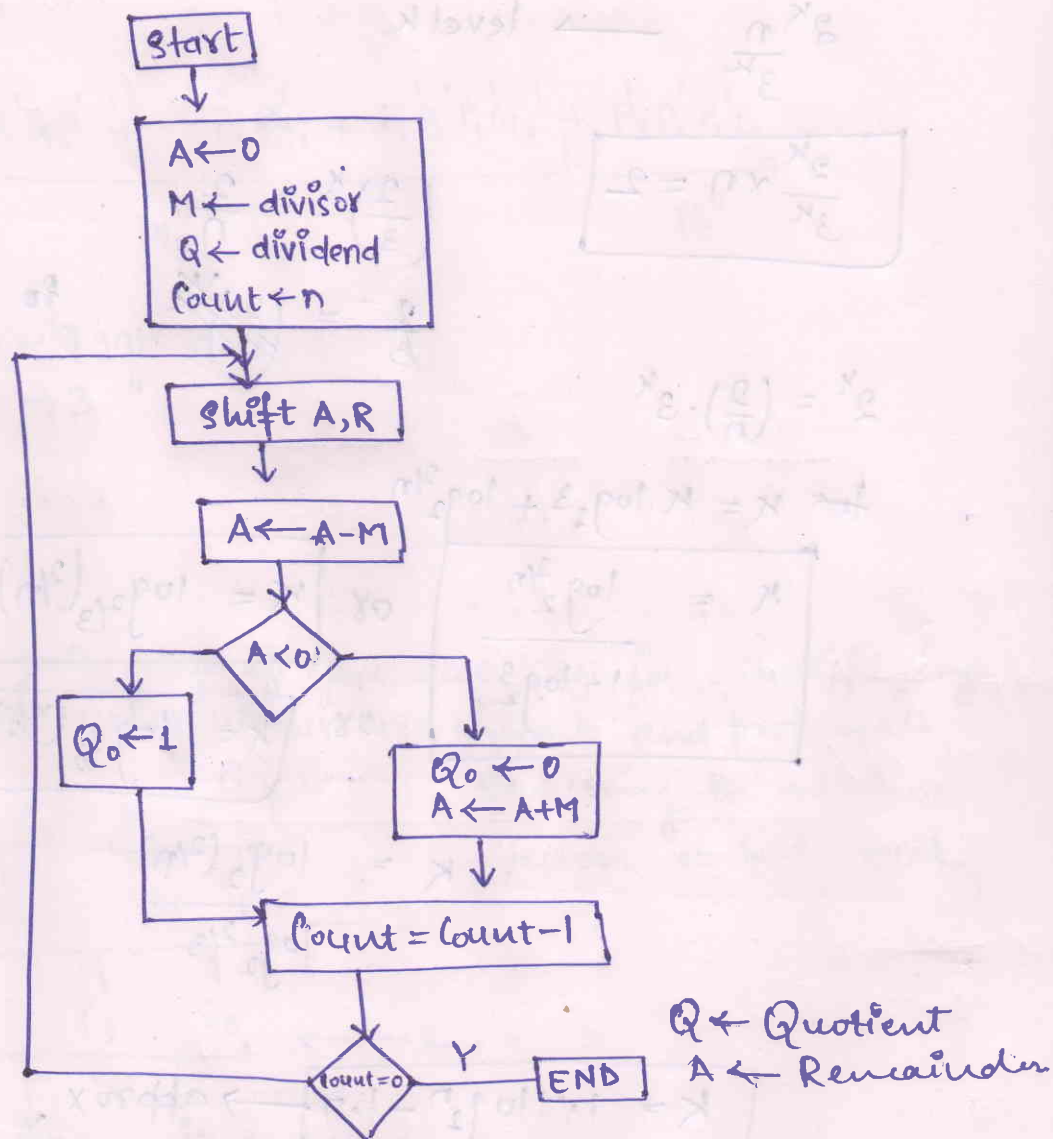
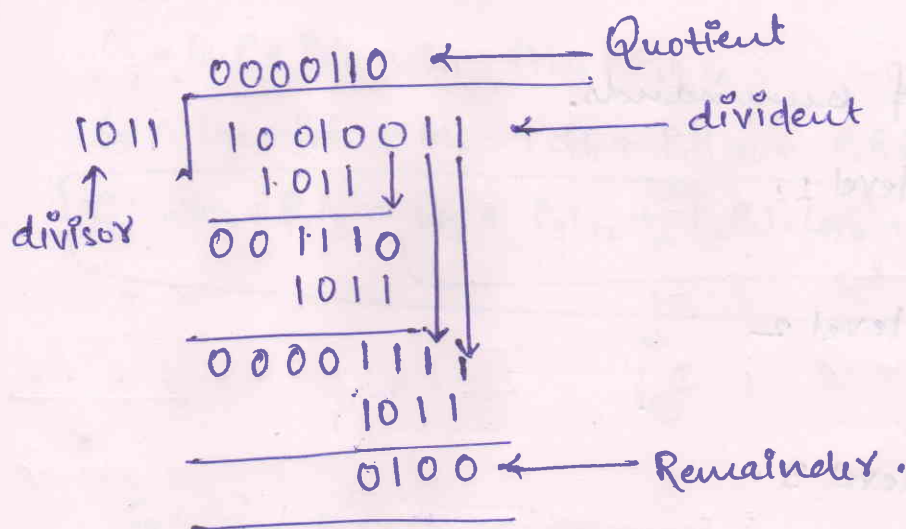


