**Hamna Qasim (55194)**

**Computer Architecture**

**Lab # 6**

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

The Fetch-Execute Cycle, also referred to as the Instruction Cycle, is a crucial process that enables a computer to retrieve and process instructions from memory. It starts with the fetch phase, where the Program Counter (PC) stores the address of the next instruction. This instruction is then loaded into the Instruction Register (IR), and the PC advances to the next address. During the decode phase, the Control Unit analyzes the instruction to determine which components, such as the Arithmetic Logic Unit (ALU) or registers, are required for execution. In the execute phase, the CPU performs the designated operation, which may include computations, data transfers, or memory interactions. The outcome is then either saved in a register, stored in memory, or directed to an output device. This cycle continuously repeats while the computer runs a program.

1. **Use a simple instruction as an example and describe each step.**
2. The computer looks at the Program Counter (PC) to find where the ADD A, B instruction is stored.
3. It takes the instruction from memory and puts it in the Instruction Register (IR).
4. The PC moves to the next instruction.
5. The Control Unit reads the instruction that states that it needs to add two numbers.
6. It finds the values stored in registers A and B.
7. The Arithmetic Logic Unit (ALU) adds the numbers from A and B.
8. The answer is stored back in register A.
9. The computer moves on to the next instruction and repeats the process.
10. **Explain the role of PC, AR, IR, AC and DR in your own words.**

Program Counter: The job of the program counter is to hold the address of the next instruction that needs to be decided and then executed.

Address Register: It stores the address of the instruction or data wherever it is located in the memory.

Instruction Register: IR stores the instruction that is being decoded and executed.

Accumulator: Accumulator Register holds the data whilst it is being calculated.

Data Register: It acts as a temporary storage to store the data that is moving between memory and CPU.

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

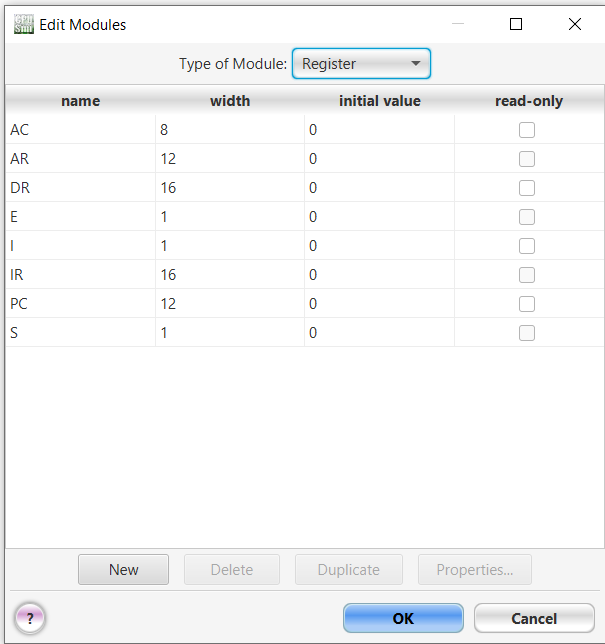
**How does ALU interact with registers and memory?**

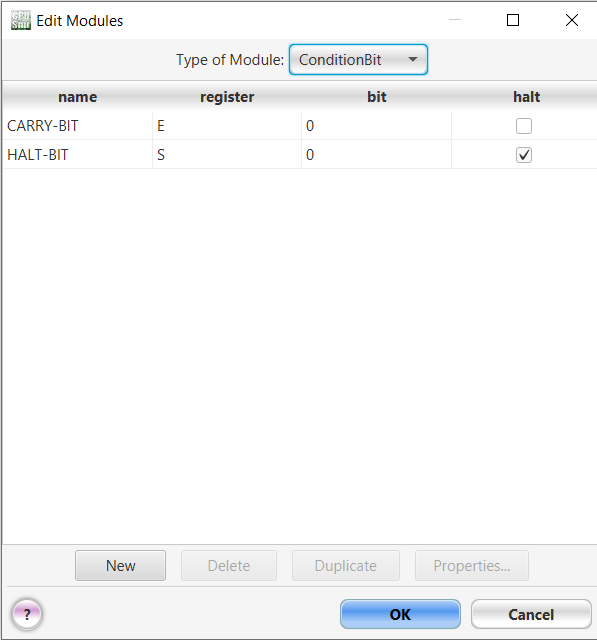
The Arithmetic Logic Unit (ALU) is the part of the CPU that does Arithmetic operations like addition, subtraction, multiplication and division and Logic operations like AND, OR, XOR, NOT and bitwise shifts.

