



Al-Mustaqbal University
College of Sciences
Artificial Intelligence



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قسم الذكاء الاصطناعي

Lecture: (1)

Introduction to computer architecture, Computer definition, History of computer Application with computer system

Subject: COMPUTER ORGANIZATION AND LOGIC DESIGN

Class: Second

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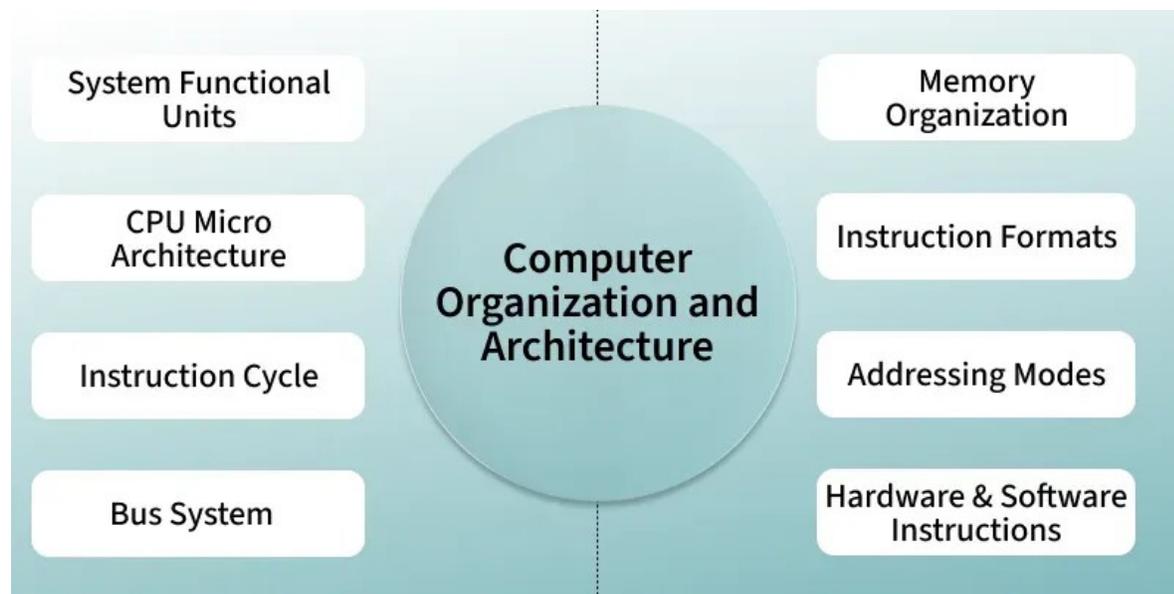


Introduction to computer architecture, Computer definition, History of computer Application with computer system

Computer architecture defines how a computer's components communicate through electronic signals to perform input, processing, and output operations.

