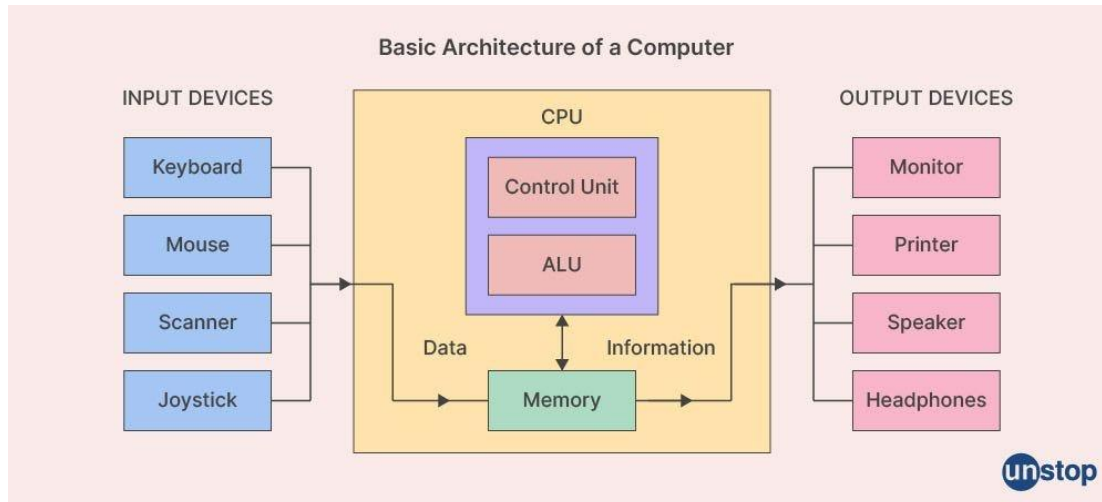# Computer Architecture

Computer architecture refers to the design, structure, and organization of a computer's main components. It focuses on how hardware components interact to process data efficiently.

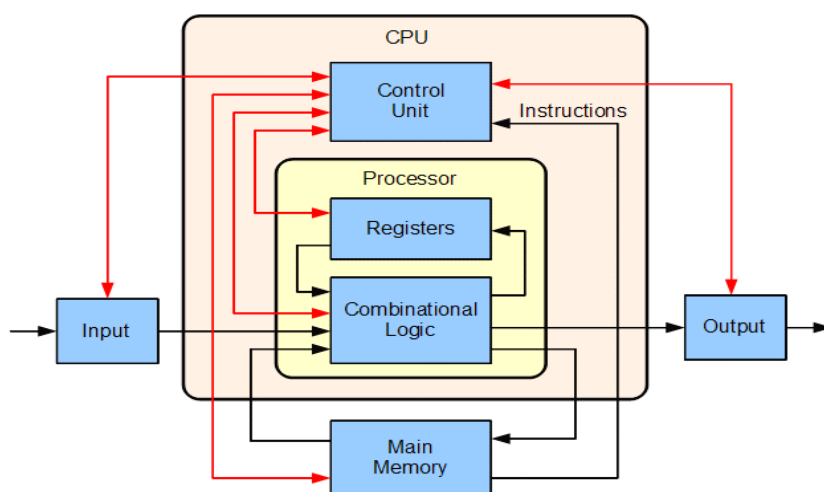Basic Architecture of a Computer

The key elements include:

- CPU (Central Processing Unit)
- Cores
- RAM (Random Access Memory)
- Cache Memory

These components work together to execute **instructions, run applications, and** manage overall system performance.

CPU (Central Processing Unit)

The CPU is the brain of the computer. Its main job is to:

- Fetch instructions

- Decode them
- Execute them
- Store the results.

Main Components of CPU

1. **ALU (Arithmetic Logic Unit):** Performs mathematical and logical operations.
2. **CU (Control Unit):** Manages instruction execution and controls data flow.
3. **Registers:** Small, high-speed storage units inside the CPU.

CPU Performance Factors

- Clock Speed (GHz) – how many cycles per second the CPU can execute.
- Number of Cores – more cores = better multitasking.
- Cache Memory – speeds up data access.
- Architecture (x86, ARM, etc.)

CPU Cores

A core is an independent processing unit inside a CPU.
Older CPUs had one core → handled one task at a time.
Modern CPUs have multiple cores → can process many tasks parallelly.
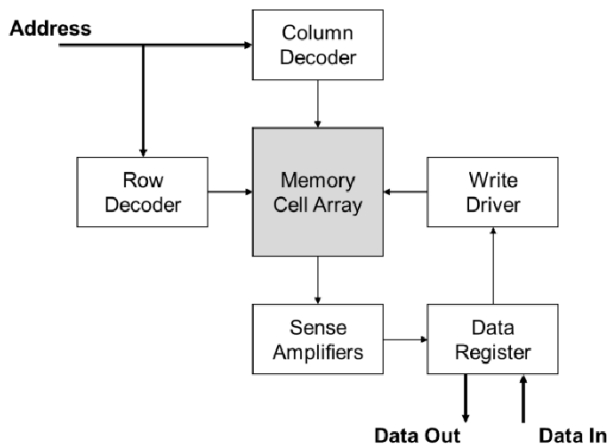
Types of Cores

- Single-Core – rare now; slow for multitasking.
- Dual-Core – 2 cores; basic multitasking.
- Quad-Core – 4 cores; common for laptops.
- Octa-Core (8 cores) – high performance systems.
- Big.Little Architecture (mobile) – combines high-power + power-efficient cores.

Benefits of multi-core CPUs

- Faster processing
- Improved performance for games better multitasking
- and heavy applications
- Less heat vs increasing clock speed alone

RAM (Random Access Memory)

RAM is your system's short-term memory. It stores data and instructions actively being used by the CPU.
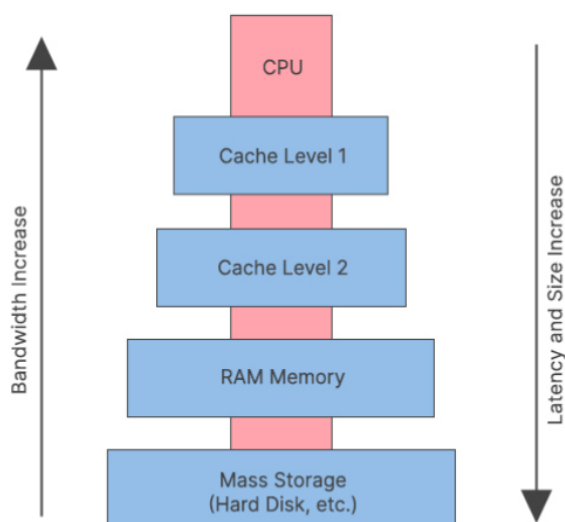
Why RAM is important

- More RAM = more applications open at once
- Reduces lag
- Helps CPU access data faster than from storage (SSD/HDD)

Types of RAM

- DRAM (Dynamic RAM) – used in main memory
- SRAM (Static RAM) – used in cache memory
- DDR3, DDR4, DDR5 – generations of RAM (DDR5 is the fastest)

Cache Memory

Cache is a very fast memory located inside or extremely close to the CPU.
It stores frequently used instructions and data.

Example: Cache stores website images and files so the website opens faster next time.

Why Cache is Needed

CPU is very fast → RAM is slower.
Cache reduces this speed gap by keeping important data close to the CPU, improving performance.