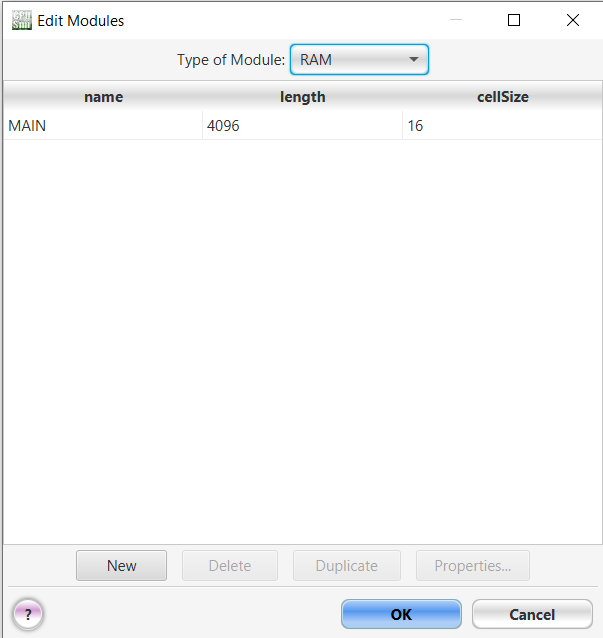
**ALU and its interaction with registers and memory:**

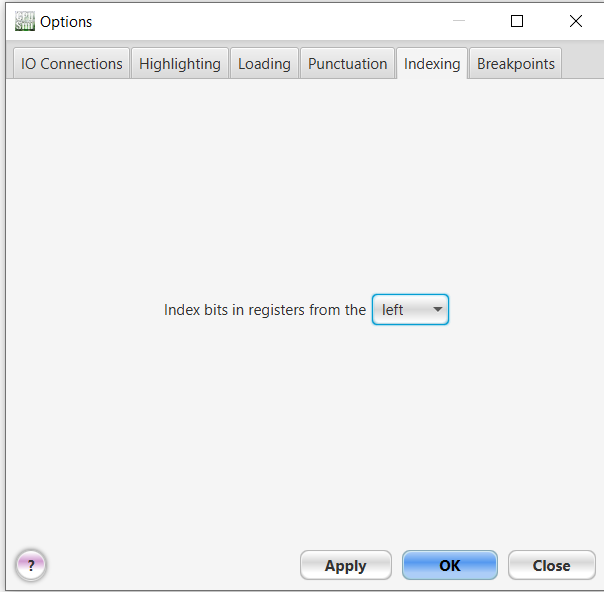
To carry out operations, the ALU receives input from general-purpose registers or registers like the Accumulator (AC). The ALU receives instructions from the Control Unit indicating what action to take. Following processing, the ALU either transmits the result to memory for later use or saves it back into a register (like AC). The ALU uses the Data Register (DR) to retrieve extra data from memory as needed. Status flags (such as zero and carry flags), which aid the CPU in making decisions for subsequent operations, can also be updated using the result. This interaction guarantees that the CPU's computations and decision-making procedures run smoothly.

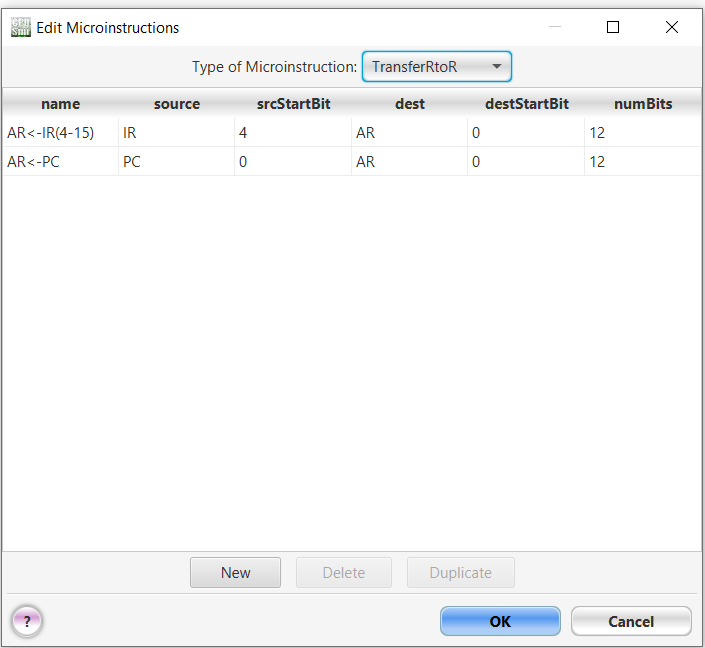
1. **Create a new base machine and change the bit width of a register (e.g., make AC 8-bit instead of 16-bit)**

