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Central Processing Unit (CPU)

& Memory

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What is the CPU?

The Central Processing Unit (CPU) is often referred to as the "**brain of the computer**". It carries out the instructions of a computer program by performing basic arithmetic, logical, control, and input/output operations.

The CPU is responsible for:

- Fetching instructions from memory
- Decoding them
- Executing commands

This process is known as the fetch-decode-execute cycle.

What is the CPU?

Main Functions of the CPU

The CPU performs four primary operations:

- Fetch – Collect instructions from the memory.
- Decode – Interpret the instructions.
- Execute – Carry out the instruction.
- Store – Write back the result to memory if necessary.

Main Components of the CPU

The CPU consists of three key parts:

a. Arithmetic Logic Unit (**ALU**)

b. Control Unit (**CU**)

c. Registers

Main Components of the CPU

a. Arithmetic Logic Unit (ALU)

- Performs mathematical operations: addition, subtraction, multiplication, division.
- Performs logical operations: AND, OR, NOT, comparisons (greater than, less than).

Main Components of the CPU

b. Control Unit (CU)

- Directs the flow of data between the CPU and other devices.
- Tells the ALU, memory, and input/output devices how to respond to instructions.

Main Components of the CPU

c. Registers

- Small, fast memory units inside the CPU.
- Temporarily hold data and instructions currently being processed.
- Common registers: Accumulator, Program Counter, Instruction Register.

CPU Clock and Speed

- The CPU clock determines how many instructions the CPU can process per second.
- Clock speed is measured in gigahertz (GHz).

  1 GHz = 1 billion cycles per second.

- A higher clock speed usually means a faster processor, but efficiency also depends on architecture.

Cores and Multicore Processors

- **Single-core processor**: One processing unit.
- **Multi-core processor**: Two or more processing units (cores) on a single chip.
- **Common core configurations**: Dual-core, Quad-core, Hexa-core, Octa-core.

More cores mean better multitasking and performance for modern applications.

Types of CPUs

a. **CISC (Complex Instruction Set Computer)**

More complex instructions.

Examples: Intel x86 processors.

a. **RISC (Reduced Instruction Set Computer)**

Simpler, faster instructions.

Examples: ARM processors (used in smartphones).

Cache Memory

1. Small, high-speed memory located inside or very close to the CPU.
2. Stores frequently used data and instructions to reduce access time.

Levels:L1 Cache: Closest to the core, fastest but smallest.

L2 Cache: Slightly slower but larger.

L3 Cache: Shared among cores, larger but slower than L1/L2.

Factors Affecting CPU Performance

- CPUs connect to the motherboard via a CPU socket.
- Different CPUs require compatible sockets

  (e.g., LGA 1200 for Intel, AM5 for AMD).

- Important to match CPU with motherboard type.

Common CPU Manufacturers

- **Intel** – Known for Core i3, i5, i7, i9 series.
- **AMD** – Known for Ryzen and EPYC series.
- **Apple** – M1, M2 chips (based on ARM architecture).
- **Qualcomm** – Snapdragon processors for mobile devices.

Computer Memory

Memory is one of the core components of a computer system. It stores data and instructions that the CPU needs to execute tasks.

Without memory, a computer would not be able to store data temporarily or permanently.

This lecture will explore the types, hierarchy, and functions of computer memory.

Definition of Memory

Computer memory refers to the physical devices used to store data or programs.

Definition of Memory

Importance of Memory

- Enables fast access to data for the CPU.
- Stores both instructions and data during processing.
- Affects the overall performance of the system.
- Provides both volatile and non-volatile storage options.

Types of Computer Memory

- A. Primary Memory (Main Memory)

- B. Secondary Memory (Storage Devices)

A. Primary Memory (Main Memory)

Primary memory is directly accessible by the CPU. It is usually volatile, meaning it loses its data when the power is turned off.

- RAM (Random Access Memory)
- ROM (Read Only Memory)

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- RAM (Random Access Memory)
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RAM (Random Access Memory)

Temporary memory that stores data and instructions currently in use.
Volatile in nature.
Two main types:

- **DRAM** (Dynamic RAM) – needs to be refreshed continuously.
- **SRAM** (Static RAM) – faster and more expensive, doesn’t need refreshing.

ROM (Read Only Memory)

Permanent memory that stores critical data needed to boot up the computer (BIOS).
Non-volatile in nature.
Types include:

- PROM (Programmable ROM)
- EPROM (Erasable Programmable ROM)
- EEPROM (Electrically Erasable Programmable ROM)

Secondary Memory (Storage Devices)

Although this is often classified separately from memory, it's essential in the memory hierarchy.

- Non-volatile and used for permanent storage.
- Examples include Hard Disk Drives (HDD), Solid State Drives (SSD), USB flash drives, CDs, DVDs.

THANKS