

IFT 307

Computer Organization and Architecture

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Processing Unit Design

- ❑ The primary function of the CPU is to execute a set of instructions stored in the computer's memory.
- ❑ A simple CPU consists of a set of registers, an arithmetic logic unit (ALU), and a control unit (CU).

CPU BASICS

A typical CPU has three major components:

- (1) register set,
- (2) arithmetic logic unit (ALU), and
- (3) control unit (CU).

The register set differs from one computer architecture to another.

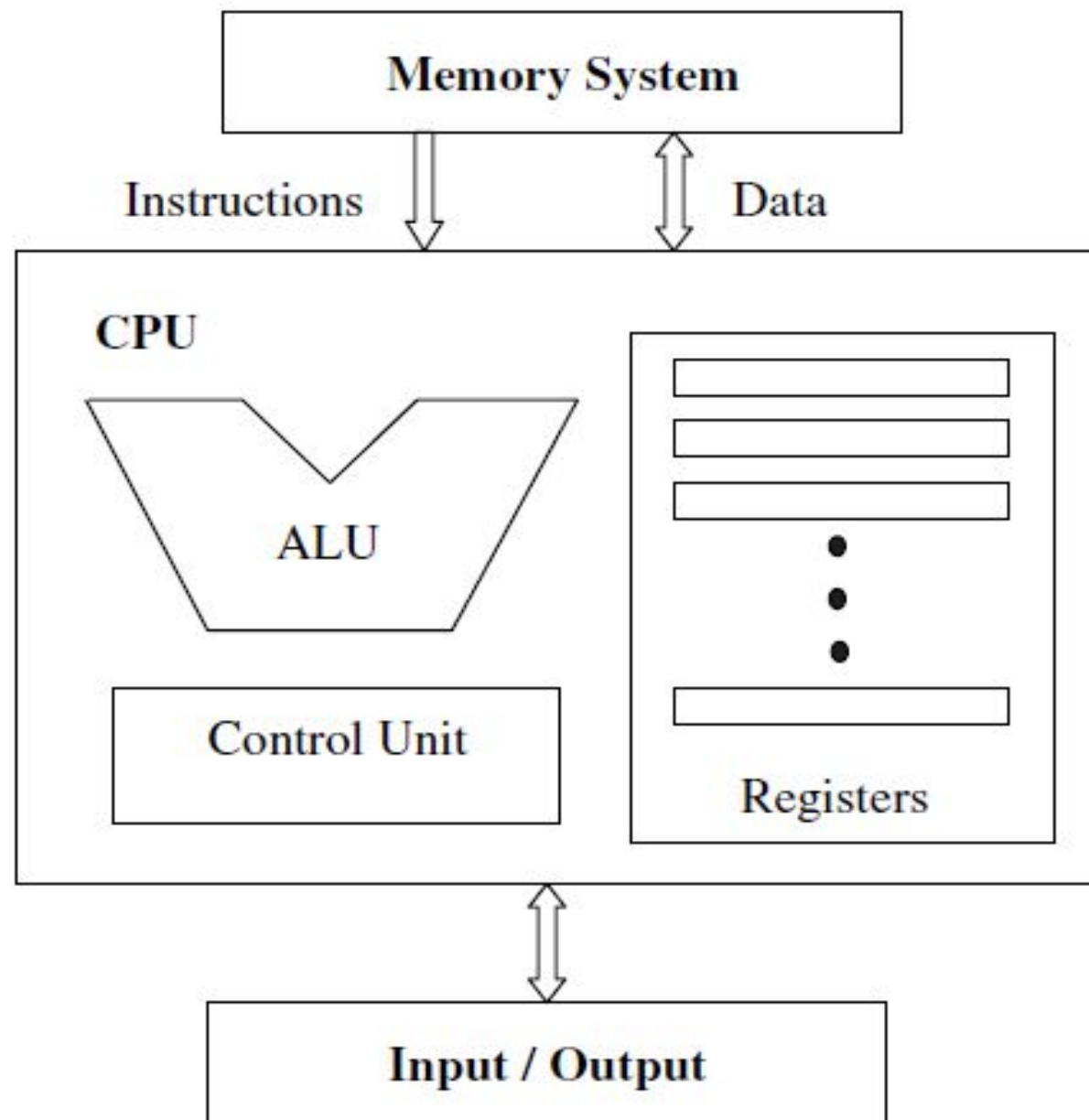
- ❑ It is usually a combination of general-purpose and special purpose registers.
- ❑ General-purpose registers are used for any purpose, hence the name general purpose. Special-purpose registers have specific functions within the CPU.

- ❑ For example, the **Program Counter (PC)** is a special-purpose register that is used to hold the address of the instruction to be executed next.
- ❑ Another example of special-purpose registers is the **Instruction Register (IR)**, which is used to hold the instruction that is currently executed.

- ❑ **The ALU** provides the circuitry needed to perform the arithmetic, logical and shift operations demanded of the instruction set.

The Control Unit is the entity responsible for fetching the instruction to be executed from the main memory and decoding and then executing it.

The CPU fetches instructions from memory, reads and writes data from and to memory, and transfers data from and to input/output devices.



Central processing unit main components and interactions with the memory and I/O

A typical and simple execution cycle
can be summarized as follows:

1. The next instruction to be executed, whose address is obtained from the PC, is fetched from the memory and stored in the IR.
2. The instruction is decoded.
3. Operands are fetched from the memory and stored in CPU registers, if needed.
4. The instruction is executed.
5. Results are transferred from CPU registers to the memory, if needed.

Register Set

❑ Memory Access Registers

– Two registers are essential in memory write and read operations:

- ✓ memory data register (MDR) and
- ✓ memory address register (MAR).

The MDR and MAR are used exclusively by the CPU and are not directly accessible to programmers.

- ❖ In order to perform a **write operation** into a specified memory location, the MDR and MAR are used as follows:

1. The word to be stored into the memory location is first loaded by the CPU into MDR
2. The address of the location into which the word is to be stored is loaded by the CPU into a MAR.
3. A signal, called write, is issued by the CPU indicating that the word stored in the MDR is to be stored in the memory location whose address is loaded in the MAR.

❖ Similarly, to perform a memory **read operation**, the MDR and MAR are used as follows:

1. The address of the location from which the word is to be read is loaded into the MAR.
2. A signal, called read, is issued by the CPU indicating that the word whose address is in the MAR is to be read into the MDR.
3. After some time, corresponding to the memory delay in reading the specified word, the required word will be loaded by the memory into the MDR ready for use by the CPU.

THANK

YOU