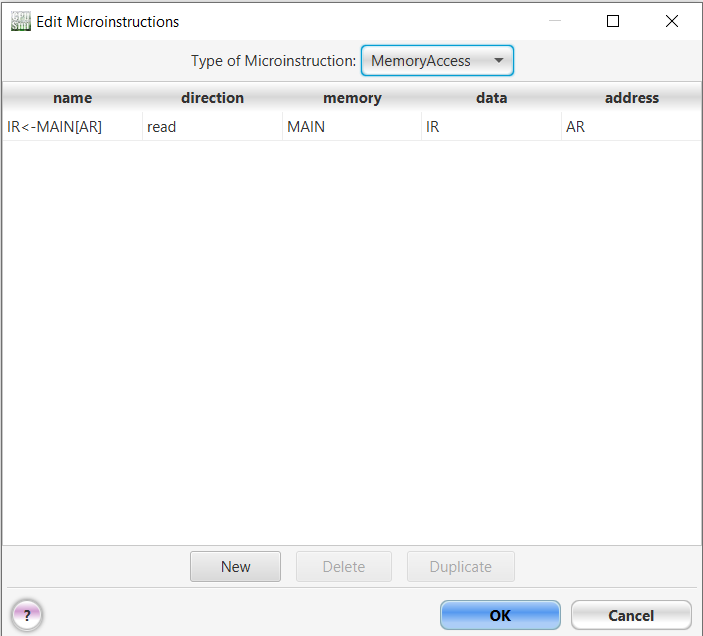


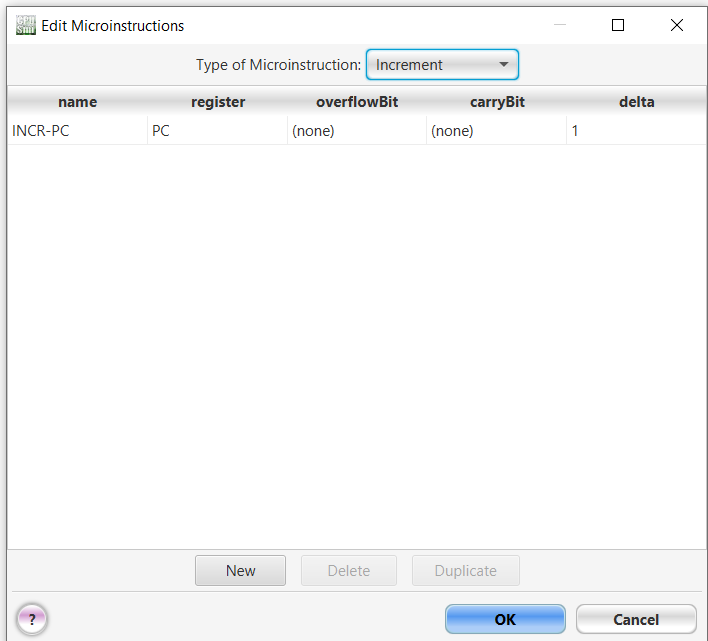


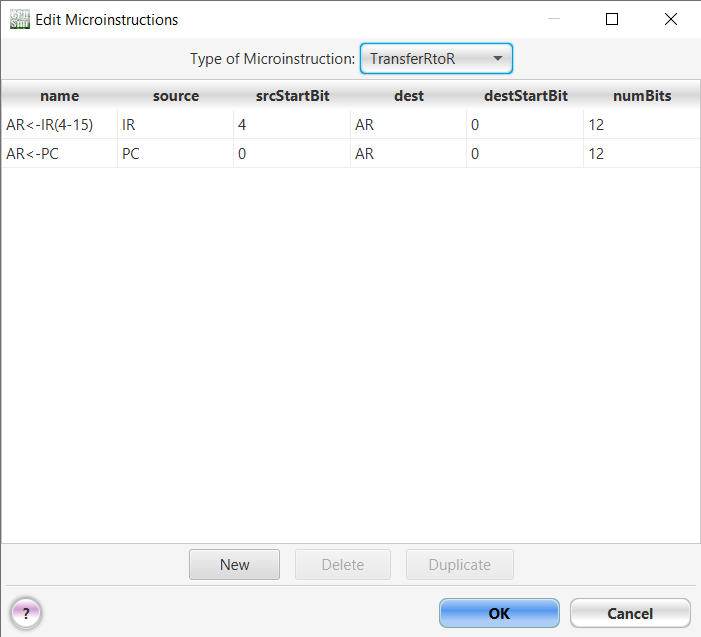


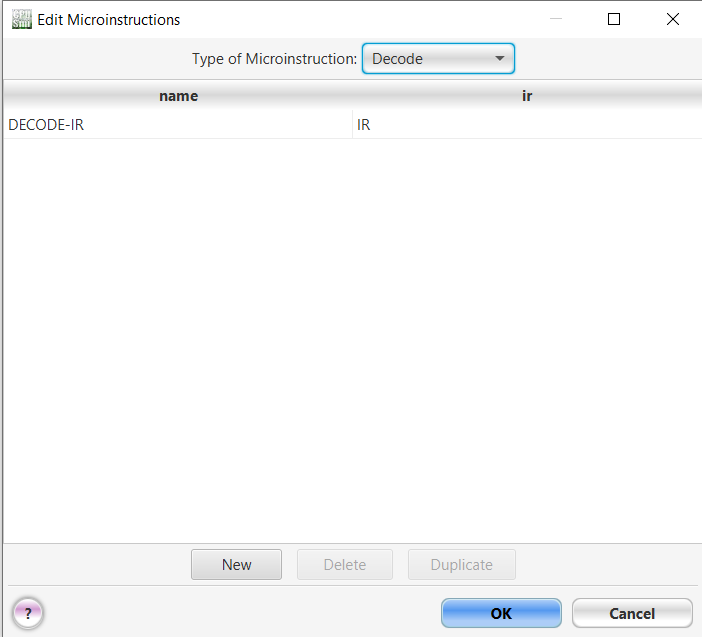


