UNIVERSITY OF ASIA PACIFIC

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING(CSE)

Course Title: Computer Architecture

Course Code: CSE 303

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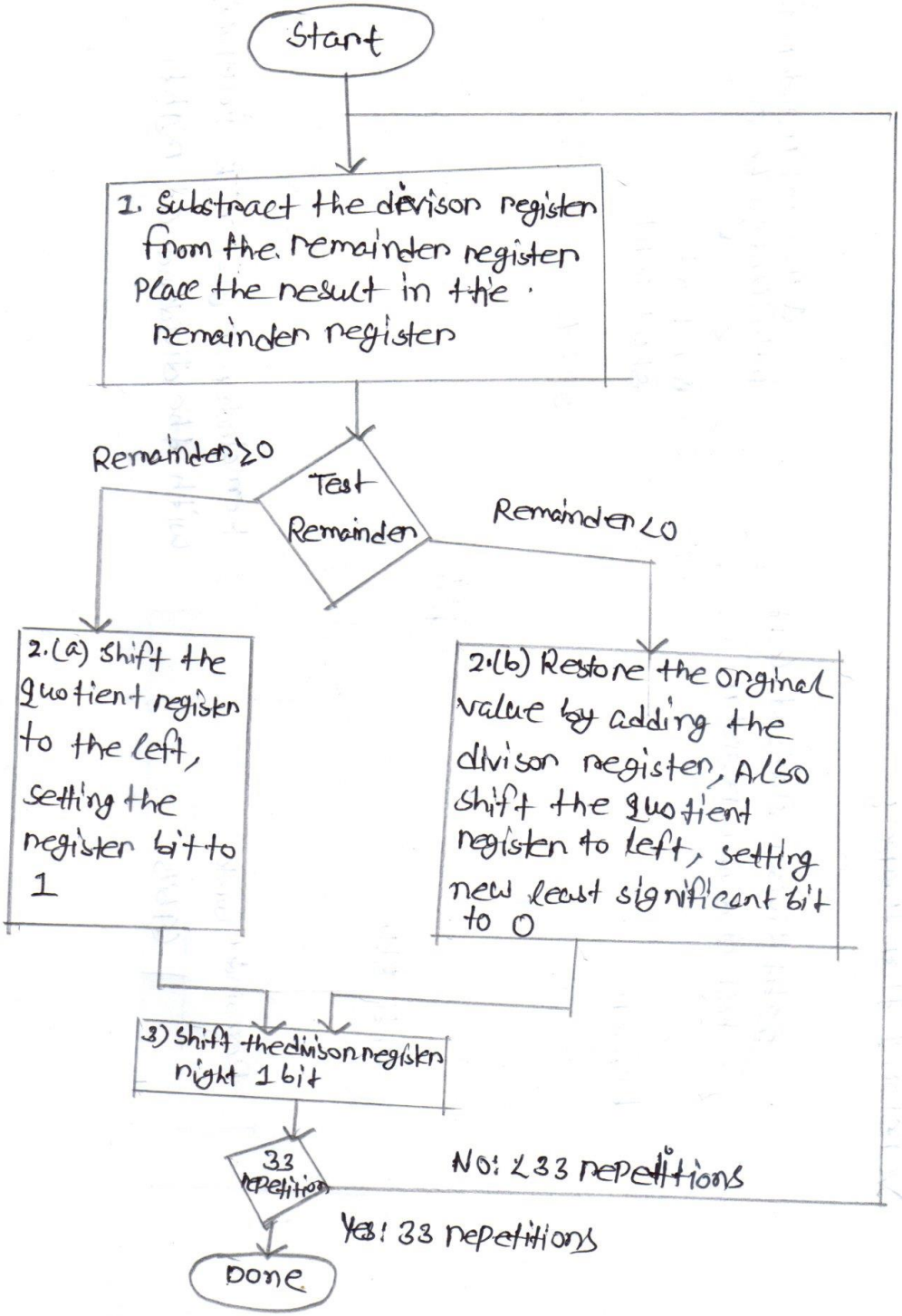
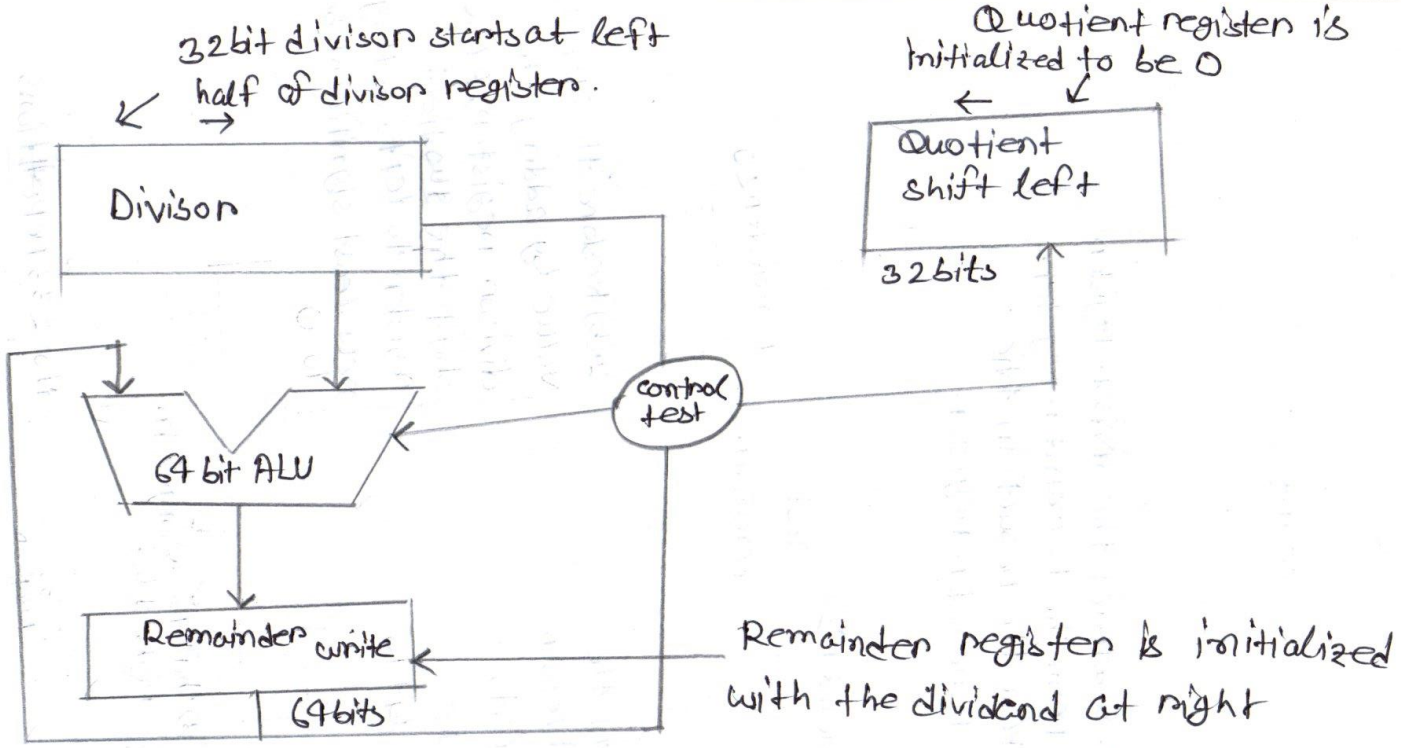
Version 1 Algorithm:



Version 1 Hardware:



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Version 1 Example:

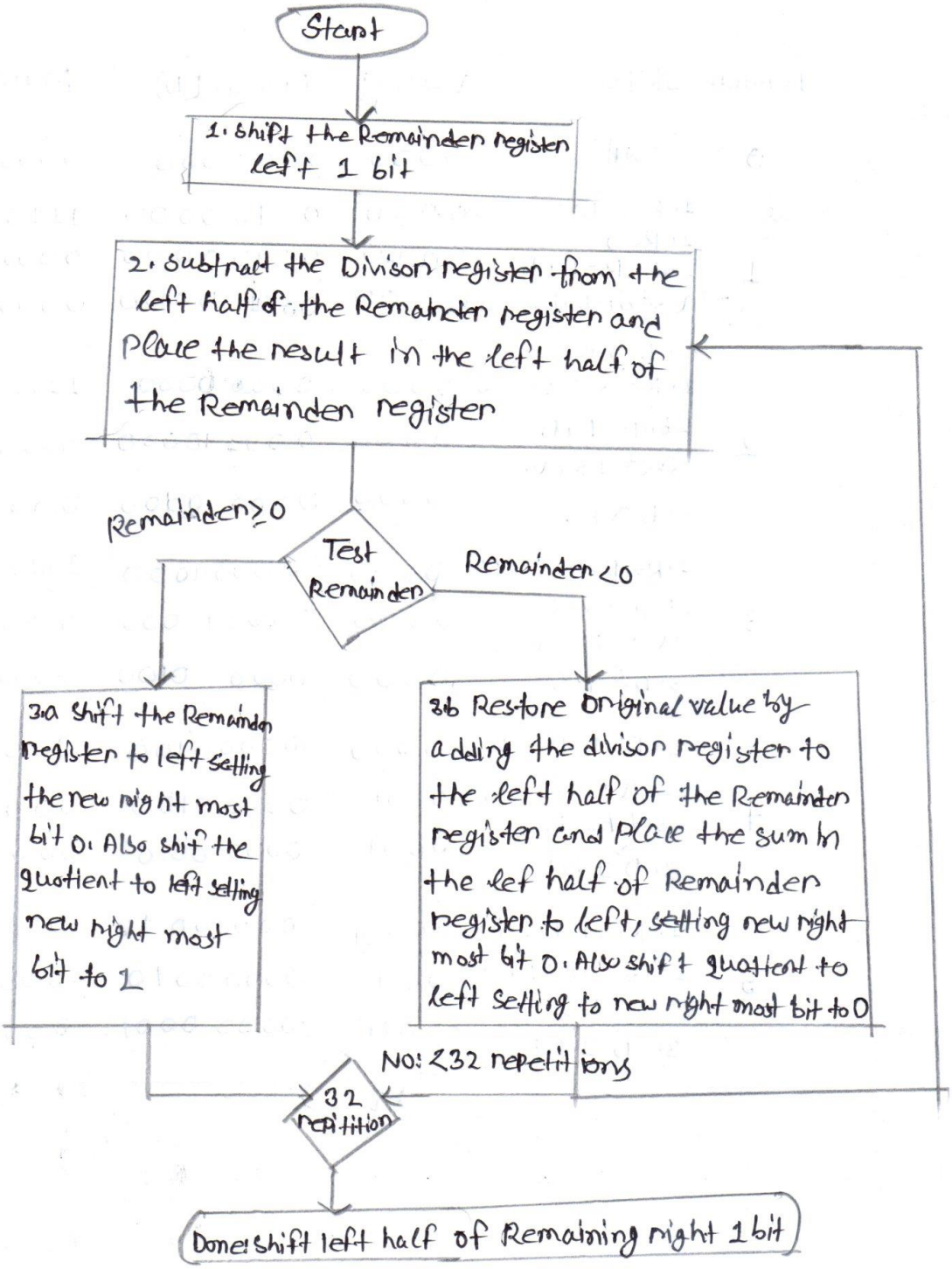
$7 \div 2 \rightarrow 0111 \rightarrow 0010$

