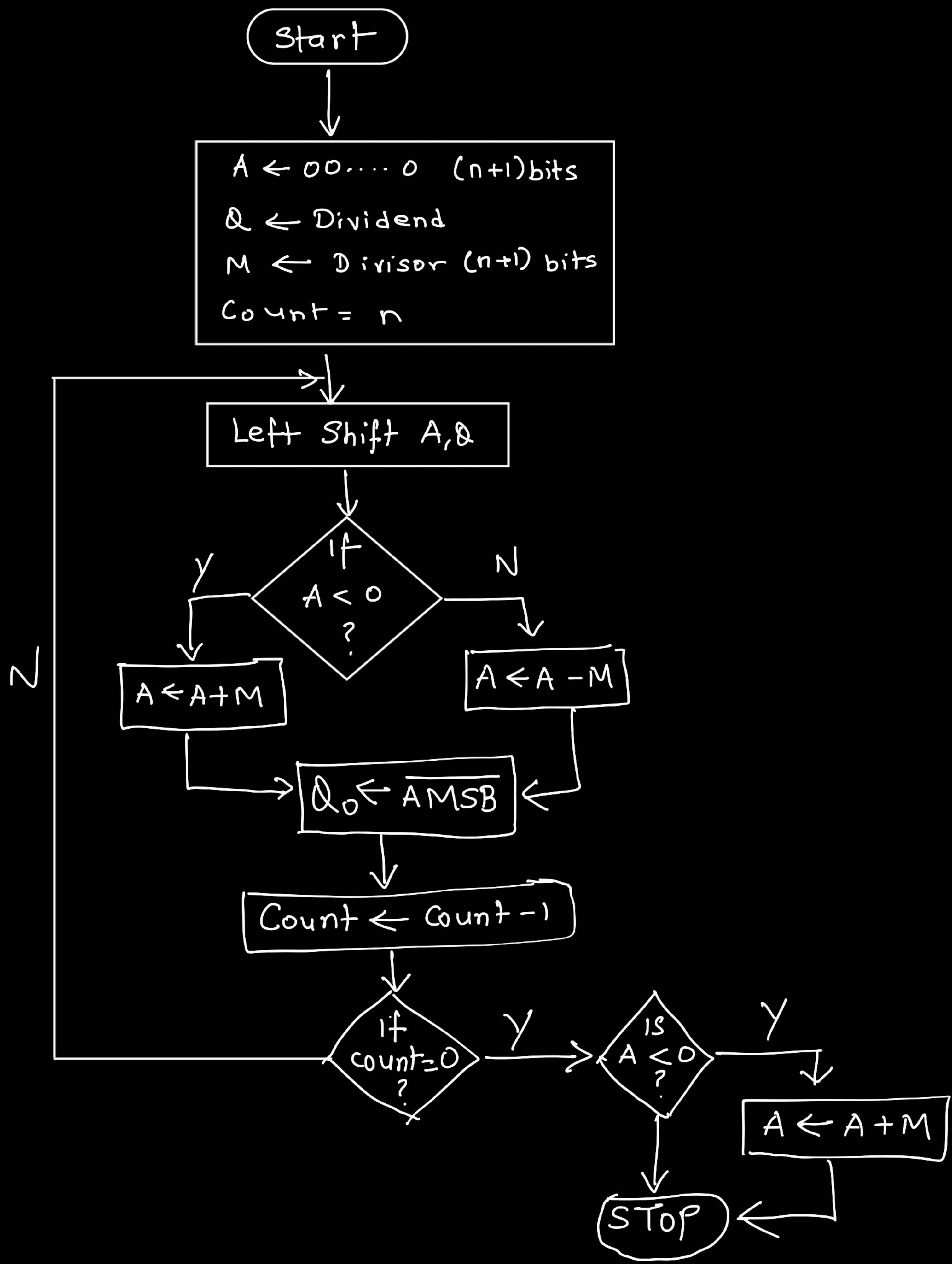
Non Restoring Division



The algorithm of restoring division can be improved by avoiding restoring after an unsuccessful subtraction.

Subtraction is said to be unsuccessful if the result is negative.

Algorithm

Step 1: Do the following n times :-

→ If the sign of A is positive, i.e $C = 0$, then shift A & Q left one bit and subtract M from A.

→ Else shift C, A and Q left one bit position & add M to A

→ If the sign of A is positive then set q_0 to 1 else set q_0 to 0.

Step2: If the sign of A is negative, then add M to A.

This step is needed to leave the proper positive remainder in A at the end of n cycles.

Q.1: Perform 15/4

Sol: M = 00100 (n+1) bits

Q = 1111

-M = 11011+1
= 11100

A	Q	Count	Action
00000	1111	4	Initialize
00001	1110		SL A ← A − M
+ 11100			
11101	1110	3	Count −−
11011	1100		SL A ← A + M
+ 00100			
11111	1100	2	Count −−

11111 1001 SL

$+$ 00100

$A \leftarrow A+M$

1 00011 1001 1

Count --

Discard the carry

00111 0011 0 SL

$+$ 11100

$A \leftarrow A-M$

1 00011 0011

Count --

Discard carry

R Q

Final Answer

Remainder = 00011 = $(3)_{10}$

Quotient = 0011 = $(3)_{10}$

Q.2 Perform $10/4$

Q.3 Perform $12/3$

Q.4: Perform the division of the following numbers using non-restoring division $1100 \div 11$

Sol: Q.4

$M = 00011$

$Q = 1100$

$\therefore -M = 11101$

A	Q	C	Action
00000	1100	4	Initialize
00001	1000		S.L.
+ 11101			$A \leftarrow A - M$
11110	1000	3	Count --
11101	0001		S.L
+ 00011			$A \leftarrow A + M$
00000	0001	2	Count --
00000	0010		S.L.
+ 11101			$A \leftarrow A - M$
11101	0010	1	Count --
11010	0100		S.L
+ 00011			$A \leftarrow A + M$
11101	0100	0	Count --

Since at the end of 4 cycles,

A is negative.

Hence we perform the operation

$$A \leftarrow A + M$$

$$\therefore A = \begin{array}{r} 11101 \\ +\ 00011 \\ \hline 00000 \\ \hline \end{array}$$

$\therefore$ Remainder $=$ $=$ 00000

Quotient $=$ 0100 $= 4$

You can verify

$$(1100)_2 = (12)_{10}$$

$$(11)_2 = (3)_{10}$$

$$\therefore \frac{12}{3} = 4$$