

# CIS 350 – INFRASTRUCTURE TECHNOLOGIES

## SMALL GROUP ACTIVITY #4

Names of group

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Topic: The operation of the CPU and memory, Machine cycle, Instructions

Logistics

1. Get in touch with your group of 4 or 5 students. (See Groups folder on Blackboard.)
2. Discuss and complete the assignment together via E-mail, Discussion Forum, Blackboard Collaborate Ultra, and/or MS Teams.
3. Choose a recorder to prepare the final copy (one per group) and submit it via the Blackboard Assignments/Small Group Activities folder to the instructor.
4. Be sure all group members' names are on final copy. Do not add names of your group classmates who did not participate in the assignment.

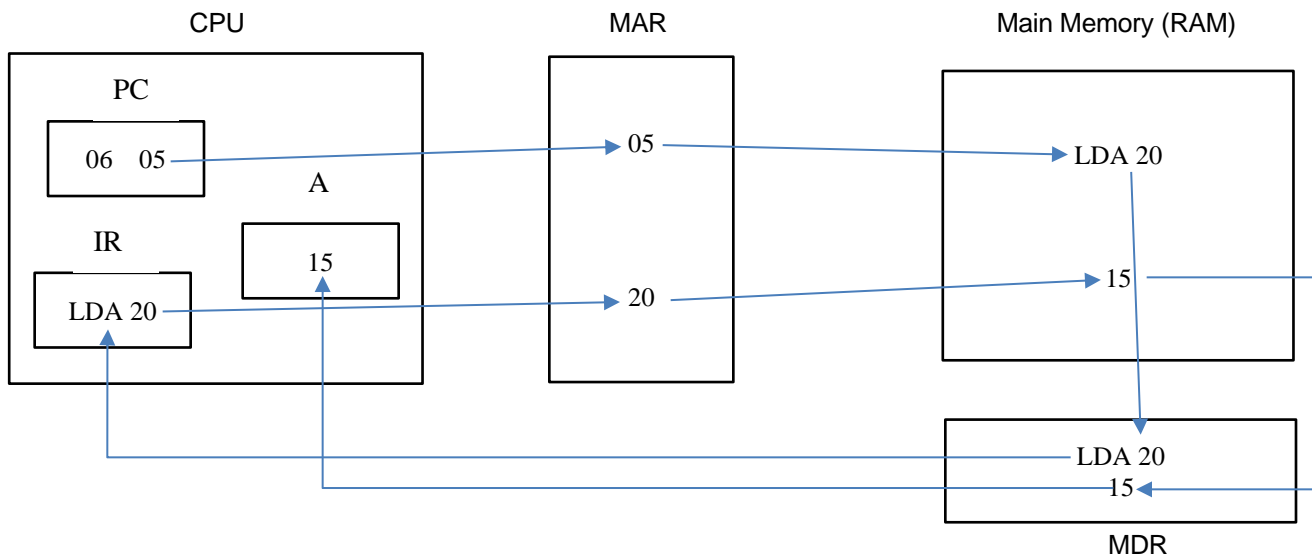
### Assignment One

Suppose that the following instruction is found at the given address/location in memory:

Address	Instruction
05	LDA 20
06	....
....	Data
20	15

The instruction LDA 20 residing at address 05 loads the contents of memory location 20, which is 15, into the Accumulator (A).

(a) Complete the diagram below showing the flow and contents of the CPU (PC, IR, A), MAR, Memory, and MDR, after each of the 5 steps of the fetch-execute cycle is executed. Number the steps 1-5. For help see page 5 in the lecture notes for Chapter 7.



(b) Fill in the table below with the contents of the PC, MAR, MDR, IR, and A as each of the 5 steps of the fetch-execute cycle is performed for that instruction. If the content of the register is unknown, write a question mark "?".

	PC	MAR	MDR	IR	A
(1) PC → MAR	<u>05</u>	<u>05</u>	LDA 20	<u>?</u>	<u>?</u>
(2) MDR → IR	<u>05</u>	<u>05</u>	LDA 20	LDA 20	<u>?</u>
(3) IR [address] → MAR	<u>05</u>	<u>20</u>	<u>15</u>	LDA 20	<u>?</u>
(4) MDR → A	<u>05</u>	<u>20</u>	<u>15</u>	LDA 20	<u>15</u>
(5) PC+1 → PC	<u>06</u>	<u>20</u>	<u>15</u>	LDA 20	<u>15</u>

### Assignment Two

\_BRZ\_ 1. The following sequence of steps in the instruction cycle  
 PC  $\rightarrow$  MAR  
 MDR  $\rightarrow$  IR  
 If A=0 Then IR [address]  $\rightarrow$  PC Else PC+1  $\rightarrow$  PC      What instruction does it represent? BRZ  
 The possibilities are: LDA, STO, SUB, ADD, IN, OUT, HLT, BR, BRP, and BRZ.

\_BRP\_ 2. The following sequence of steps in the instruction cycle  
 PC  $\rightarrow$  MAR  
 MDR  $\rightarrow$  IR  
 If A $\geq$ 0 Then IR [address]  $\rightarrow$  PC Else PC+1  $\rightarrow$  PC      What instruction does it represent? BRP

\_IN\_ 3. The following sequence of steps in the instruction cycle  
 PC  $\rightarrow$  MAR  
 MDR  $\rightarrow$  IR  
 In-basket  $\rightarrow$  A  
 PC + 1  $\rightarrow$  PC      What instruction does it represent? IN

\_ADD\_ 4. The following sequence of steps in the instruction cycle  
 PC  $\rightarrow$  MAR  
 MDR  $\rightarrow$  IR  
 IR [address]  $\rightarrow$  MAR  
 A + MDR  $\rightarrow$  A  
 PC+1  $\rightarrow$  PC      What instruction does it represent? ADD

\_BR\_ 5. The following sequence of steps in the instruction cycle  
 PC  $\rightarrow$  MAR  
 MDR  $\rightarrow$  IR  
 IR [address]  $\rightarrow$  PC      What instruction does it represent? BR

\_SUB\_ 6. The following sequence of steps in the instruction cycle  
 PC  $\rightarrow$  MAR  
 MDR  $\rightarrow$  IR  
 IR [address]  $\rightarrow$  MAR  
 A - MDR  $\rightarrow$  A  
 PC+1  $\rightarrow$  PC      What instruction does it represent? SUB

\_LDA\_ 7. The following sequence of steps in the instruction cycle:  
 PC  $\rightarrow$  MAR  
 MDR  $\rightarrow$  IR  
 IR [address]  $\rightarrow$  MAR  
 MDR  $\rightarrow$  A  
 PC+1  $\rightarrow$  PC      What instruction does it represent? LDA

\_HLT\_ 8. The following sequence of steps in the instruction cycle  
 PC  $\rightarrow$  MAR  
 MDR  $\rightarrow$  IR  
 PC  $\rightarrow$  0 or PC  $\rightarrow$  PC (remains the same)      What instruction does it represent? HLT

\_OUT\_ 9. The following sequence of steps in the instruction cycle  
 PC  $\rightarrow$  MAR  
 MDR  $\rightarrow$  IR  
 A  $\rightarrow$  Out-basket  
 PC + 1  $\rightarrow$  PC      What instruction does it represent? OUT

\_STO\_ 10. The following sequence of steps in the instruction cycle:  
 PC  $\rightarrow$  MAR  
 MDR  $\rightarrow$  IR  
 IR [address]  $\rightarrow$  MAR  
 A  $\rightarrow$  MDR  
 PC+1  $\rightarrow$  PC      What instruction does it represent? STO