Microprocessors

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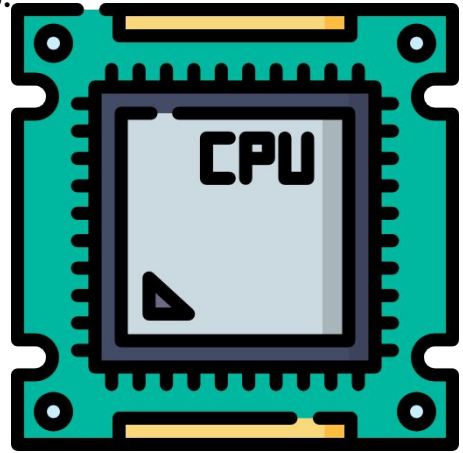
Outlines

- What is a microprocessor?
- Microprocessor internal components
- CPU registers
- Instruction cycle
- Pipelining

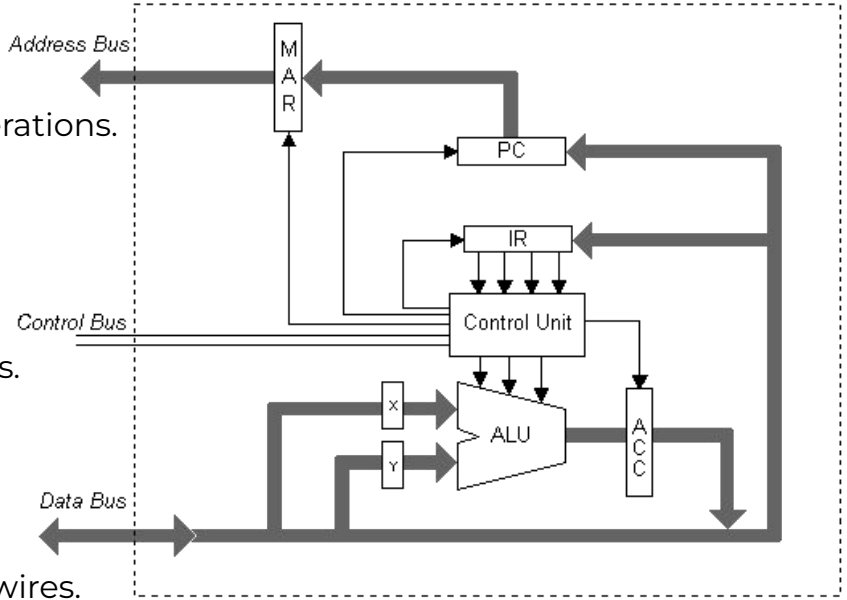
What is a microprocessor?

- A microprocessor is an Integrated Circuit unit in a computer system that performs **logical**, **arithmetic** and **controlling** operations.
- It is called also **C**entral **P**rocessing **U**nit.
- The CPU is the brain of any microcontroller.
- It executes all the instructions provided by a program.



Microprocessor internal components

- **Arithmetic and logic unit (ALU):**
  - It is responsible for all arithmetic and logical operations.
- **Registers**:
  - Are used to facilitate CPU operations.
- **Control Unit**:
  - It is responsible for controlling all CPU operations.
- **Interconnections**:
  - **Data bus**: data carrying wires.
  - **Address bus**: address carrying wires.
  - **Control bus**: read/write control signals carrying wires.

