Digital Design
First Semester 2020-21
Tutorial : 13

Binary Multiplication

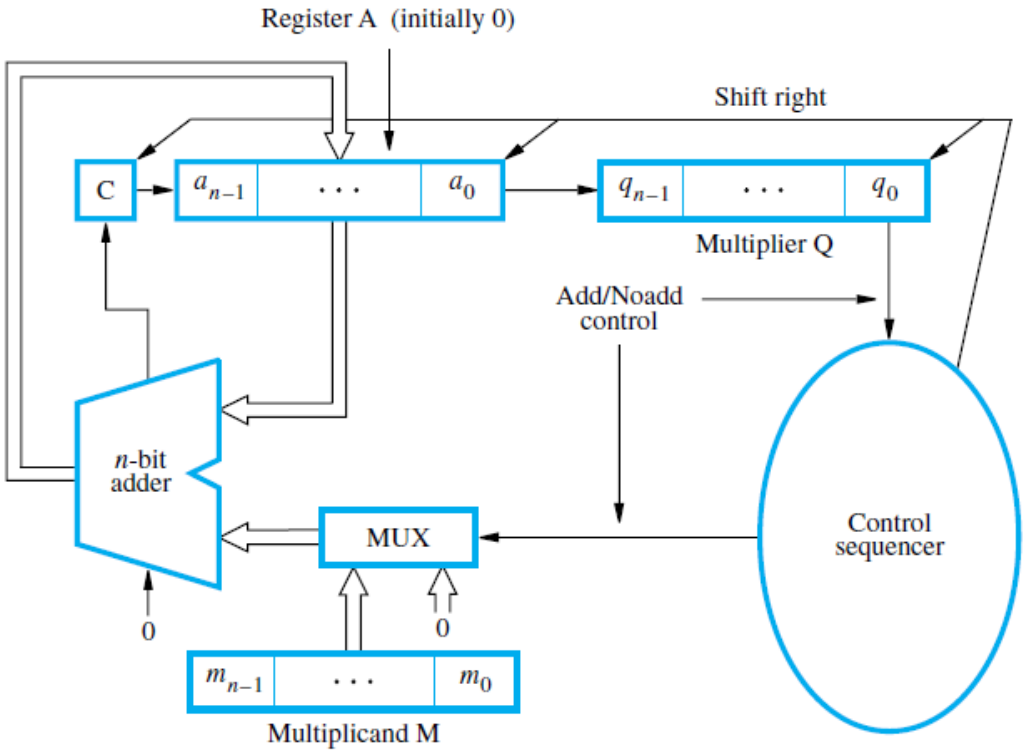
Problem 1

1. Multiply 4 X 5 using sequential multiplier

			1	0	0	0
		x	1	0	0	1
			1	0	0	0
		0	0	0	0	
	0	0	0	0		
1	0	0	0			
1	0	0	1	0	0	0

Problem 1

1. Multiply 4 X 5 using sequential multiplier



(a) Register configuration

Problem 1

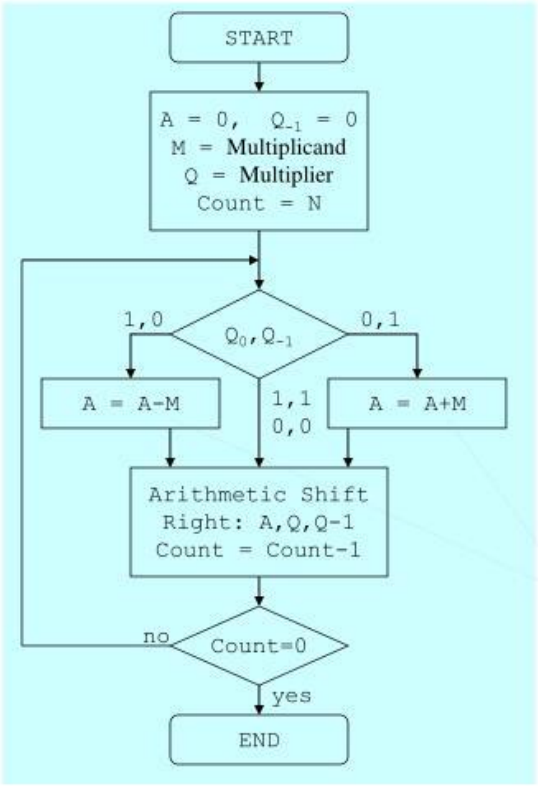
1. Multiply 4 X 5 using sequential multiplier

4x5					
		M	A	Q	
	Initial Condition	0100	00000	0101	
	Load	0100	00100	0101	1
	Shift Right	0100	00010	0010	
	Load	0100	00010	0010	2
	Shift Right	0100	00001	0001	
	Load	0100	00101	0001	3
	Shift Right	0100	00010	1000	
	Load	0100	00010	1000	4
	Shift Right	0100	00001	0100	

Problem 2

2. Multiply -4 X 2 using 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
  00011110(2) = 30(10)
```

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.

Problem 2

1. Multiply -4 X 2 using Booth Algorithm

-4X2	1100	0010			-M = 0100
	A	Q	Q-1	N	
Initial Condition	0000	0010	0		
Nothing	0000	0010	0	1	
Shift Right	0000	0001	0		
Substract	0100	0001	0	2	
Shift Right	0010	0000	1		
Add	1110	0000	1	3	
Shift Right	1111	0000	0		
Nothing	1111	0000	0	4	
Shift Right	1111	1000	0		