WEEK-13

- Instruction Processing

• The RTN for this instruction is the most complex.

• The *fetch-decode-execute cycle* is the series of steps that a computer carries out when it runs a program.

• We first have to *fetch* an instruction from memory, and place it into the IR.

• Once in the IR, it is *decoded* to determine what needs to be done next.

• If a memory value (operand) is involved in the operation, it is retrieved and placed into the MBR.

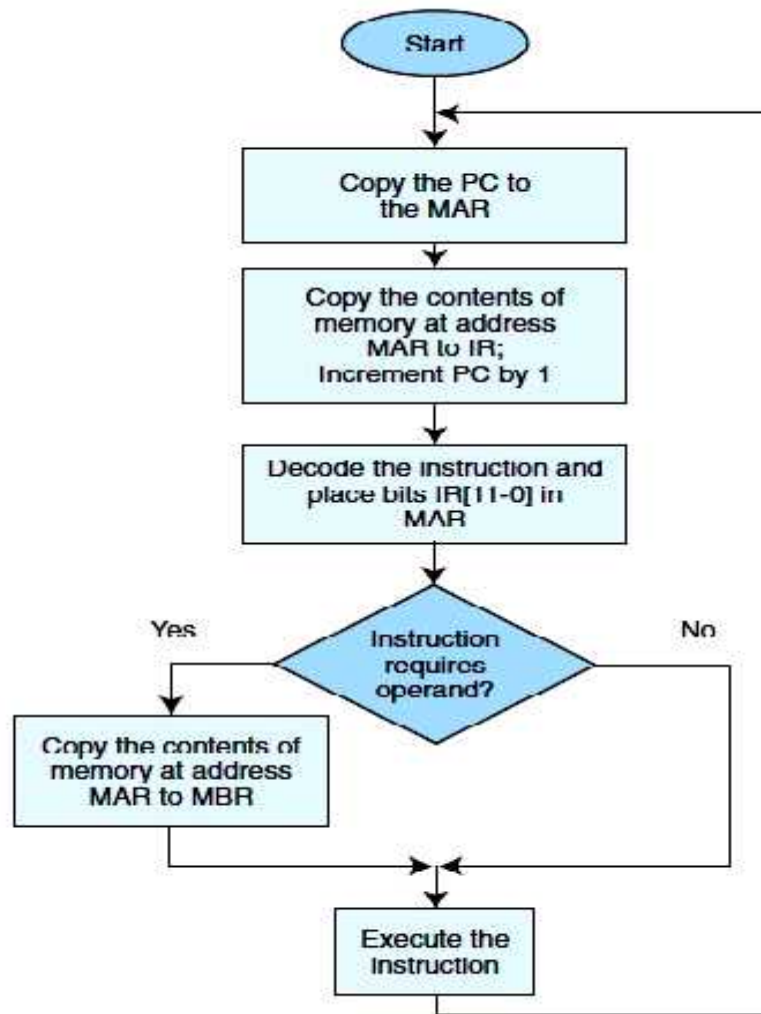• With everything in place, the instruction is *executed*.

Figure 3.4 Shows the fetch-decode-execute cycle.

• Consider the simple MARIE program given below.

    We show a set of mnemonic instructions stored at addresses
        100 - 106 (hex):

Hex Address	Instruction		Binary Contents of Memory Address	Hex Contents of Memory
100	Load	104	0001000100000100	1104
101	Add	105	0011000100000101	3105
102	Store	106	0010000100000110	2106
103	Halt		0111000000000000	7000
104	0023		0000000000100011	0023
105	FFE9		1111111111101001	FFE9
106	0000		0000000000000000	0000

• Let's look at what happens inside the computer when our program runs.
) This is the **LOAD 104** instruction:
) Our second instruction is **ADD 105**.

a) Load 104

Step	RTN	PC	IR	MAR	MBR	AC
(initial values)		100	-------	-------	-------	-------
Fetch	MAR ←— PC	100	-------	100	-------	-------
	IR ←— M[MAR]	100	1104	100	-------	-------
	PC ←— PC + 1	101	1104	100	-------	-------
Decode	MAR ←— IR[11—0]	101	1104	104	-------	-------
	(Decode IR[15—12])	101	1104	104	-------	-------
Get operand	MBR ←— M[MAR]	101	1104	104	0023	-------
Execute	AC ←— MBR	101	1104	104	0023	0023

b) Add 105

Step	RTN	PC	IR	MAR	MBR	AC
(initial values)		101	1104	104	0023	0023
Fetch	MAR ⟵ PC	101	1104	101	0023	0023
	IR ⟵ M[MAR]	101	3105	101	0023	0023
	PC ⟵ PC + 1	102	3105	101	0023	0023
Decode	MAR ⟵ IR[11—0]	102	3105	105	0023	0023
	(Decode IR[15—12])	102	3105	105	0023	0023
Get operand	MBR ⟵ M[MAR]	102	3105	105	FFE9	0023
Execute	AC ⟵ AC + MBR	102	3105	105	FFE9	000C

c) Store 106

Step	RTN	PC	IR	MAR	MBR	AC
(initial values)		102	3105	105	FFE9	000C
Fetch	MAR ⟵ PC	102	3105	102	FFE9	000C
	IR ⟵ M[MAR]	102	2106	102	FFE9	000C
	PC ⟵ PC + 1	103	2106	102	FFE9	000C
Decode	MAR ⟵ IR[11—0]	103	2106	106	FFE9	000C
	(Decode IR[15—12])	103	2106	106	FFE9	000C
Get operand	(not necessary)	103	2106	106	FFE9	000C
Execute	MBR ⟵ AC	103	2106	106	000C	000C
	M[MAR] ⟵ MBR	103	2106	106	000C	000C