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MPI Tutorial-1

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Addition & Subtraction

- **Two's Complement Arithmetic**
- **Result & Nature of Result**

Problem 1:

44 + 52

P1: 44+52

	1	1	1	1			
0	0	1	0	1	1	0	0
0	0	1	1	0	1	0	0
0	1	1	0	0	0	0	0

Auxiliary Carry – 1

No Carry

Result Not Zero

Positive Number

No 2's Complement overflow

Parity - Even

P1: 44+52

FLAG REGISTERS

- Flag Register: It is a group of 5 flip flops used to know status of various operations done and is given by:

S	Z	X	AC	X	P	X	CY

- S: Sign flag is set when result of an operation is negative.
- Z: Zero flag is set when result of an operation is 0.
- AC: Auxiliary carry flag is set when there is a carry out of lower nibble or lower four bits of the operation.
- CY: Carry flag is set when there is carry generated by an operation.
- P: Parity flag is set when result contains even number of 1's.

  Rest(X) are don't care flip flops.
- 8085 uses these flags in decision-making process.

Problem-2

Perform the indicated operations on the following numbers

(a) Subtr act 4CH from 17AH

(b) Add two BCD numbers 79 and 89 with the result as BCD

(c) Subtract 26_{10} from 37_{10} using 2's complement method.

	1	7	A	(H)
-		4	C	(H)
	1	2	E	(H)

Problem-2

Perform the indicated operations on the following numbers

(a) Subtr act 4CH from 17AH

(b) Add two BCD numbers 79 and 89 with the result as BCD

(c) Subtract 26_{10} from 37_{10} using 2's complement method.

	1	
	0111	1001
	1000	1001
1	0000	0010
	0110	0110
1	0110	1000

Problem-2

Perform the indicated operations on the following numbers

(a) Subtr act 4CH from 17AH

(b) Add two BCD numbers 79 and 89 with the result as BCD

(c) Subtract 26_{10} from 37_{10} using 2's complement method.

26	0001	1010
	1110	0101
-26	1110	0110
37	0010	0101
-26	1110	0110
	0000	1011

Exercises

- 97 +48
- 99-33
- 33-99
- -29+-32
- -41-95
- Is a two's complement overflow possible during subtraction

Multiplication - Rules

1. LSB of multiplier is 1 – write down the multiplicand and shift left by one place

2. LSB of multiplier is 0 – write down as many zeros as size of multiplicand and shift left by one place

3. For each bit of multiplier repeat either (1) or (2)

4. Add all partial products

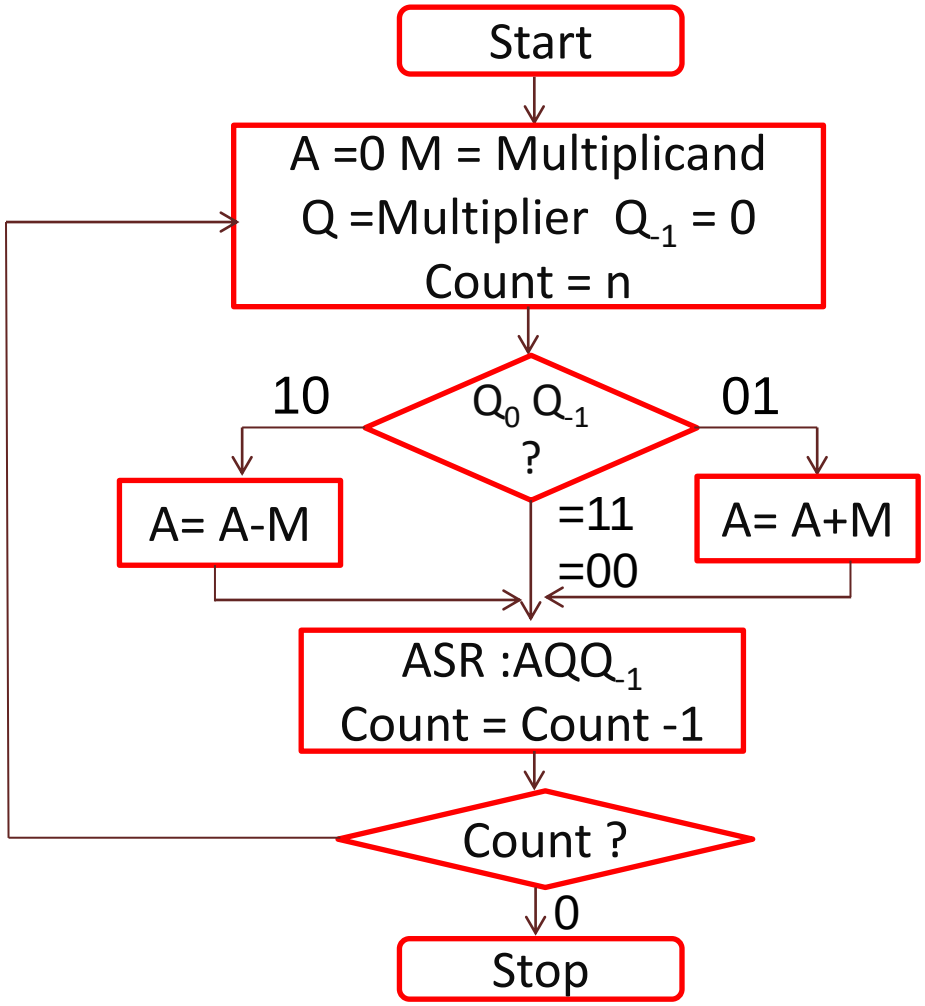
Multiplication

- **Multiply two n- bit numbers results in a maximum of 2n bit number.**
- **Multiply a m-bit number by n-bit**
- **result in a maximum of m+n bit number**

