Digital Electronics and Computer Organization

Digital Design

Lecture 29: Booth Multiplier

Birla Institute of Technology & Science, Pilani
Hyderabad Campus

Booth Algorithm

3 X 14

$0011 \text{ X } 1110 = 0011 \text{ x } (2^4 - 2^1)$

$0011 \text{ X } 1110 = (0011 \text{ x } 2^4) - (0011 \text{ x } 2^1)$

$0011 \text{ X } 1110 = (00110000) - (00110) = 101010$

Booth Algorithm

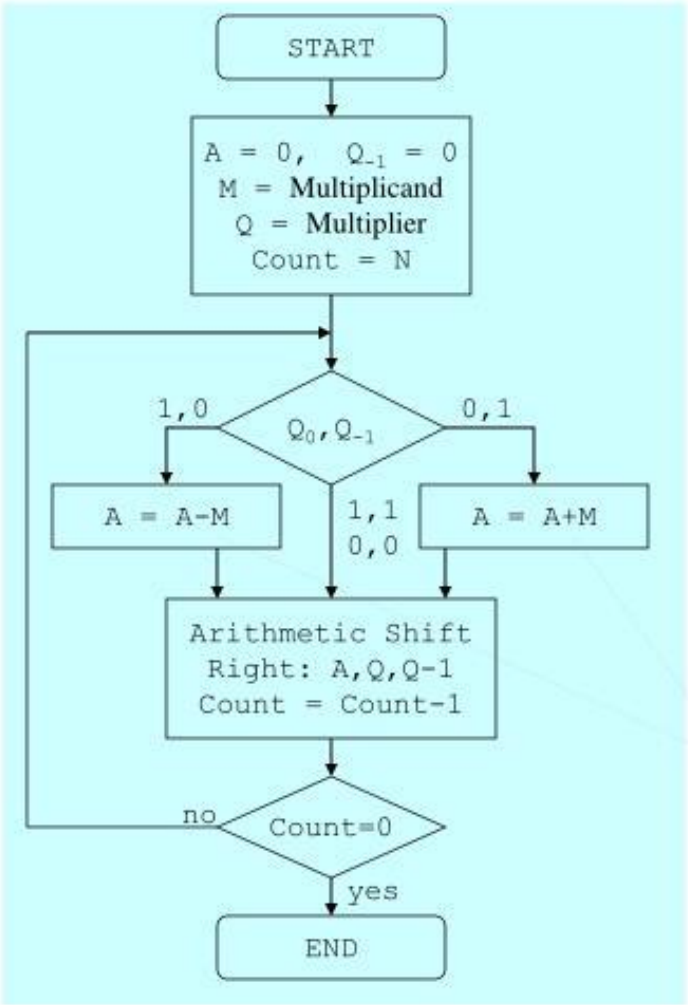
3 X 51

$0011 \times 110011 = 0011 \times (2^6 - 2^4 + 2^2 - 2^1)$

$0011 \times 110011 = 0011 \times (2^6 - 2^4 + 2^2 - 2^1)$

Booth Algorithm

Booth's Algorithm for 2's Complement Multiplication



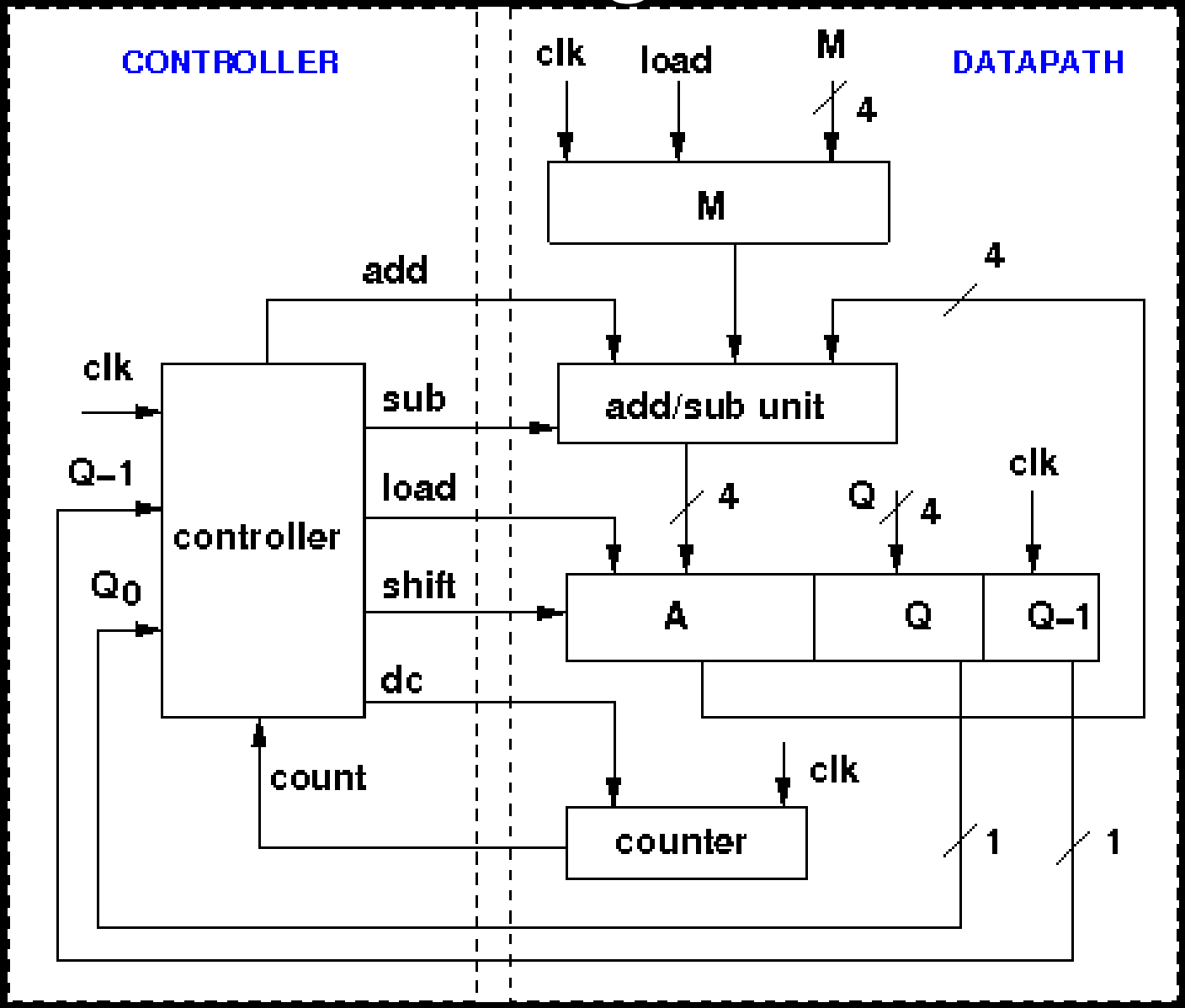

```
M = 0101    -M = 1011
Q = 0110
N = 4

 A      Q     Q-1  N
0000   0110   0    4
0000   0011   0    3
1011   0011   0
1101   1001   1    2
1110   1100   1    1
0011   1100   1
0001   1110   0    0

Answer is in A,Q
  00011110₂ = 30₁₀
```

Two's complement multiplication can be performed using Booth's Algorithm.

To save time, both M and -M can be computed ahead and provided as one of the inputs to the adders for A-M and A+M.

Instead of a loop, the math processor can provide separate hardware for each stage of the multiplication algorithm.

Booth Algorithm



Booth Algorithm

5X6	M=0101	0110			-M = 1011
	A	Q	Q-1	N	
Initial Condition	0000	0110	0		
Nothing	0000	0110	0	1	
Shift Right	0000	0011	0		
Substract	1011	0011	0	2	
Shift Right	1101	1001	1		
Nothing	1101	1001	1	3	
Shift Right	1110	1100	1		
Add	0011	1100	1	4	
Shift Right	0001	1110	0		

Booth Algorithm

-3X4	M=1101	0100			-M = 0011
	A	Q	Q-1	N	
Initial Condition	0000	0100	0		
Nothing	0000	0100	0	1	
Shift Right	0000	0010	0		
Nothing	0000	0010	0	2	
Shift Right	0000	0001	0		
Substract	0011	0001	0	3	
Shift Right	0001	1000	1		
Add	1110	1000	1	4	
Shift Right	1111	0100	0		

Thank You