Introduction to Computer system Organization

1. Introduction to computer System

A **computer** is an electronic device that can be programmed to accept data (input), process it and generate result (output). A computer along with additional hardware and software together is called a **computer system**.

A **computer system** primarily comprises a central processing unit (CPU), memory, input/output devices and storage devices.

A computer system comes in various forms and sizes. It can vary from a high-end server to personal desktop, laptop, tablet computer, or a smartphone.

Figure 1 shows the block diagram of a computer system. The directed lines represent the flow of data and signal between the components.

1.1 Central Processing Unit (CPU)

It is the electronic circuitry of a computer that carries out the actual processing and usually referred as the brain of the computer. It is commonly called processor also. Physically, a CPU can be placed on one or more microchips called integrated circuits (IC). The ICs comprise semiconductor materials.

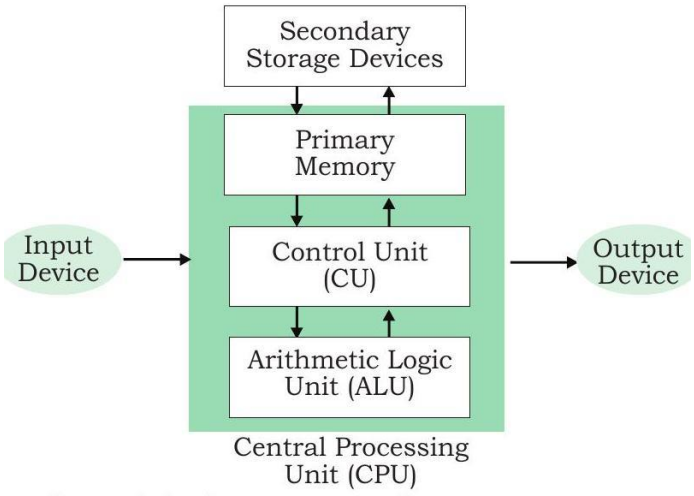

Figure 1: Components of a Computer System

The CPU is given instructions and data through programs. The CPU then fetches the program and data from the memory and performs arithmetic and logic operations as per the given instructions and stores the result back to memory. While processing, the CPU stores the data as well as instructions in its local memory called registers.

Registers are part of the CPU chip and they are limited in size and number. Different registers are used for storing data, instructions or intermediate results.

Other than the registers, the CPU has two main components: Arithmetic Logic Unit (ALU) and Control Unit (CU). **ALU** performs all the arithmetic and logic operations that need to be done as per the instruction in a program. **CU** controls sequential instruction execution. CPU is also popularly known as microprocessor.

1.2. Input Devices

The devices through which control signals are sent to a computer are termed as input devices. These devices convert the input data into a digital form that is acceptable by the computer system. Some examples of input devices include keyboard, mouse, scanner, touch screen, etc., as shown in Figure 1.2

Figure 2: Input devices

1.3. Output Devices

The device that receives data from a computer system for display, physical production, etc., is called output device. It converts digital information into human understandable form. For example, monitor, projector, headphone, speaker, printer, etc. Some output devices are shown in Figure 1.3.

