveness and flexibility to the basic system. In cases where the programmer may wish the expert system he is building to explore an indirectly related matter, he may use forward chaining to give the inference engine new goals which might not otherwise have been considered.

The backward chaining approach has the advantage of being simpler for a non − programmer to use. All the user need do is specify rules and let the system decide when and how to apply those rules.

Context Switching

The HUMBLE shell can handle complex problems through the use of entity trees. In the diagram, for example, a knowledge base about an airplane might decompose the information about it into several similar parts, each of which should have the same rules applied independently to it. In any case where a complex object can be decomposed into simpler parts, but the number of parts is variable, multiple contexts provide a practical method of dealing with the individual parts. Obviously, if problems of any complexity are to be approached, the ability to maintain multiple contexts is vital.

An Entity Tree
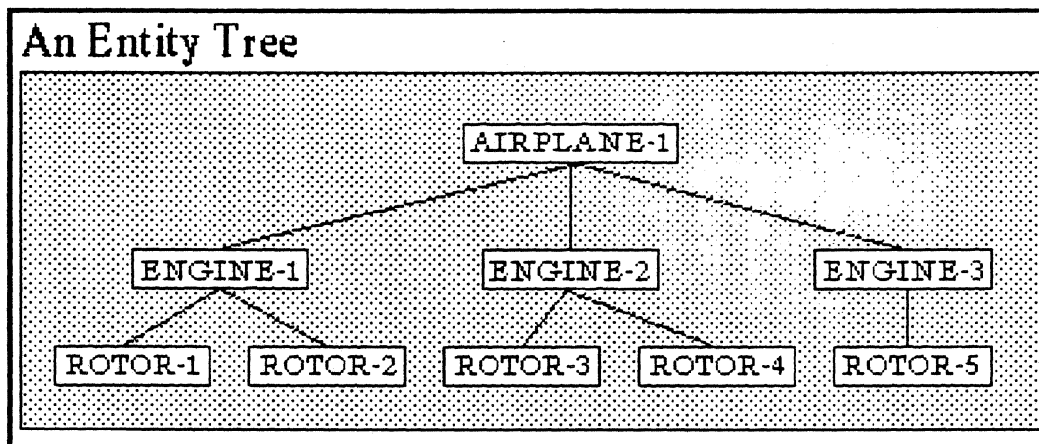
Reasoning Under Uncertainty

Reasoning under uncertainty is an important capability in any expert system. Without it, any problem to be attacked must be susceptible to extremely clearcut solutions, and information must be exact. In the real world, of course, this is very seldom the case. This need to reason about uncertain events has spawned a host of techniques for representing them and making inferences with them.

HUMBLE uses the same model for certainty used by the MYCIN system. It maintains a number indicating the system's degree of belief or disbelief in a particular hypothesis. When several chains of logic point to a similar conclusion, they will reinforce one another. Similarly, if there is negative evidence, the system will weaken the belief in that hypothesis accordingly.

The system is also designed to allow a programmer to rapidly and easily change the uncertainty model to something different, perhaps a Bayesian or similar uncertainty scheme. A small set of localized changes are all that is required to effect a complete overhaul of certainty factors in HUMBLE. This allows for experimentation in the development of a given expert system, to find exactly which uncertainty scheme best suits the task at hand.

Explanation

HUMBLE provides a number of facilities which make it easy to receive explanations and examine alternatives generated by a consultation. The listener window supports a complete backward chaining explanation facility, which gives complete explanations of any fact HUMBLE knows or has inferred. This facility is mouse based, so the user can simpy select the fact he is interested in (or type a description of it) and get a full explanation.

HUMBLE also supports examination of the alternatives to any given conclusion. Since each parameter in a HUMBLE entity can support many differing conclusions independently, it is often valuable to be ableto examine the alternate conclusions HUMBLE has examined. This feature allows HUMBLE to be used not only as an expert system but also as a training aid.

The listener also supports complete examination facilities, so that the user can quickly scan the entire contents of the fact base HUMBLE generates. This makes it particularly convenient to examine the facts and alternatives and then ask for the reasons behind them.

Integration with Smalltalk

HUMBLE includes a programmers interface to allow it to integrate easily with Smalltalk – 80 applications. Among the features of the programmers interface are:

1. A modular inquiry interface. This feature allows the programmer to alter the method by which HUMBLE makes inquiries of the user. If needed, the programmer can actually intercept questions and satisfy them under program control by reading databases, other Smalltalk objects, etc.
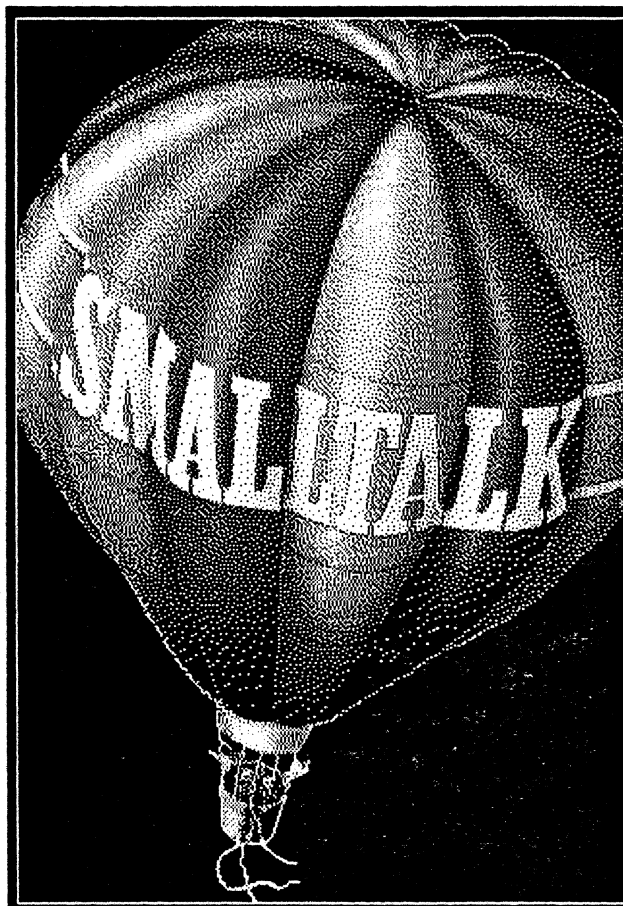
2. Interfaces which allow any of the following activities from any Smalltalk object:
  — initialization of knowledge bases under program control
  — examination of the fact base
  — execution of rules from other objects
  (very useful for integrating HUMBLE as the inference
  engine of a frame — based expert system)
  — program driven explanation
  — active values on HUMBLE parameters
  (Particularly useful for graphic based interfaces)
  — many other functions

3. Modular certainty models. The programmer can alter the certainty model used by HUMBLE to meet the needs of his particular knowledge domain.

HUMBLE rules can also contain directly imbedded Smalltalk — 80 code. This code can take any action available to Smalltalk as a side effect of the evaluation of any rule.

Example Rules

A number of example rules follow, with some explanation of what should be going on when the rule is fired. HUMBLE rules make inferences about *entities*. These entities are described by their *parameters*. Whenever a parameter is referred to in a HUMBLE rule, it appears as a string surrounded by the { and } characters.

Typical Rules

Here are a few typical rules:

bloodPressureCheck
  "if the patient's blood pressure is high (above 120/80)
  then his condition is probably critical"
  if: ({bloodPressure} > (120/180))
  then: [{condition} is: 'critical' withCertainty: 0.4].

In this rule, the premise checks the parameter bloodPressure against the literal (120/80). if bloodPressure is greater, then conclude that parameter condition is now 'critical', with the rather low certainty of 0.4.
soilAcidity
  "litmus > 50% blue indicates high soil acidity and poor lime content"
  if: ({acidityCutoff} < = {litmusColor})
  then: [{soilAcidity} is: 'high'.
    {limeContent} is: 'poor' withCertainty: 0.8]

> else: [{soilAcidity} is: 'acceptable'.
>   {limeContent} is: 'acceptable' withCertainty: 0.8].

This rule checks the color of litmus paper (parameter litmusColor) against the parameter acidityCutoff. If the test indicated high acidity, the parameter soilAcidity is set as well as the parameter limeContent. Note that this rule uses an else clause.

Forward Chaining Rules

In some cases, it is desirable to create rules which immediately fire other rules in a certain order. HUMBLE allows this by the creation of a *forward chain specification.*

bloodPressureCheck
> *"if the patient's blood pressure is high (above 120/80)*
> *then his condition is probably critical"*
> if: ({bloodPressure} > (120/180))
> then: [{condition} is: 'critical' withCertainty: 0.4.
>   {@checkSodiumLevel}.
>   {@checkObesity}].

This rule is similar to the example given in the previous section, except that it also specifies that the rules named checkSodiumLevel *and* checkObesity *are to be fired whenever the condition is met.*

Context Switching Rules

Certain rules switch the execution context of the system as they operate. These rules are searching rules, which make conclusions about any sub−entity which meets a criteria. An example:

olivineCheck
> *"if this rock contains olivine*
> *then it is very likely a gabbro,*
> *   it is unlikely to be a granite,*
> *   and it is unlikely to be a diorite"*
> ifAnyOf: Mineral
> have: [{mineralName} = 'olivine']
> then: [{name} is: 'gabbro' withCertainty: 0.8.
>   {name} is: 'diorite' withCertainty: −0.5.
>   {name} is: 'granite' withCertainty: −0.5].

This rule checks whether olivine is present among a rock's minerals. If any of the sub−entities of type Mineral have parameter mineralName set to 'olivine', then the system makes conclusions about what sort of rock this one is likely to be. During execution, the context is switched to execute in each Mineral entity, both for the premise and the conclusions. Note the negative certainty in one conclusion, indicating that

the system believes that the rock is not diorite or gabbro.

Nested Rules

In some cases, for efficiency's sake, it is desirable to nest rules. HUMBLE allows this sort of rule and will take the necessary steps to see that certainty information is properly maintained for conclusions made by the nested rules. Here is an example:

siltstoneCheck
    "if the rock is sedimentary, small grained, and gritty to the tongue
    then it is probably a siltstone"
    if: ({class} = 'sedimentary' & ({grainSize} < = 0.1))
    then: [
        if: {gritty}
        then: [{name} is: 'siltstone' withCertainty: 0.8]
        ]

If more than one if—then is placed as part of an action block, then the result is an implied forward chain, since the nested rules will be executed in the sequence they appear.

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