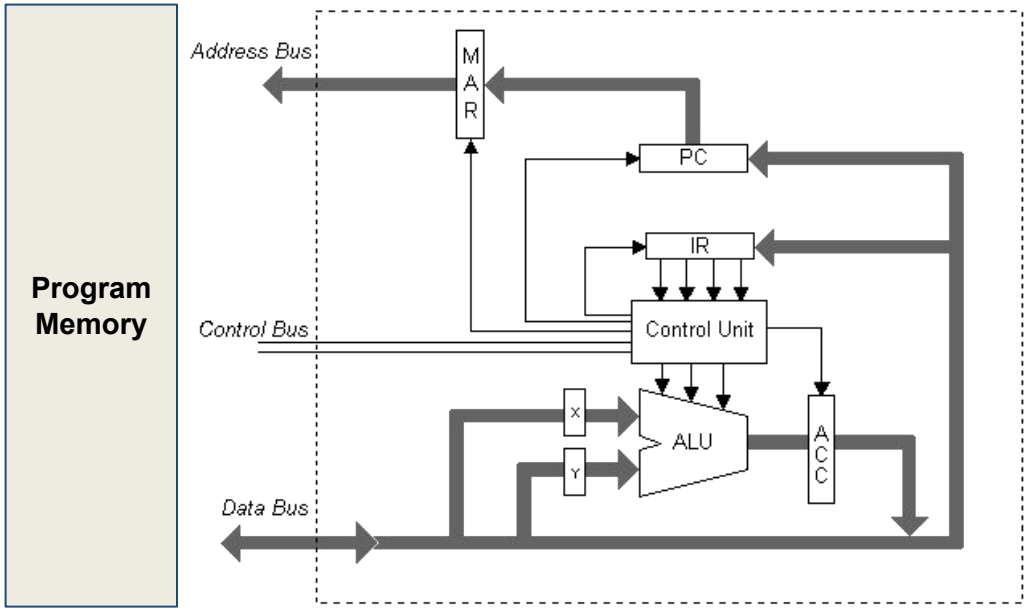


CPU registers

- Registers are the fastest types of memories.
- It is used to facilitate CPU operations.
- **General Purpose Registers**:
  - These are used for internal storage: at least 8 and as many as 32 and numbered as R1,...., Rn
- **Special Purpose Registers**:
  - **Status Register**: It contains information about the state of the processor.
  - **Program Counter**: It contains the memory address of the next instruction to be fetched.
  - **Accumulator**: This is the most frequently used register used to store data taken from memory.
  - **Instruction Register**: It holds the instruction which is just about to be executed.
  - **Memory Address Register and Memory Data Register**: These facilitates memory R/W operations.

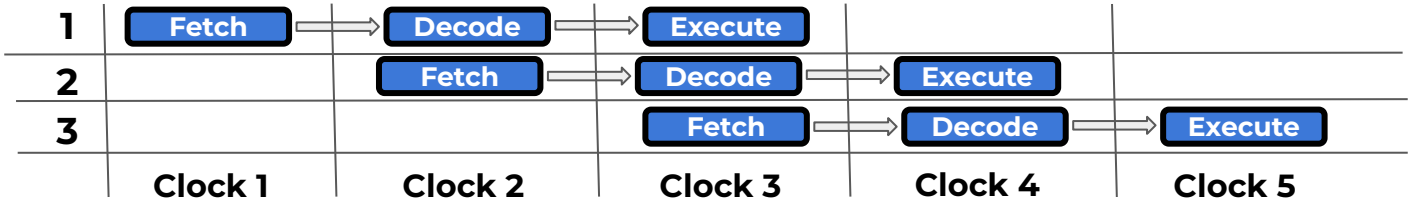
Instruction cycle

- **Fetch:**
  - PC points to the instruction to be executed
  - Get instruction Opcode from memory and store it into IR
- **Decode:**
  - Know what operation will be done
- **Execute:**
  - The ALU to execute the instruction



Pipelining

- If we supposed that fetch, decode, and execute take **1 clock cycle each**, then to perform **3 instructions we need 9 clock cycles**.
- Pipelining is a process of **arrangement of hardware** elements of the CPU such that its **overall performance is increased**.



Pipelining

- Pipelining hazards:
  - **Structural hazards**: It is a resource conflict situation when more than one instruction tries to access the same resource in the same cycle.
  - **Data hazards**: Instruction depends on result of prior instruction still in the pipeline
  - **Control hazards**: Caused by delay between the fetching of instructions and decisions about changes in control flow (branches and jumps).
- Solution to these hazards is by adding delays.

Summary

- You have learned what is a microprocessor
- You have learned CPU components
- You have learned the instruction cycle
- You have learned what is pipelining and its hazards.