

# Tutorial #7

CSE 321a: Computer Organization (I)  
Third Year, Computer and Systems Engineering

## Problem 10.6 (text book)

Compare zero-, one-, two-, and three-address machines by writing programs to compute:

$$X = (A + B * C) / (D - E * F)$$

For each of the following four machines. The instructions available for use are as follows:

0 Address	1 Address	2 Address	3 Address
PUSH M	LOAD M	MOVE ( $X \leftarrow Y$ )	MOVE ( $X \leftarrow Y$ )
POP M	STORE M	ADD ( $X \leftarrow X + Y$ )	ADD ( $X \leftarrow Y + Z$ )
ADD	ADD M	SUB ( $X \leftarrow X - Y$ )	SUB ( $X \leftarrow Y - Z$ )
SUB	SUB M	MUL ( $X \leftarrow X \times Y$ )	MUL ( $X \leftarrow Y \times Z$ )
MUL	MUL M	DIV ( $X \leftarrow X/Y$ )	DIV ( $X \leftarrow Y/Z$ )
DIV	DIV M		

Zero-address	One-address	Two-address	Three-address
PUSH A	LOAD E	MOV R0, E	MUL R0, E, F
PUSH B	MUL F	MUL R0, F	SUB R0, D, R0
PUSH C	STORE T	MOV R1, D	MUL R1, B, C
MUL	LOAD D	SUB R1, R0	ADD R1, A, R1
ADD	SUB T	MOV R0, B	DIV X, R1, R0
PUSH D	STORE T	MUL R0, C	
PUSH E	LOAD B	ADD R0, A	
PUSH F	MUL C	DIV R0, R1	
MUL	ADD A	MOV X, R0	
SUB	DIV T		
DIV	STORE X		
POP X			

## External problem

If AC is 8 bits and contains -4 decimal number that is represented in sign and magnitude representation. Show the contents of AC register after perform the following shift operation:

- 1) Logical Right Shift
- 2) Logical Left Shift
- 3) Arithmetic Right Shift
- 4) Arithmetic Left Shift
- 5) Rotate Right
- 6) Rotate Left

- 1) Logical Right Shift

-4 = 10000100 in binary after perform LRS = 01000010 = + 66 in decimal

- 2) Logical Left Shift

-4 = 10000100 in binary after perform LLS = 00001000 = + 8 in decimal

- 3) Arithmetic Right Shift

-4 = 10000100 in binary after perform ARS = 11000010 = - 66 in decimal

- 4) Arithmetic Left Shift

-4 = 10000100 in binary after perform ALS = 10001000 = - 8 in decimal

- 5) Rotate Right

-4 = 10000100 in binary after perform LRS = 01000010 = + 66 in decimal

- 6) Rotate Left

-4 = 10000100 in binary after perform LRS = 00001001 = + 9 in decimal