Exercises

- **1011 X 1101 (11 x13]**

Booth's Algorithm



Booth's Algorithm

3 X 12

$0011 \times 1100 = 0011 \times (2^4 - 2^2)$

$0011 \times 1100 = (0011 \times 2^4) - (0011 \times 2^2)$

Booths Algorithm -3 X 7

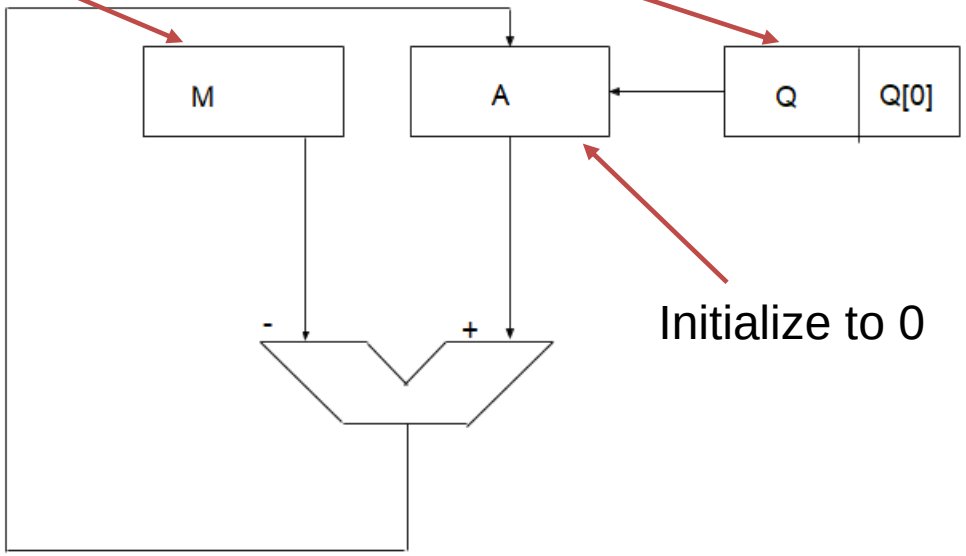
A				Q				Q_1	M
0	0	0	0	1	1	0	1	0	0111
1	0	0	1	1	1	0	1	0	0111
1	1	0	0	1	1	1	0	1	0111
0	0	1	1	1	1	1	0	1	0111
0	0	0	1	1	1	1	1	0	0111
1	0	1	0	1	1	1	1	0	0111
1	1	0	1	0	1	1	1	1	0111
1	1	1	0	1	0	1	1	1	0111
1	1	1	0	1	0	1	1	1	0111

Exercises

- -5 x 7
- -5 x -8

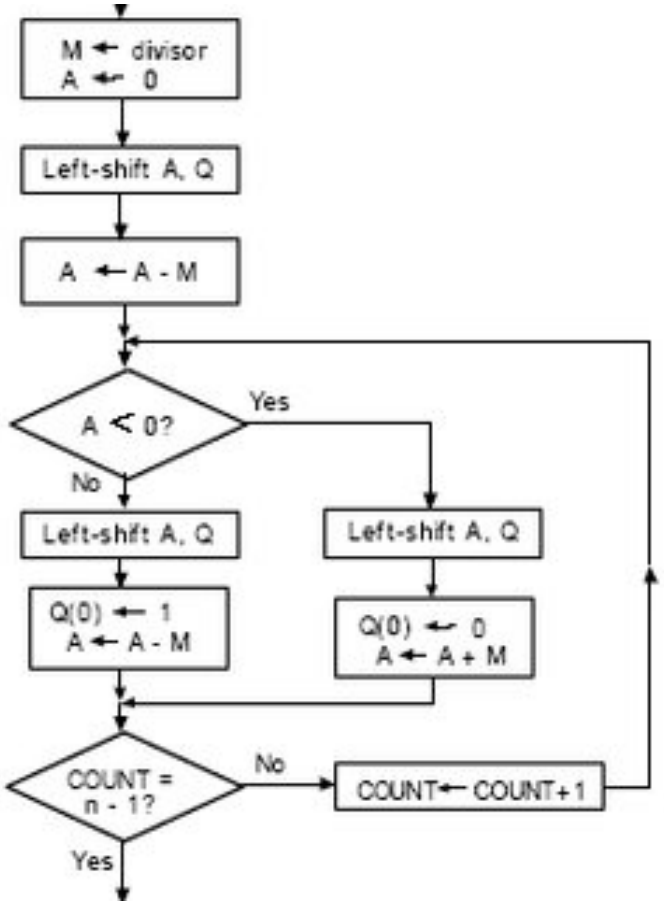
Restoring Division

	0011	Quotient
11	1010	
	011	
	100	
	11	
	1	Remainder



Restoring Division

M=0011	A	Q	N=4
-M=1101	0000	1010	
	0001	010?	Shift Left, N=3
	1110	010?	A-M
	0001	0100	Q[0]=0, Restore A
	0010	100?	Shift Left, N=2
	1111		A-M
	0010	1000	Q[0]=0, Restore A
	0101	000?	Shift Left, N=1
	0010	000?	A-M
	0010	0001	Q[0]=1
	0100	001?	Shift Left, N=0
	0001	001?	A-M
	0001	0011	Q[0]=1



Exercise

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