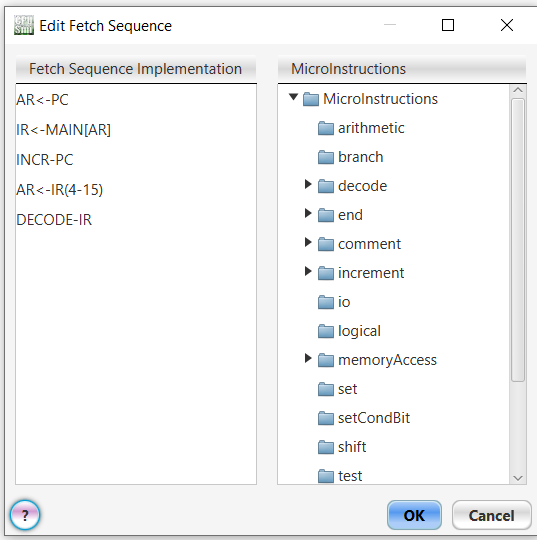


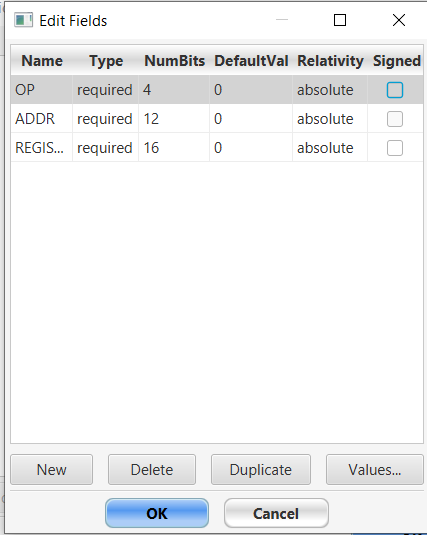










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