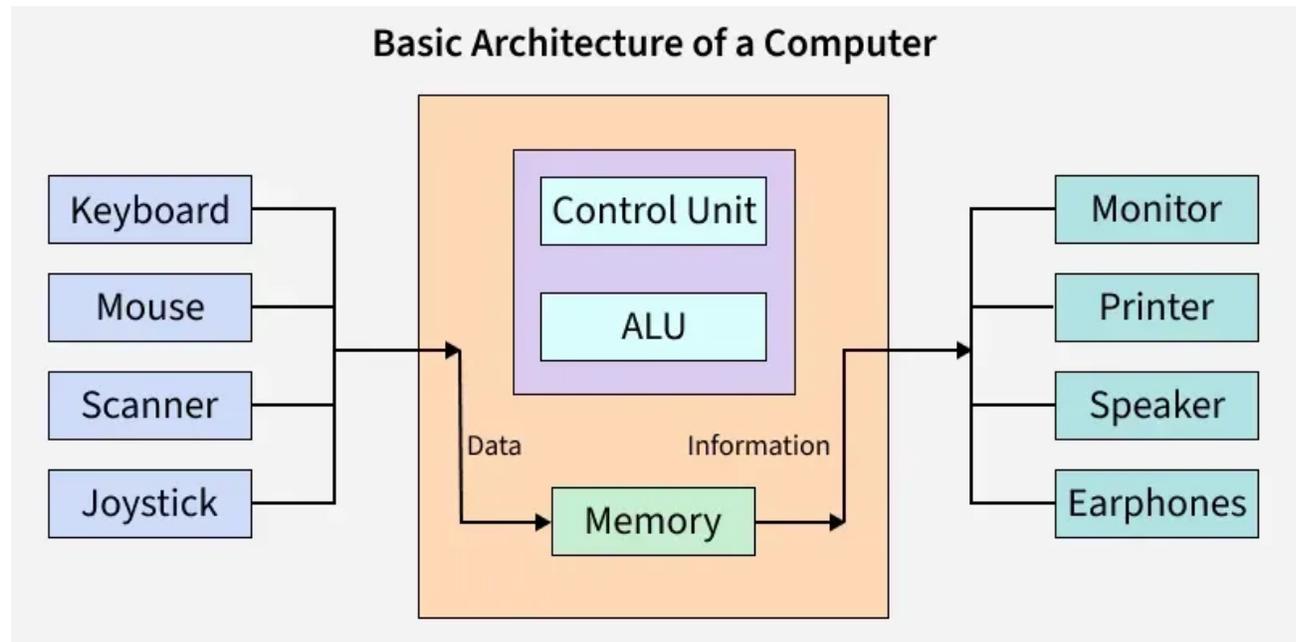
- It covers the design and organization of the CPU, memory, storage, and input/output devices.
- Describes how these components interact through buses, control signals, and data pathways.
- It directly influences the overall speed, functionality, and reliability of a computer system.

Computers have become one of the most essential technologies in modern life. They are used in almost every field including education, healthcare, engineering, business, communication, and scientific research. Understanding how computers work internally is very important for students in computer science, information technology, and engineering disciplines.

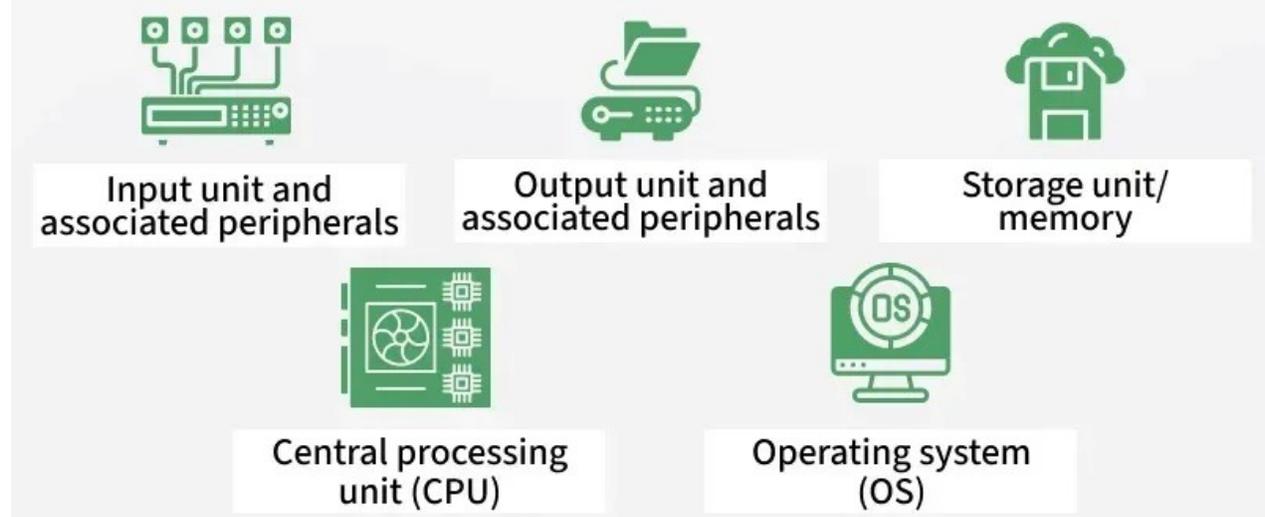




Computer architecture is the field that studies the design, structure, and organization of computer systems. It focuses on how hardware components interact with each other and how software communicates with the hardware to perform computational tasks.