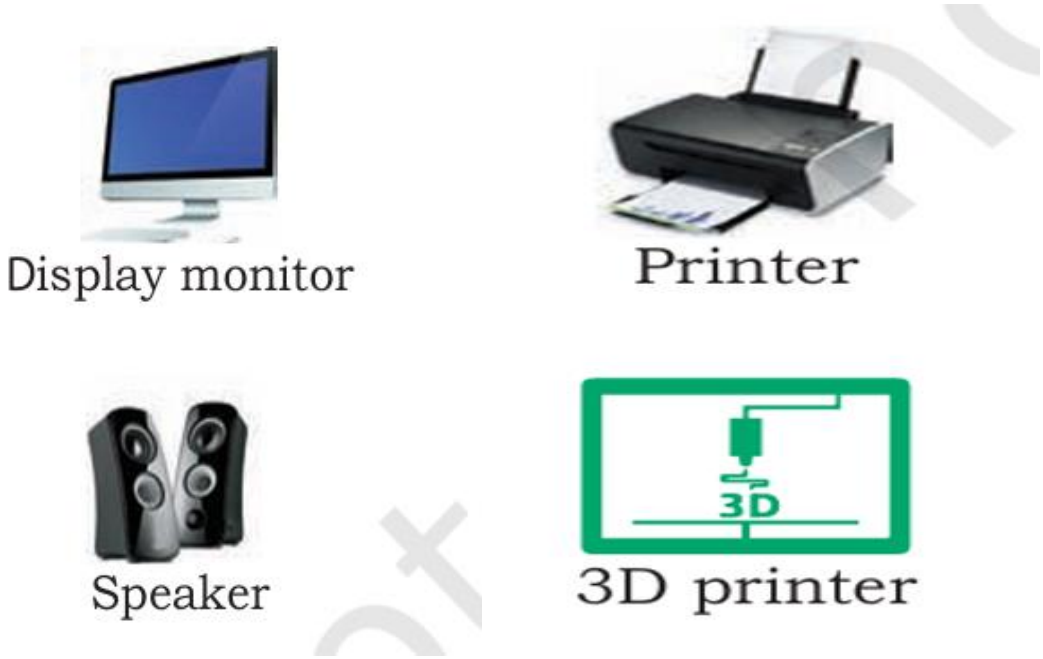

Figure 3: Output devices

1.4. Memory Unit

Memory devices are digital systems that store data either temporarily or for a long term. There are two types of Memory:

Primary memory is fast but limited in capacity and volatile, used for temporary data storage.

Secondary memory is slower but offers much larger, permanent storage for long-term data retention.

2. Computer Architecture

computer architecture refers to the design and basic structure of a computer system, including its hardware structures, their interconnections, and the principles that guide their organization. It encompasses the higher-level aspects of computer design, such as the instruction set architecture (ISA), memory hierarchy, and the organization of the central processing unit (CPU). Computer architecture sets the foundation for building efficient, reliable, and high-performance computer systems.

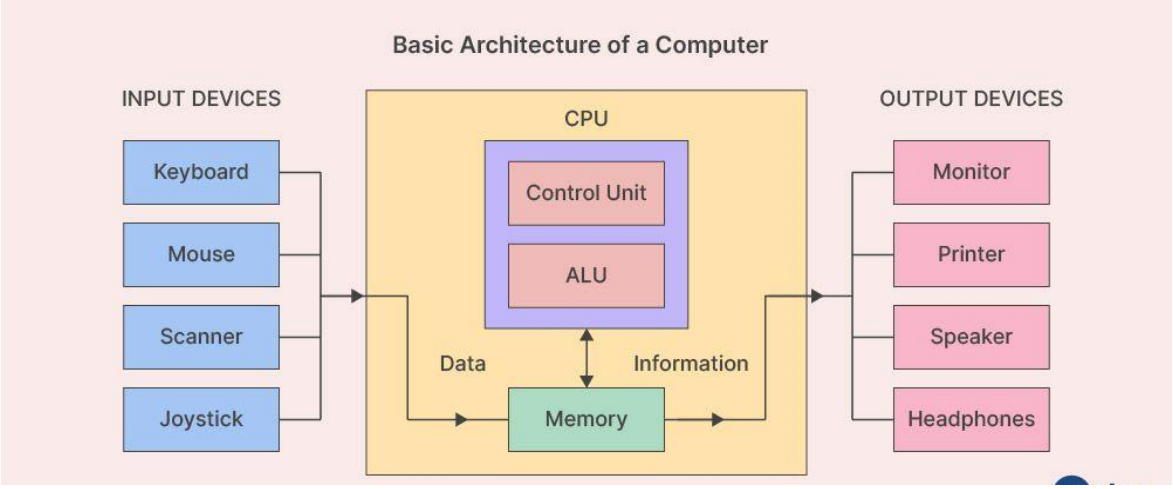

Figure 4: Basic Architecture of Computer

The following 3 main categories are considered while considering the design of architecture:

- System Design (contains hardware components that are used for building the system)
- Instruction Set Architecture (includes all the instructions provided to the computer system)
- Micro Architecture (give detail about storage element) Computer architecture plays a critical role in determining the overall performance, power efficiency, and scalability of a computer system.

3. Computer Organization

Computer organization refers to the way the various components of a computer system are interconnected and work together to perform tasks and execute programs. It encompasses the design and arrangement of hardware components, **including** the central processing unit (CPU), memory, input/output devices, and control units, to ensure efficient and effective operation of the computer.

Computer organization **deals** with the physical components of a computer. Computer organization includes the physical connection component, like circuits with adder subtractor. If we talk about CPU organization, its three types are:

- Single Accumulator Organization: a single accumulator is used to hold the intermediate results of arithmetic and logical operations.
- General Register Organization: multiple general-purpose registers are available for storing both operands and results.
- Stack Organization: A stack-based CPU organization uses a stack data structure (LIFO: Last In, First Out) to hold operands.

4. Difference between Computer Architecture and Computer Organization

Computer Architecture	Computer Organization
Computer Architecture is concerned with the way hardware components are connected to form a computer system.	Computer organization is concerned with the structure and behavior of the computer system as seen by the user.

Designing a computer system, architecture is decided first.	Computer organization is decided after the architecture.
It involves logical components	It involves physical units
Computer architecture deals with high-level design issues.	Computer organization deals with low-level design issues.