

**“Computer Architecture”**

**LAB 5**

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BS-CS 4

Submitted to:

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**Task#1:**

Write a **detailed explanation** of how the Fetch-Decode-Execute cycle works.

**“Fetch-Decode-Execute Cycle”**

The Fetch-Decode-Execute (FDE) cycle is the basic event of CPU processing within a computer. It is, moreover, relatively obligatory to apprehend the grounding of how computers operate. A detailed explanation of the FDE cycle follows below:

**Fetch Cycle:**  
**1. Instruction Fetch:** The most recently born CPU goes to memory for a needed instruction. This very instruction was expressed and saved in a binary fashion for satisfactory digestion by the CPU.  
**2. Program Counter:** The value of the Program Counter is the memory address of the next instruction to be fetched by the CPU. It should be noted that technically the PC is used to reference just the instruction memory, but for simplicity, we imply the microprocessor high order address.  
**3. Instruction Register:** The content of the fetched instruction is placed in the Instruction Register; there, it is available until the time comes to decode it.

**Decode Cycle:**  
**1. Instruction Decode:** The CPU reads the instruction from the IR, decodes it, and figures out what to be done.  
**2. Opcode and Operand:** An instruction is broken into an opcode (operation) and an operand (data on which the operation is to be performed).  
**3. Control Signals:** After decoding the instructions, the CPU produces control signals to regulate the paths of data to be used by different units in the CPU.  
  
**Execute Cycle:**  
**1. Operand Fetch:** Necessary operands are fetched from anywhere between memory and up to registers by the CPU for executing the instruction.  
**2. Operation Execution:** The CPU executes the operation specified by the opcode upon the operands fetched.  
**3. Result Storage:** The result of the operation will be stored by the CPU either in the register or in memory.  
**4. PC Update:** Updating the PC to indicate where to find the following instruction in the sequence.

This FDE cycle is repeated continuously. The CPU fetches, decodes, and executes operations in a continuous manner. This is the basis for computer program execution.

**Task#2:**

Use a simple instruction as an example and describe each step.

**Instruction:** MOV A, B **Step 1: Fetch**The CPU fetches the MOV A, B from memory and stores it in IR.   
PC increments to the next instruction.

**Step 2: Decode**The Control Unit decodes the instruction as:   
Operation: MOV (Move Data)  
Source Register: B  
Destination Register: A

**Step 3: Execute**Transfers the value from Register B to Register A.  
This instruction is carried out and the cycle repeats itself.

**Task#3:**

Explain the role of **PC, AR, IR, AC and DR** in your own words.

1. **Program Counter (PC):**

The PC maintains track of the current instruction being carried out, much like a bookmark. It saves the memory location of the subsequent command that has to be retrieved.

1. **Address Register (AR):**

The memory address of the data that has to be accessed must be stored in the AR. It directs the CPU to the appropriate spot in memory, much like a map.

1. **Instruction Register (IR):**

The current instruction being executed is temporarily stored in the IR. The CPU decodes and interprets the instruction in a manner similar to a workspace.

1. **Accumulator Register (AC):**

The output of logical and arithmetic operations is stored in the AC register. Similar to a scratchpad, it is where the CPU does calculations and saves the results.

1. **Data Register (DR):**

The DR is a register that contains the information that is being transported or processed. It functions similarly to a temporary container that holds data while it is being moved or altered.

**Task#4:**

What is the function of the Arithmetic Logic Unit (ALU**)** in CPU operations?

How does ALU interact with registers and memory?

* **Arithmetic logic’s unit (ALU):**

The Arithmetic Logic Unit (ALU) is one of the most important parts of the CPU because it does almost all the computing and logical functions. Imagine it like the CPU’s mind, making all the additions and comparisons it needs to do in order for your machine to function.

* **Relationship between registers and memory:**

Memory and registers are aspects in the ALU’s sphere of activity.

1. Registers are like loose bits of bits that the CPU need to store temporarily. The ALU gets output from registers, and processes it, then puts the processed data back in registers. The ALU has the capability to put the data in memory and also take the data from memory.
2. Memory, in some sense, is used to keep some information for a longer period. Processed data as a result of its functions can also be fed back to memory.

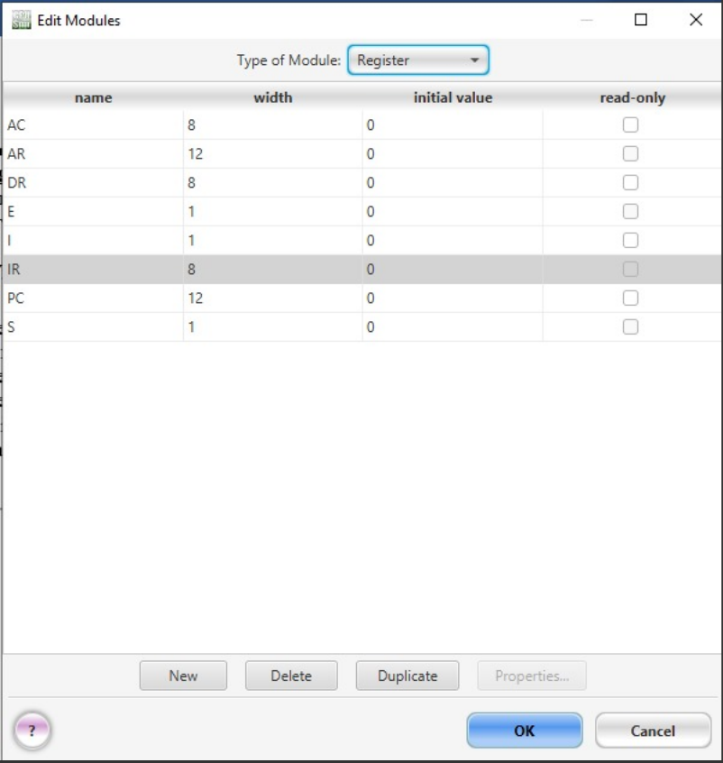
**Task#5:**

Create a new base machine and change the bit width of a register (e.g., make AC 8-bit instead of 16-bit)

**AC (16 to 8)**

**IR (16 to 8)**

**DR (16 to 8)**

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