Components of Computer Architecture





Computer architecture refers to the conceptual design and fundamental structure of a computer system. It defines how the hardware components are organized and how they interact with each other to execute instructions.

Computer architecture includes:

- Instruction set design
- Memory organization
- Processor design
- Input/output systems
- Data pathways

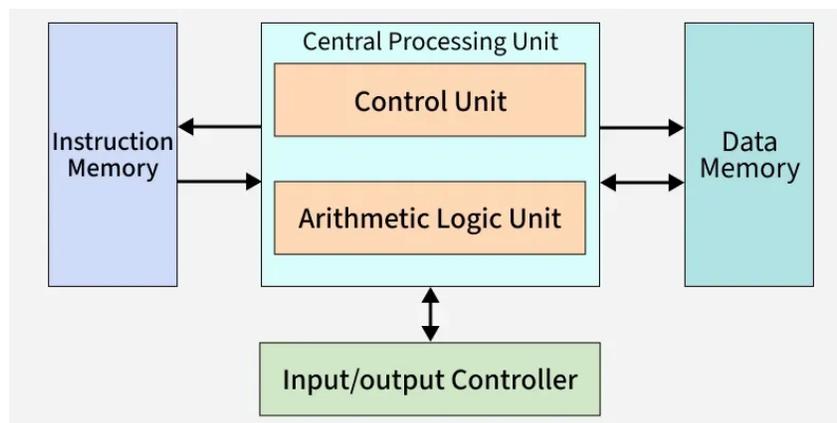
One of the most widely used models in computer architecture is the **Von Neumann architecture**.

Von Neumann Architecture

The Von Neumann model divides a computer system into five basic components:

1. Input Unit
2. Output Unit
3. Memory Unit
4. Control Unit
5. Arithmetic Logic Unit

In this architecture, both data and program instructions are stored in the same memory.





What is a Computer?

A computer is an electronic device that processes data according to instructions provided by software programs. It takes input (data), processes it using a central processing unit (CPU), stores information, and produces output (results) to perform various tasks.

Basic Characteristics of a Computer

Computers have several key characteristics that make them powerful tools:

1. **Speed**
Computers can process millions or billions of instructions per second.
2. **Accuracy**
If the instructions are correct, computers produce highly accurate results.
3. **Automation**
Once a program is started, the computer performs tasks automatically without human intervention.
4. **Storage**
Computers can store large amounts of data and retrieve it quickly when needed.
5. **Versatility**
Computers can perform many different tasks such as calculations, communication, graphics processing, and data analysis.

Types of Computers

Computers can be categorized in various ways based on size, processing power, functionality, and other parameters. Here's an overview of the different types:

1. Types of Computers Based on Size

- **Microcomputers:** Microcomputers are meant for individual use. They are small, compact and very small. For example smartphones and desktops.



- **Minicomputers:** They are used in businesses that are mid-sized and are more powerful than microcomputers. Servers are an example of minicomputers.
- **Mainframe computers:** These are used by large organizations. They help in the processing of bulk data.
- **Supercomputers:** These are extremely powerful computers that help in carrying out complex calculations. They aren't meant for personal use and are often used for research purposes.

2. Types of Computers Based on Processing Power

- **Personal computers (PCs):** These are the most common type of computer and are designed for personal use. PCs include desktops, laptops, and tablets.
- **Servers:** Servers are designed to manage and distribute resources and data to multiple users or devices. They are often used in businesses or organizations to store and share data and run applications.
- **Mainframes:** Mainframe computers are large, powerful machines that are designed to handle massive amounts of data and perform complex operations. They are often used in large corporations or government agencies.
- **Supercomputers:** Supercomputers are extremely powerful computers that are designed to process data at extremely high speeds. They are often used for scientific research and other specialized applications.
- **Embedded systems:** Embedded systems are small computers that are built into other devices, such as appliances, cars, and medical devices. They are designed to perform specific functions and operate without human intervention.
- **Wearable computers:** Wearable computers are small, portable devices that are worn on the body, such as smartwatches or fitness trackers. They are designed to track data and provide information on the go.