Integer division (stallings)

Pencil and Paper method



2's Complement Division

1. Load the divisor into register M and dividend into A, Q registers. Note that Dividend must be represented in $2n$ bits and in 2's Complement.

$$1001(-7) \rightarrow \begin{array}{r} 1111 \\ \hline A \end{array} \quad \begin{array}{r} 1001 \\ \hline Q \end{array}$$

$$0111 \quad \begin{array}{r} 0000 \\ \hline A \end{array} \quad \begin{array}{r} 0111 \\ \hline Q \end{array}$$

2. Shift A, Q 1 bit left
3. If M and A have the same sign, perform $A \leftarrow A - M$;
 $A \leftarrow A + M$ otherwise.
4. The previous operation is successful if sign of A is the same before and after the operation.
 - a) If the operation is "successful" or $A = 0$, then set $Q_0 \leftarrow 1$
 - b) If operation is not successful and $A \neq 0$, then set $Q_0 \leftarrow 0$ and restore the previous value of A.
5. Repeat step 2. to step 4. as many times as there are bits in Q.
6. The remainder is in A. If the sign of Dividend and divisor are same, then Quotient is in Q. otherwise, correct quotient is the 2's Complement of Q.

Q1. $-7/3$

	A	Q	Count	
1001 ← Dividend.	1111	1001	4	; initial values.
0011 ← Divisor.	1111	0010	4	; shift left
M = 0011	0010	0010	4	; $A \leftarrow A + M$
	1111	0010	3	; Restore A.
	1110	0100	3	; shift left.
	0001	0100	3	; $A \leftarrow A + M$
	1110	0100	2	; Restore A.

1100	1000	2 ; left shift A, Q
1111	1000	2 ; $A \leftarrow A+M$
1111	1001	1 ; $Q_0 \leftarrow 1$
<hr/>		
1111	0010	1 ; left shift
0010	0010	1 ; $A \leftarrow A+M$
1111	0010	0 ; Restore A.
<hr/>		
1111	0010	
↓	↓	
Remainder	2's Complement	

$$\text{Divident} = \text{Quotient} \times \text{Divisor} + \text{Remainder}$$

$$= -2 \times 3 + (-1)$$

Q2. $+7/3$

Divident = 0111	A	Q	Count
Divisor = 1101	0000	0111	4 ; initial
M = 1101	0000	1110	4 ; shift left
	1101	1110	4 ; $A \leftarrow A+M$
	0000	1110	3 ; Restore A
	0001	1100	3 ; shift left
	1110	1100	3 ; $A \leftarrow A+M$
	0001	1100	2 ; Restore A
	0011	1000	2 ; shift left
	0000	1000	2 ; $A \leftarrow A+M$
	0000	1001	1 ; $Q_0 \leftarrow 1$

1100	1000	2 ; left shift A, Q
1111	1000	2 ; $A \leftarrow A+M$
1111	1001	1 ; $Q_0 \leftarrow 1$
<hr/>		
1111	0010	1 ; left shift
0010	0010	1 ; $A \leftarrow A+M$
1111	0010	0 ; Restore A.
1111	0010	

1111 \downarrow Remainder
0010 \downarrow 2's complement.

$$\text{Divident} = \text{Quotient} \times \text{Divisor} + \text{Remainder}.$$

$$= -2 \times 3 + (-1)$$

Q2. $+7/3$

Divident = 0111	A	Q	Count
Divisor = 1101	0000	0111	4 ; initial
M = 1101	0000	1110	4 ; shift left.
	1101	1110	4 ; $A \leftarrow A+M$
	0000	1110	3 ; Restore A
	0001	1100	3 ; shift left
	1110	1100	3 ; $A \leftarrow A+M$
	0001	1100	2 ; Restore A
	0011	1000	2 ; shift left
	0000	1000	2 ; $A \leftarrow A+M$
	0000	1001	1 ; $Q_0 \leftarrow 1$

Integer division (stallings)

Pencil and Paper method

