Division of Integers - Restoring Method

→ Similar to the multiplication algorithm, we also have a method for division called as the restoring method of division for binary numbers.

→ Here also we have the registers namely 'A', 'M', 'Q' and count to store the result, dividend, divisor and count respectively.

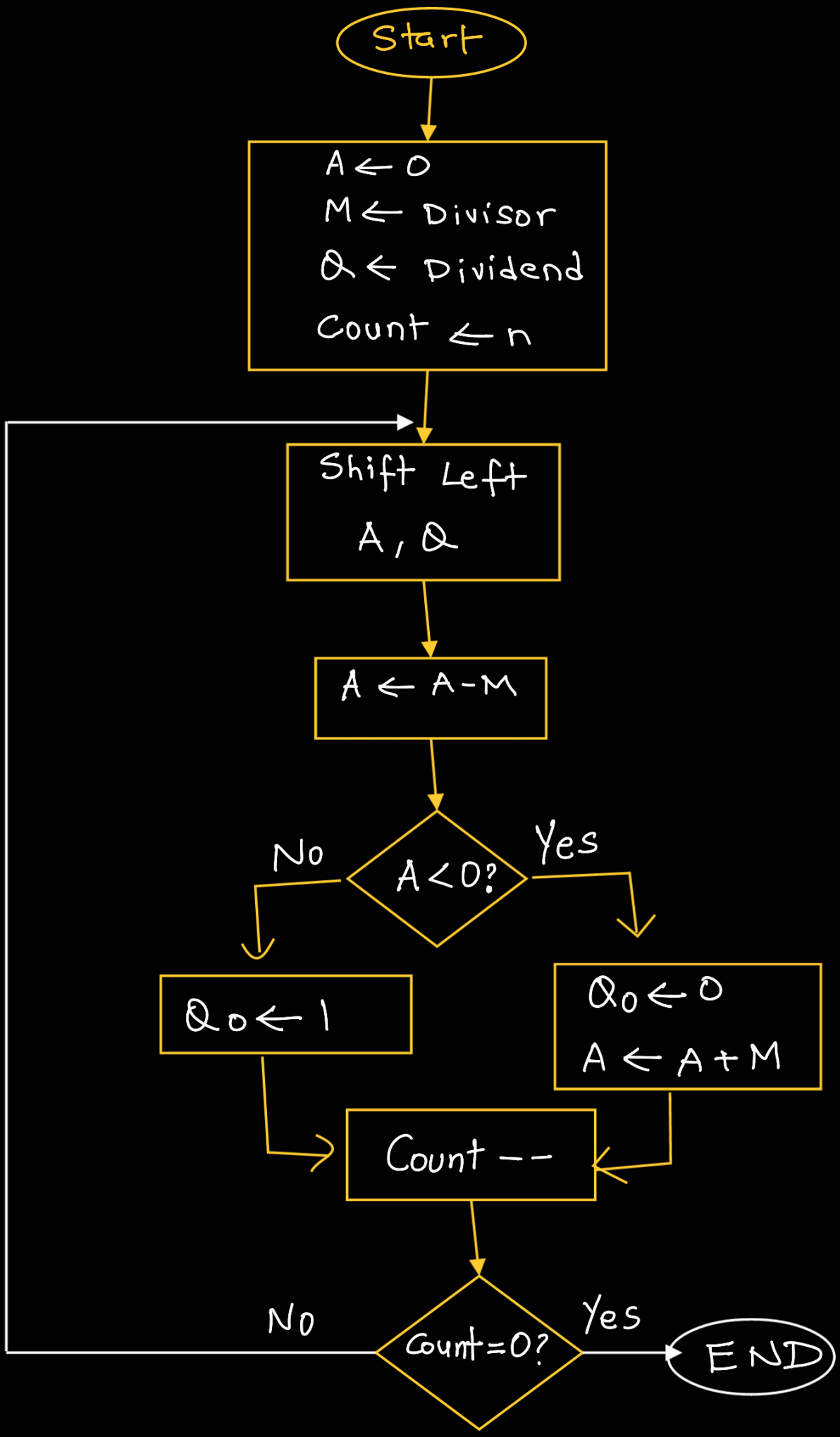
→ In this case, we shift the registers A and Q to their left and then check whether the value in 'A' is greater than the divisor or not.

→ To find out whether it is greater or not, we check that the result is positive or not.

→ If yes, then we put '1' in the LSB of the Q register, which was initially left blank while shifting.

→ If NO, then we put a '0' in the LSB of the Q register and add the divisor back to the value of register 'A' or RESTORE the previous value of register 'A', hence the name "Restoring Division Method"

→ The count is decremented and the above process is repeated until the count is not equal to zero.


Start
A ← 0
M ← Divisor
Q ← Dividend
Count ← n
Shift Left
A, Q
A ← A-M
A<0?
No
Yes
Q0 ← 1
Q0 ← 0
A ← A+M
Count --
Count=0?
No
Yes
END

Q.1. Divide 13/5 using the RESTORING method of division and give the values of all the registers after each step

---

Sol:

A	Q	M	Action
00000	01101	00101	Initialize
00000	1101_	00101	Shift Left

Here $A - M = A + (-M)$

$= A +$ 2's complement of M

∴ 2's complement of M = 11011

∴
$$\begin{array}{r} 00000 \\ +\ 11011 \\ \hline 11011 \end{array}$$

11010 00101

↑ Negative, hence put a 0 on the LSB of Q.

$$\begin{array}{r} 11011 \\ +\ 00101 \\ \hline 00000 \end{array}$$

11010 00101 Count--

First Cycle

A	Q	M	Action	Count
00000	11010	00101		4
00001	1010_	00101	Shift Left	
+ 11011	10100	00101	$Q_0 \leftarrow 0$	
11100			$A \leftarrow A+M$	
+ 00101				
00001				

2nd Cycle

00001	10100	00101		3
00011	0100_	00101	Shift left	
+ 11011	01000	00101	$Q_0 \leftarrow 0$	
11110			$A \leftarrow A+M$	
+ 00101	01000	00101		
00011				

3rd Cycle

00011	01000	00101		2
00110	1000_	00101	Shift Left	
+ 11011				
00001	1000 1	00101	$Q_0 \leftarrow 1$	

4th Cycle

00001	10001	00101	1
00011	0001_	00101	Shift Left
+11011	00010	00101	$Q_0 \leftarrow 0$
11110			$A \leftarrow A+M$
+00101			
00011			

Count = 0

Last Cycle

Final Answer

Quotient $= (00010)_2 = (2)_{10}$

Remainder $= (00011)_2 = (3)_{10}$

Q.2. Explain how to divide 13 by 3 in the register and show how the quotient and the remainder is placed after the division (All are 5bit registers).

Q.3. Perform division of the following numbers using Restoring Division

Dividend Q = 17

Divisor M = 03

Q.4: Perform division of the following numbers using restoring division algo.

A → 1100

B → 0100