UNIVERSITY OF ILLINOIS

DIGITAL COMPUTER

LIBRARY ROUTINE P 16 - 214

TITLE	Infraprint (DOI or SADOI)
TYPE	Closed with one program parameter
NUMBER OF WORDS	56
TEMPORARY STORAGE	0, 1, 2
ACCURACY	1 to 12 digit exactly rounded fractions or exact integers
SPEED	Punching time
USE	This INteger FRAction PRINT routine will print A to n-places (1 to 12) correctly rounded (n digits or spaces if the integer is less than 10^n, all digits if greater than 10^n), with (optional) decimal point anywhere, with non-significant zeros before the decimal point (whether this point is printed or not) replaced by spaces, sign before the first non-space character, with a - sign for a negative number and your choice of +, space, or delay character for a positive number, and no extra spaces.
If Q contains:	Then before going to the R.H. order at q+1:
50 nF	A is printed as an n-place fraction with a sign + or -,
50 qF	with no zero suppression.
52 nF	A is printed as an n-place integer with sign + or -
50 qF	with zero suppression on all but the last digit.
54 100p+nF	A is printed as an n-place fraction with sign + or -
50 qF	with a decimal point after p digits and zero suppression on the first p digits $0 \leq p \leq n$.
56 100p+nF	A is printed as an n-place integer with sign + or -
50 qF	with a decimal point after p digits, and zero suppression before the decimal point. $0 \leq p \leq n$.
	J0, J2, J4, J6 have the same effect as 50, 52, 54, 56 except that a space is printed instead of a + sign for positive numbers.

Entering the routine at the right hand order at 1 rather than the left hand order at 0, with a J-type parameter causes a delay character to be punched for the sign if A is positive. This unsigned number entry omits the sign of a positive number.

To obtain a space instead of a decimal point, change the order pair at 51L (the 52nd word of the routine) to

92 963F
22 35L

To obtain unrounded fractions instead of rounded fractions, change the order pair at 20L to

50 1F
75 F

This routine does not print spaces after the number.

REMARKS

Fractions are converted to integers by a rounded multiplication by 10^n. (The sign is the sign of the rounded number so a small enough negative fraction is printed as +0). The absolute value of the resulting integer is taken, and converted to 12 decimal digits which are omitted, replaced by spaces, or printed according to the following rules:

1. The last digit is always printed.
2. The last n digits are always printed if 50 or J0 parameter was specified.
3. All digits following a decimal point are printed.
4. The first non-zero digit is printed even if it occurs before the last n digits, and all subsequent digits are printed.
5. If no digits have been printed, zeros before the last n digits are omitted, and zeros during the last n places are replaced by spaces.

6. The sign is printed just before the first non-space character (which may be a digit or a point).

Thus all digits of an integer are printed, and if a fraction after correct rounding would equal 1 in absolute value, the fraction is printed to one more place. The number 1 to 3 places is 1000. The only exception is n = 12, when -1 is printed as

-+00000000000

meaning -K00000000000

If integers or 12 place fractions are read back into the machine, the original numbers are recovered, without rounding - off error.

EXAMPLES

The numbers -.001, 1/2, .999, -1 would be printed via the following parameters as shown

50 2F:	J4 3F:	54 103F:	54 303F:
+00	-.001	-.01	-1.
+50	.500	+5.00	+500.
+100	.999	+9.99	+999.
-100	-1.000	-10.00	-1000.

The numbers $3x2^{-39}$, $-21x2^{-39}$, $450x2^{-39}$, $1364x2^{-39}$ would be printed via the following parameters as shown

52 1F:	J2 4F:	56 1F:	56 404F:
+3	3	+.3	+3.
-21	-21	-2.1	-21.
+450	450	+45.0	+450.
-1364	-1364	-136.4	-1364.