3. Types of Computers Based on Functionality

- **Analog computers:** In analog computers data is stored using continuous physical quantities. A mechanical integrator is an example of an analogue computer.
- **Digital computers:** These are the most common types of computers found in the market today. Data is processed in digital computers using discrete values. Smartphone is a common example of digital computers.
- **Hybrid computers:** These are a combination of both analogue and digital computers. Examples include complex medical equipment.

Components of a Computer System

A computer system consists of two main components: **hardware** and **software**.

Hardware

Hardware refers to the physical components of a computer system.

Examples include:

- Central Processing Unit (CPU)
- Memory (RAM)
- Hard disk or SSD
- Keyboard and mouse
- Monitor
- Motherboard
- Network devices

Central Processing Unit (CPU)

The CPU is often called the **brain of the computer**. It performs arithmetic and logical operations and controls all other components.

The CPU consists of three main parts:



1. **Control Unit (CU)**
Directs the operation of the processor.
2. **Arithmetic Logic Unit (ALU)**
Performs mathematical and logical operations.
3. **Registers**
Small memory locations used for fast data access.

Computer Generations (Definitions with Examples)

1. First Generation (1940–1956) – Vacuum Tubes

The first generation of computers used vacuum tubes for processing and magnetic drums for memory. These computers were very large, consumed a lot of electricity, and produced a lot of heat.

Example: ENIAC

2. Second Generation (1956–1963) – Transistors

In the second generation, transistors replaced vacuum tubes. This made computers smaller, faster, more reliable, and more energy-efficient. Programming languages such as assembly and early high-level languages began to be used.

Example: IBM 1401

3. Third Generation (1964–1971) – Integrated Circuits (ICs)

The third generation introduced integrated circuits, which combined multiple electronic components on a single chip. This significantly improved speed and reduced the size and cost of computers.

Example: IBM System/360

4. Fourth Generation (1971–Present) – Microprocessors

This generation introduced microprocessors, where the entire CPU is placed on a single chip. It led to the development of personal computers, laptops, and many modern digital devices. Example: IBM Personal Computer (IBM PC)

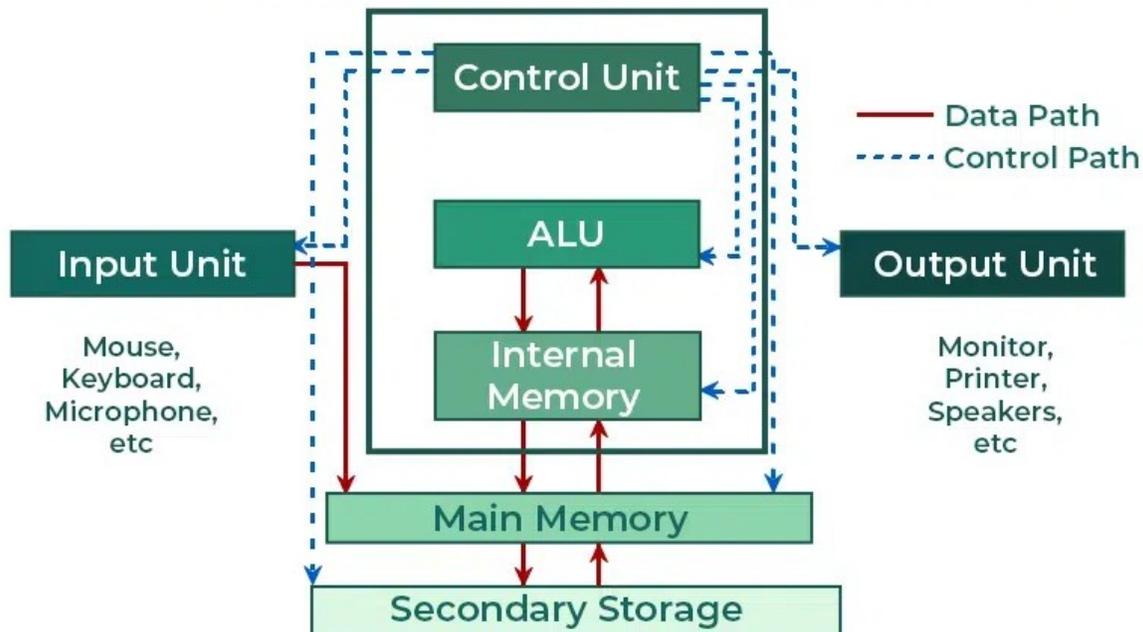
5. Fifth Generation (Present and Future) – Artificial Intelligence (AI)