Iteration	Steps	Quotient (Q)	Divisor (D)	Remainder (R)
0	init	0000	0010 0000	0000 0111
1	1. R=R-D; 2. R<0 2.(b) R=R+D Q ← 1 bit left shift, Q_0=0 3. D → RS	0000 0000 0000	0010 0000 0010 0000 0001 0000	1110 0111 0000 0111 0000 0111
2	1. R = R-D 2. R<0 2b. R=R+D Q ← 1s, Q_0=0 3. D → RS	0000 0000 0000	0001 0000 0001 0000 0000 1000	1111 1111 0000 0111 0000 0111
3	1. R= R-D, 2. R<0 2b. R=R+D Q ← 1s, Q_0=0 3. D → RS	0000 0000 0000	0000 1000 0000 1 000 0000 0100	1111 1111 0000 0111 0000 0111
4	1. R=R-D 2. R>0 2a. Q ← 1 bit and set lsb to 1 3. D → 1 bit	0000 0001 0001	00000100 0000 0100 0000 0010	00000011 00000011 00000011
5	1. R= R-D 2. R>0 2a. ← bit and set lsb to 1 3. D → 1 bit	0001 0011 0011	00000010 00000010 0000 0001	0000 0001 0000 0001 0000 0001

0011 → 3

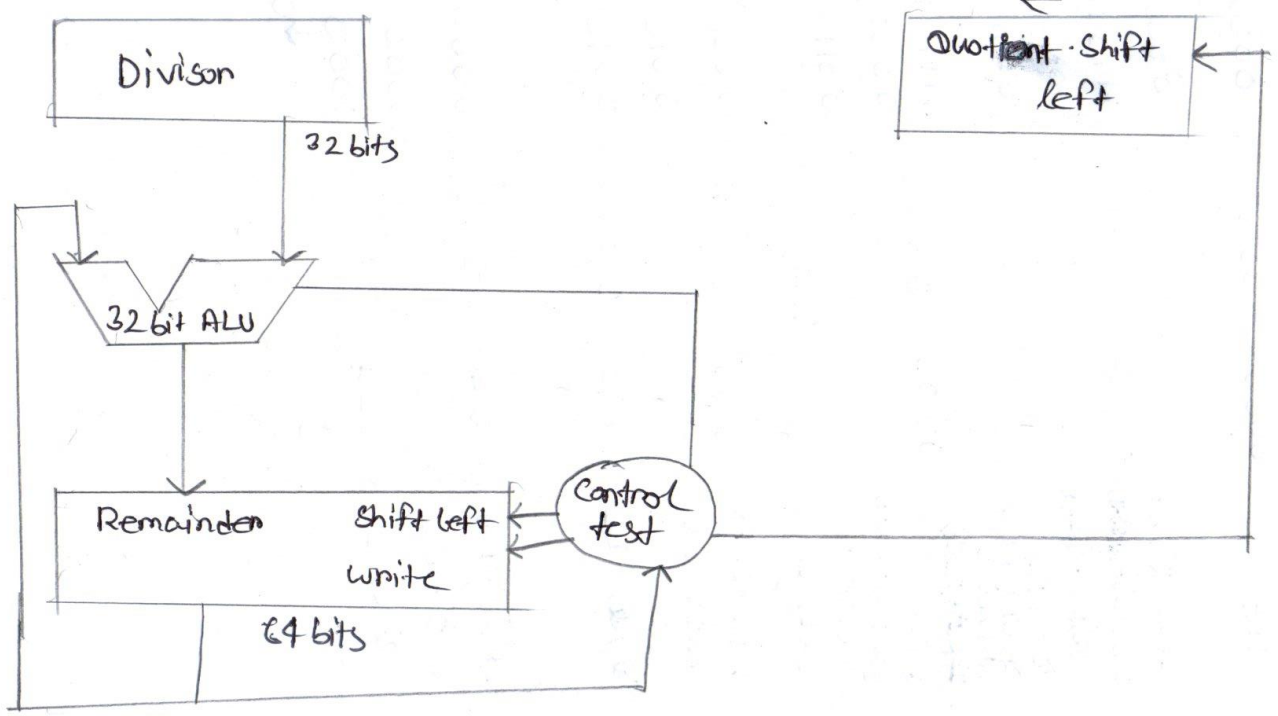
0000 0001 → 1

Version 2 Algorithm:



Version 2 Hardware:

Remainder register is initialized with the divided at right



Version 2 Example:

Iteration	Steps	Quotient Q	Divisor D	Remainder R
0	init	0000	0010	0000 0110
1	1. shift R ← 1 bit 2.b R(L) = R(L) − D 3(b) R(L) = R(L) + D R ← set LSB 0 Q ← 1 bit set 1 sb right most 0	0000	0010	0000 1100 1110 1100 0000 1100 0001 1000
2	2. R(L) = R(L) − D 3. R<0 3(b) R(L) = R(L) + D R ← LS, R0 = 0 Q ← LS, Q0 = 0	0000	0010	1111 1000 0001 1000 0011 0000
3	2. R(L) = R(L) − D 3(a) R ← set LSB 0 Q ← Q0 = 1	0000 0001	0010 0010	0001 0000 0010 0000 0010 0000
4	2. R(L) = R(L) − D 3(a) R ← R0 = 0 Q ← Q0 = 1	0001 0011 ↓ 3	0010	0000 0000 0000 0000 0000 0000 ↓0

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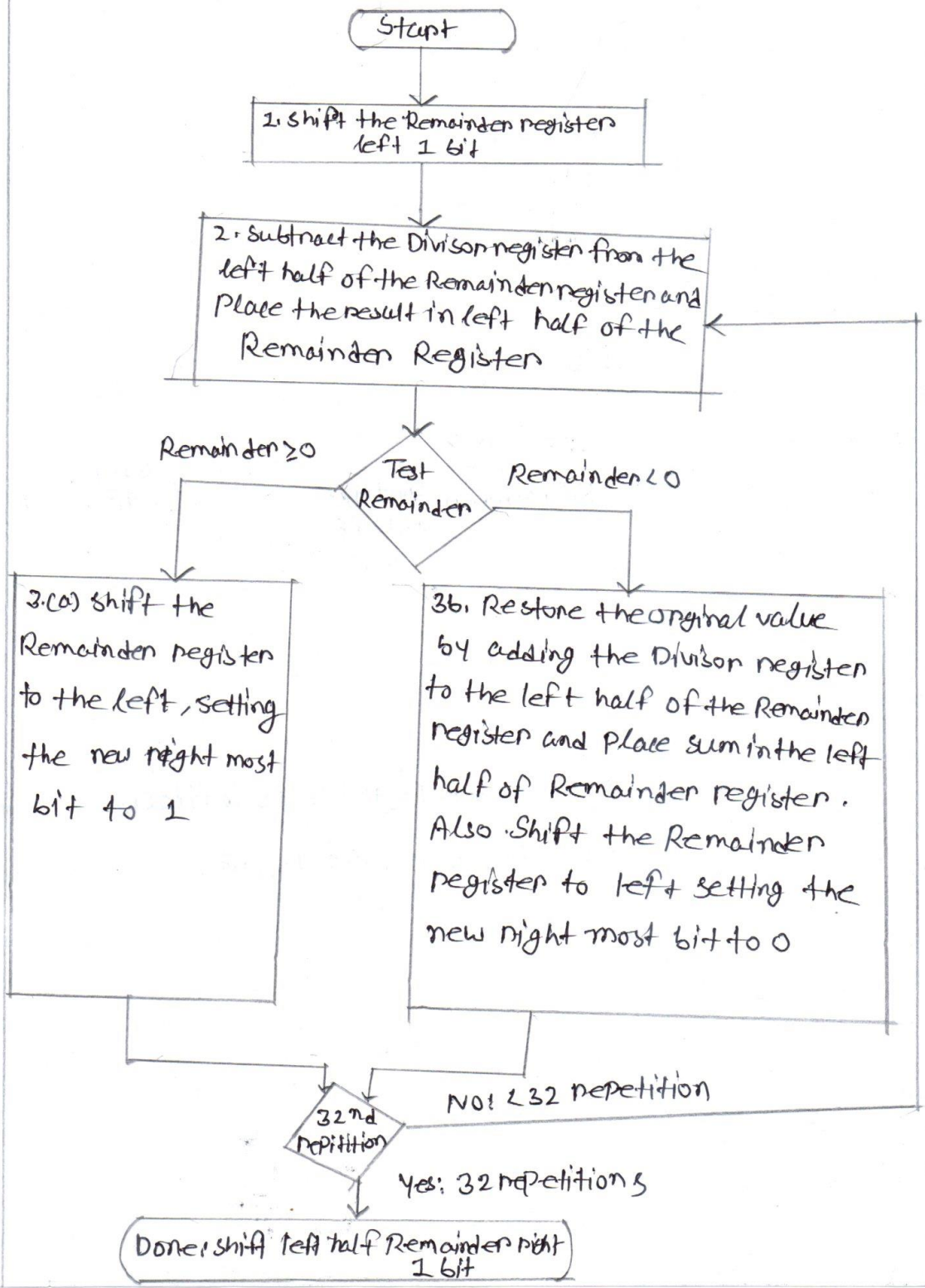
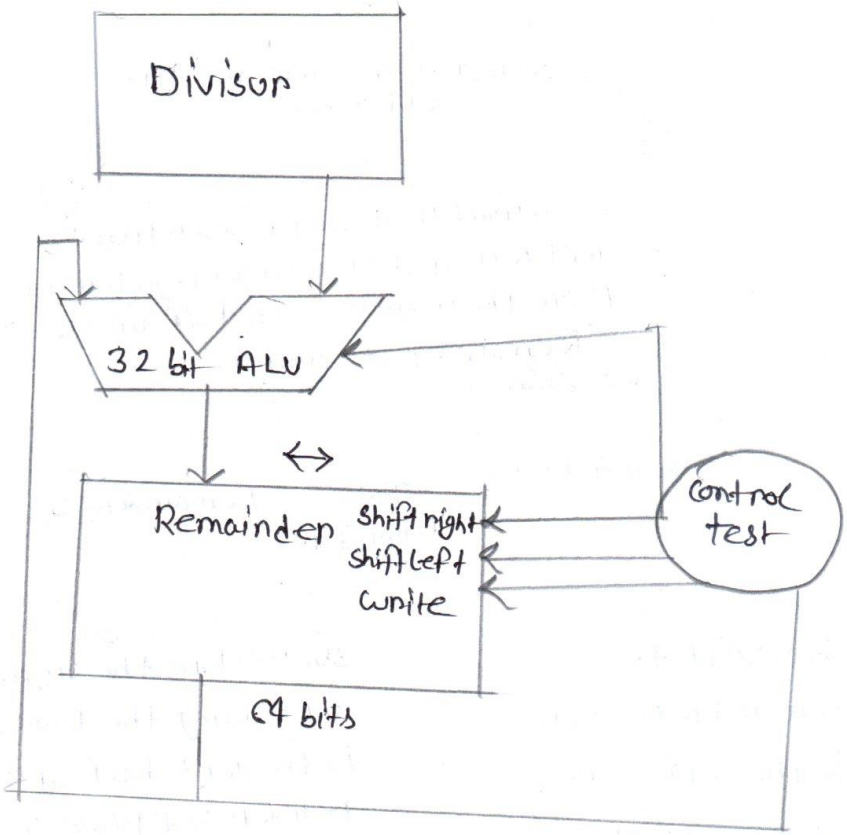
Version 3 Algorithm



Version 3 Hardware:



Remainder register is initialized with the dividend at right

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Version 3 Example: $(7 \div 2)$ → 0111 → 0010

Iteration	Steps	Divisor, D	Remainder, R
0	init	0010	0000 0111
1	1. Shift ← R 1 bit 2. R(H) = R(H) − D 3. R<0, 3b R(H) = R(H) + D ← R 1LS, R_0 = 0	0010	0000 1110 1110 1110 0000 1110 0001 1100
2	2. R(H) = R(H) − D, 3. R<0 3b. R(H) = R(H) + D ← R 1LS, R_0 = 0	0010	1111 1100 0001 1100 0011 1000
3	2. R(H) = R(H) − D 3a. ← R 1LS, R_0 = 1	0010	0001 1000 0011 0001
4	2. R(H) = R(H) − D 3a. ← R 1LS, R_0 = 1	0010	0001 0001 0010 0011
	Done: R(H) → RS	0010	0001 0011