DATE June 19, 1956 rt: 13/9/59
PROGRAMMED BY D. B. Gillies
APPROVED BY J. P. Nash

lgr

LOCATION	ORDER		NOTES PAGE 1
	00 K(P16)		
0	40 F	←	Normal entry
	L5 3L		
1	22 2L		
	40 F	←	Entry omitting space on positive number
2	L5 8L	←	
	46 40L		Plant space or delay character
3	K5 965F	by 0'	Plant order pair
	40 2F		
4	42 42L		Plant link
	49 1F		Set 1/2 in 1 (for $\frac{10^n}{2}$)
5	00 7F		
	11 26F		
6	66 47L		$A = 2n \cdot 2^{-39}$ $Q = (2p+1) \cdot 2^{-39}$
	00 24F		
7	40 55L		
	10 4F		
8	S0 515F	by 2	$A = -2^{-14} + (n-p+3) \cdot 2^{-18} + \ldots + 4.2^{-33} + 3.2^{39}$
	L4 54L		$55L = n.2^{-14}$
9	22 13L		
	L1 2F	←	If integer, skip ($\frac{10^n}{2}$) calculation
10	00 6F		
	36 13L		
11	50 1F		Calculate ($\frac{10^n}{2}$)
	75 52L		
12	S4 642F		by 29'
	40 1F		
13	L5 27L	←	
	L4 55L	←	Count down by 2^{-14}, up by 2^{-38}
14	40 55L		[Produces finally
	32 9L		$-2^{-14}+(n-p+3)2^{-18}+\ldots+4\ 2^{-33} + (n+3)2^{-39}$]
15	L1 2F		If decimal point required leave counter
	00 5F		intact.
16	32 19L		
	00 1F		If no dec. pt. test no zero-suppression
17	36 19L		
	50 55L		No zero suppression

LOCATION	ORDER		NOTES PAGE 2
18	00 45F		
	42 55L		
19	47 55L	←	No decimal point
	19 1F	←	
20	50 1F		Rounded multiplication by 10^N or 1
	74 F		(with scaling factor 1/2)
21	32 27L	+→27	Test sign of rounded number
	00 1F		
22	40 F		If negative take the modulus
	L1 F		
23	40 F		And plant - sign
	L5 34L		
24	46 40L	←30	(Or + sign from 30L)
	50 53L	←sp 29	(or leave sign sp. or delay)
25	L5 F		
	32 30L	→30'	Test $1 \leq$ number < 2 (different round-off)
26	L1 33L		Negative round-off
	26 31L	→31	
27	LL 4064F		
	00 1F	←21	Store positive number
28	40 F		
	L1 2F		Print space or delay?
29	32 24L	→24'	
	L5 12L		Then plant + sign instead.
30	26 24L	→24	
	L5 33L	←25'	Positive round-off
31	74 F		Multiply by $2^{35}/10^{11} + (.2142)2^{-39}$
	36 33L	→33	Test size of multiplier
32	L4 53L		$1 \leq$ multiplier < 2 cause sign to have
	L4 53L		effect of +1 or -1 in multiplication.
33	10 35F	←31'	A = digit $\cdot 2^{-39}$ Q = fractional part.
	40 F	←49'	Plant both halves
34	S5 706F	by 23'	of product
	40 1F		
35	L5 50L		
	L4 55L	←51'	Multiple (4-way) count

LOCATION	ORDER		NOTES PAGE 3
36	40 55L		
	36 39L		Prepare to print point?
37	00 29F		No
	36 39L		Prepare to print even non-significant zero?
38	L3 F		No
	36 41L	→ 41	This digit zero?
39	L3 2F	← .	No
	36 41L	→ 41	have printed some digit already?
40	92 ( )F	by 2',24	Print sign
	41 2F		Record fact that all digits now to be printed
41	L5 55L	←38',39'	Print point?
	32 50L	→50'	
42	00 20F		Obey link?
	32 (link)F	by 4	
43	L3 2F		The result of these orders is negative if
	L4 F	.	no digit to be printed, and is that digit if print.
44	32 47L	→47'	Print digit?
	L5 55L		
45	00 35F		Don't print space
	32 48L	→48'	
46	92 963F		Print space
	22 48L	→48'	
47	00 F		
	00 100F	←44	Shift left 36
48	82 4F		Print
	50 52L	←45',46'	Multiply fraction by 10 to
49	75 1F		produce a digit in A, plus a
	22 33L	33'	fractional part in Q
50	00 2F		
	09 65F	41'	Print ⊙ and enter count loop in such
51	92 643F		a way as to inhibit further
	22 35L	35'	decimal pts.
52	00 F	$10\ 2^{-39}$	
	00 10F		
53	2S 4015F	$2^{35}/10^{11}$	Constants
	LN 755F		

LOCATION	ORDER		NOTES PAGE 4 P 16
54	LL 4071F	Count	
	90 1283F		
55	00 F		Intermediate storage for the
	00 F		multiple count.