The fifth generation focuses on artificial intelligence technologies such as machine learning, natural language processing, and advanced robotics. These computers aim to simulate human intelligence and solve complex problems.

Example: IBM Watson



Components of computer



Component	Description
<u>Central Processing Unit (CPU)</u>	The CPU often referred to as the "brain" of the computer. It's responsible for executing instructions, performing calculations, and handling tasks that ensure the system runs efficiently. The CPU processes input data and transforms it into useful information. It consists of the Arithmetic Logic Unit (ALU) and Control Unit (CU) .
<u>Motherboard</u>	The main circuit board connects and allows communication between all computer components.
<u>Memory (RAM)</u>	Random Access Memory (RAM) stores data temporarily for quick access while the computer is running.
<u>Storage</u>	Includes Hard Disk Drives (HDD) and Solid-State Drives (SSD) that store data permanently.
<u>Input Devices</u>	Devices are used to input data into the computer. Examples: keyboard, mouse, scanner.
<u>Output Devices</u>	Devices that display or output the results of the computer's processing. Examples: printer, speakers.



Software

Software is the collection of programs and instructions that tell the computer what to do.

Software is divided into two main types:

System Software

System software manages the hardware and provides a platform for applications.

Examples include:

- Operating systems (Windows, Linux, macOS)
- Device drivers
- System utilities

Application Software

Application software refers to computer programs that are designed to help users perform specific tasks or activities. Unlike system software, which manages the computer hardware and basic system operations, application software focuses on providing tools that allow users to complete practical tasks such as writing documents, analyzing data, creating graphics, or communicating online.

Application software works on top of the operating system and uses the computer's hardware resources through the operating system. These programs are usually user-friendly and designed with graphical interfaces so that users can easily interact with them.

Characteristics of Application Software

Application software has several important characteristics:

- It is designed to perform **specific user-oriented tasks**.
- It runs **on top of the operating system**.
- It usually provides a **graphical user interface (GUI)**.
- It helps increase **productivity and efficiency** in different fields.



- It can be **general-purpose or specialized** depending on the user's needs.

Types of Application Software

1. Word Processing Software

Word processing applications are used to create, edit, format, and print text documents such as letters, reports, and research papers.

Example: Microsoft Word

2. Spreadsheet Software

Spreadsheet applications are used for performing calculations, organizing data in tables, and creating charts and graphs. They are widely used in finance, accounting, and data analysis.

Example: Microsoft Excel

3. Presentation Software

Presentation software is used to create visual presentations with slides that may include text, images, charts, and multimedia elements.

Example: Microsoft PowerPoint

4. Database Management Software

Database applications help users store, manage, and retrieve large amounts of structured data efficiently.

Example: Microsoft Access

5. Web Browsers

Web browsers allow users to access and navigate websites on the internet.

Example: Google Chrome

6. Graphic and Design Software

These applications are used to create and edit images, illustrations, and visual designs.

Example: Adobe Photoshop

Importance of Application Software

Application software plays a critical role in modern computing because it allows users to perform daily tasks efficiently. It is widely used in education, business,



healthcare, engineering, communication, and entertainment. Without application software, computers would not be very useful for solving real-world problems.

Application software continues to evolve with advances in technology such as cloud computing, artificial intelligence, and mobile platforms, making it more powerful and accessible to users around the world.

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