UNIVERSITY OF ILLINOIS

DIGITAL COMPUTER

LIBRARY ROUTINE P 15 - 207

TITLE	Multiple Precision Integer Conversion
TYPE	Closed with two program parameters
PURPOSE	To convert to decimal from a multiple precision positive binary integer
NUMBER OF WORDS	32
TEMPORARY STORAGE	Location 0
ACCURACY	Exact
DURATION	About $1.29m^2 + 1.21m$ milliseconds where m is the number of locations occupied by the multiple precision integer.
METHOD	The base 2^{39} integer $A_0 + A_1(2^{39}) + \ldots + A_n(2^{39})^n$ located with A_0 at ℓ, A_1 at $\ell - 1$, ..., A_n at $\ell - n$ is converted to a base 10^{11} integer $b_0 + b_1(10^{11}) + b_2(10^{11})^2 + \ldots + b_k(10^{11})^k$ with b_0 at $\ell + 1$, b_1 at ℓ, ... b_k at $\ell + 1 - k$.
ENTRY	Place $\ell - n$ as the right hand address in A and enter with

q	50 (ℓ+ 1)F
	50 qF
q + 1	26 cF

where this routine is at location c. The routine is left with $\ell + 1 - k$ as the right hand address in A and with the coefficients b_i in the locations described above. These coefficients can be printed with a standard 11-place integer print routine by printing successively from locations $\ell + 1 - k$ to $\ell + 1$.

NOTES 1. This routine may be used to convert a multiple precision binary integer to any positive integral base b ($0 < b < 2^{39}$). This change can be made by replacing the integer 10^{11} in word 31 by b.

2. This routine overwrites the original integer and as many other locations as are needed to store the result in the new base. It also overwrites the location immediately preceding the first significant figure of the number in the new base.

3. If the programmer knows k, the highest power of 10^{11}, he may calculate the number of additional locations needed as follows:

(a) $k \leq n$. Locations $\ell + 1, \ell, \ell - 1, \ldots \ell - n - 1$ will be used

(b) $k > n$. Locations $\ell + 1, \ell, \ell - 1, \ldots \ell - k$ will be used.

4. There is no restriction on the number of locations occupied by the original integer. For example, the integer $2^{39} + 8$ may be written as $1 \cdot 2^{39} + 8$, occupying 2 locations, or as

$$0 \cdot (2^{39})^3 + 0(2^{39})^2 + 1(2^{39})^1 + 8,$$

occupying 4 locations. In the latter case the locations containing the coefficients of $(10^{11})^3$ and $(10^{11})^2$ will be zero and the routine will convert the given number to

$$0\ (10^{11})^3 + 0(10^{11})^2 + 54(10^{11}) + 9755813896$$

DATE February 7, 1956
PROGRAMMED BY W. Scott Bartky
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WSB/mge
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LOCATION	ORDER	NOTES PAGE 1
0	42 28L	Plant y_0
	K5 F	
1	42 26L	Link
	10 20F	
2	42 29L	Plant x
	22 19L	
3	41 (x-j)F	start for each reduction
	L5 (y_j+i)F	
4	10 1F	Store least
	01 1F	Significant bit of dividend
5	40 F	
	50 (y_j+i)F	
6	L5 (x-j)F	
	66 31L	$\div 10^{11}$
7	L4 F	
	L0 31L	$- 10^{11}$
8	36 10L	
	L4 31L	$+ 10^{11}$
9	10 1F	
	00 1F	
10	40 (x-j)F	
	S5 F	
11	L0 30L	
	36 27L	Test quotient for 0
12	L4 30L	
	40 (y_j+i-1)F	
13	43 30L	Block 0 test
	L5 5L	
14	42 12L	Store $y_j + i - 1$
	F5 5L	
15	42 3L	Store $y_j + i$
	42 5L	

LOCATION	ORDER	NOTES PAGE 2
16	L0 29L	Test for end of
	32 3L	a reduction
17	L5 4L	
	42 30L	Restore 0 test
18	L5 29L	
	L0 30L	Form x - j - 1
19	42 29L	
	00 20F	
20	46 3L	
	46 6L	
21	46 10L	
	L5 28L	
22	42 3L	Set location
	42 5L	of most significant
23	L0 30L	digit
	42 12L	
24	42 28L	
	L5 5L	
25	L0 29L	
	36 3L	
26	F5 3L	
	22 ( )F	Out
27	F5 28L	
	42 28L	Store $y_j + 1$
28	26 13L	
	00 (y_j)F	
29	N0 F	
	50 (x-j)F	Constants
30	80 F	
	00 (1)F	
31	17 1159F	10^{11}
	6F 2048F	