

CPU(central processing unit)

The computer does its primary work in a part of the machine we cannot see, a control center that converts data input to information output. This control center, called the central processing unit (CPU), is a highly complex, extensive set of electronic circuitry that executes stored program instructions. All computers, large and small, must have a central processing unit. The central processing unit consists of two parts:

1. The control unit
2. The arithmetic/logic unit.

Before we discuss the control unit and the arithmetic/logic unit in detail, we need to consider data storage and its relationship to the central processing unit

- Computers use two types of storage:
 1. Primary storage
 2. secondary storage.
- The CPU interacts closely with primary storage, or main memory, referring to it for both instructions and data.

- **1-1 Control Unit: CU**

- The control unit of the CPU contains circuitry that uses electrical signals to direct the entire computer system to carry out, or execute, stored program instructions. Like an orchestra leader, the control unit does not execute program instructions; rather, it directs other parts of the system to do so. The control unit must communicate with both the arithmetic/logic unit and memory.
- CU has a specific function
 1. Directs the computer system to execute stored program instructions
 2. Must communicate with memory and ALU
 3. Sends data and instructions from secondary storage to memory as needed

- **Arithmetic Logic Unit**

- The arithmetic/logic unit (ALU) contains the electronic circuitry that executes all arithmetic and logical operations.
- The arithmetic/logic unit can perform four kinds of arithmetic operations, or mathematical calculations: addition, subtraction, multiplication, and division.
- As its name implies, the arithmetic/logic unit also performs logical operations. A logical operation is usually a comparison. The unit can compare numbers, letters, or special characters. The computer can then take action based on the result of the comparison. This is a very important capability. Logical operations can test for three conditions:
 1. **Equal-to condition.**
 2. **Less-than condition.**
 3. **Greater-than condition.**

- **1-3 Registers**

- A, special, high-speed [storage](#) area within the [CPU](#). All [data](#) must be represented in a register before it can be processed, temporary storage
Located inside CPU.

- **1-4 Cache memories**

- A fast, subset of RAM, typically built into CPU chip
- Fast memory, much smaller in size than main memory, but a lot more than just a few registers.
- It is between CPU and memory
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the process of reading

- 1. Address taken from the central processing unit (control unit) and stored in the address register (MAR).
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- 2. The local control unit supervised the search for the word is specified address in Address register.
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- 3. When you find the word specific under the specified address is transferred to the word Register (MBR) and then transported to the processing unit

the process of writing

- 1. Address specifies the word to be registered where to put the address at Registered address(MAR).
- 2. The process of search for locations under the supervision the the local control.
- 3. Records the word at word Register (MBR) and after the locations determines the movement of the Registrar to the specified location

Relationship between CPU and memory

1. CPU cannot process data from disk or input device
 - It must first reside in memory
 - Control unit retrieves data from disk and moves it into memory
2. Items sent to ALU for processing
 - Control unit sends items to ALU, then sends back to memory after processing
 - Data and instructions held in memory until sent to an output or storage device or program is shut down

How the CPU Executes Program Instructions

- 1. fetch:** The *control unit fetches* (gets) the instruction from memory.
- 2. decode:** The *control unit decodes* the instruction (decides what it means) and directs that the necessary data be moved from memory to the arithmetic/logic unit. These *first two steps* together are called *instruction time, or I-time*.
- 3. execute:** The *arithmetic/logic unit executes* the arithmetic or logical instruction. That is, the ALU is given control and performs the actual operation on the data.
- 4. store:** The *arithmetic/logic unit stores* the result of this operation in memory or in a register. *Steps 3 and 4* together are called *execution time, or E-time*.

The Machine Cycle

1. The time required to retrieve, execute, and store an operation
2. Components
 - Fetch Instruction time
 - Execution time
3. System clock synchronizes operations

- - **Parallel Processing and Pipelining**

- ***Pipelining:*** A variation of traditional serial processing Feeds a new instruction into CPU at each step of the machine cycle

- a) Instruction 2 fetched when instruction 1 is being decoded, rather than waiting until cycle is complete.

1. Parallel Processing

- a) Control processor divides problem into parts

- ❖ Each part sent to separate processor
 - ❖ Each processor has its own memory
 - ❖ Control processor assembles results