MODULE 4: Computer Organization and MARIE

Lecture 4.4
Simple Programming

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Lecture 4.4 Objectives

- Write a simple program using MARIE's assembly language

- Assemble a program and determine the contents of the space in memory where the program resides

- Trace through a program and determine the contents of all relevant registers after each microoperation

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Example: Add Two Integers

- Add two integers (in memory locations 104 and 105) and store result (to memory location 106)

Program

100	Load	104
101	Add	105
102	Store	106
103	Halt	
104	0023	
105	FFE9	
106	0000	

Memory Contents

100	1104
101	3105
102	2106
103	7000
104	0023
105	FFE9
106	0000

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Program Trace (1)

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

Program Trace (2)

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

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Program Trace (3)

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
Execute	MBR ← AC	103	2106	106	000C	000C
	M[MAR] ← MBR	103	2106	106	000C	000C

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Program Trace (4)

Step	RTN	PC	IR	MAR	MBR	AC
(initial values)		103	2106	106	000C	000C
Fetch	MAR ← PC	103	2106	103	000C	000C
	IR ← M[MAR]	103	7000	103	000C	000C
	PC ← PC + 1	104	7000	103	000C	000C
Decode	MAR ← IR[11-0]	104	7000	000	000C	000C
	(Decode IR[15-12])	104	7000	000	000C	000C

CHECK POINT

As a checkpoint of your understanding, please pause the video and make sure you can do the following:

- Step through the trace of the simple program on slide 3 and follow how the program instructions are executed by the MARIE processor

If you have any difficulties, please review the lecture video before continuing.

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Summary

- We can write programs using the MARIE assembly language to perform simple operations

- In the example in this lecture, all data is written from and to memory

- When the program executes, instructions and data are brought in from memory to the registers supported by the MARIE ISA, including the PC, IR, MAR, MBR, and AC

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