INTRODUCTION TO COMPUTER FUNDAMENTALS

Lecture 1

AL-Zahraa College of Medicine

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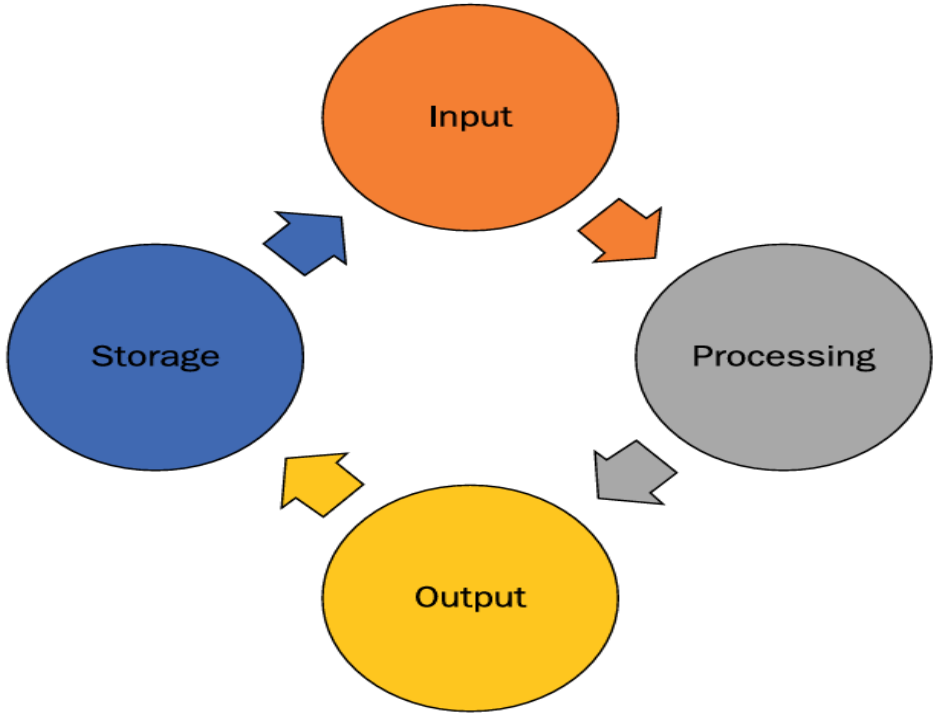
Objectives

By the end of this lecture, students should be able to:

- Define what a computer is and explain the four operations of the information processing cycle.
- Differentiate between computer hardware and software, and identify examples of each.
- Identify the basic hardware components of a computer
- Distinguish between data (raw facts) and information (processed, meaningful data), using a medical example.
- Categorize different types of peripheral devices as Input, Output, or Input/Output devices.

What is computer?

A computer is an electronic device that receives **input**, performs **processing**, according to a set of instructions, produces results (**output**), and **stores** these results for future reference. It performs four basic operations known as the **information processing cycle**.



- Computers are made up of hardware and software.
  - Hardware refers to the physical components of a computer, such as the motherboard, CPU, RAM, storage devices, and input/output devices.
  - Software refers to the programs and instructions that tell the computer what to do.

Hardware is tangible, while software is intangible;

hardware needs software to function,

and software requires hardware to execute.

Categories of Software

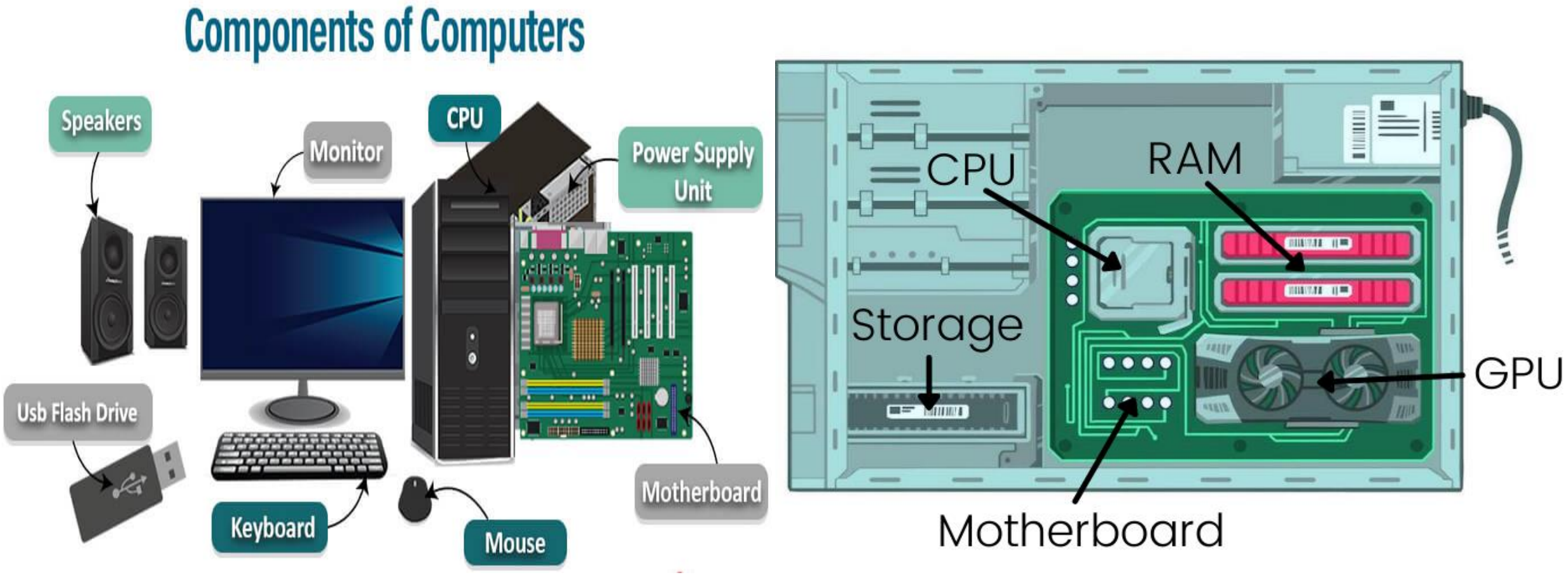
- **System Software:** is designed to manage the hardware and provide a platform for running application software. It acts as an intermediary between the computer hardware and the user.

  Examples: operating systems like Windows, macOS, Linux and Android.

Categories of Software

- **Application Software:** Application software is designed to perform specific tasks or solve particular problems for the user. It relies on system software to function. **Examples:** Microsoft Word, Excel, PowerPoint, Google Chrome, Video games and medical software.
- **Utility Software:** supports system operation (e.g., antivirus programs, file compression tools).

Basic Components of a Computer



Basic Components of a Computer

❑ The basic components of a computer include:

- Motherboard: This is the main circuit board of the computer. It connects all of the other components of the computer together.
- CPU (Central Processing Unit): This is the brain of the computer. It is responsible for processing all of the instructions that are given to the computer.
- RAM (Random Access Memory): This is the computer's short-term memory. It stores the data that the computer is currently using.
- ROM (Read-Only Memory): It's a type of memory that stores data permanently, even when the computer is turned off. Unlike RAM, which is volatile and loses its data when the system is powered down, ROM retains its information.

Basic Components of a Computer

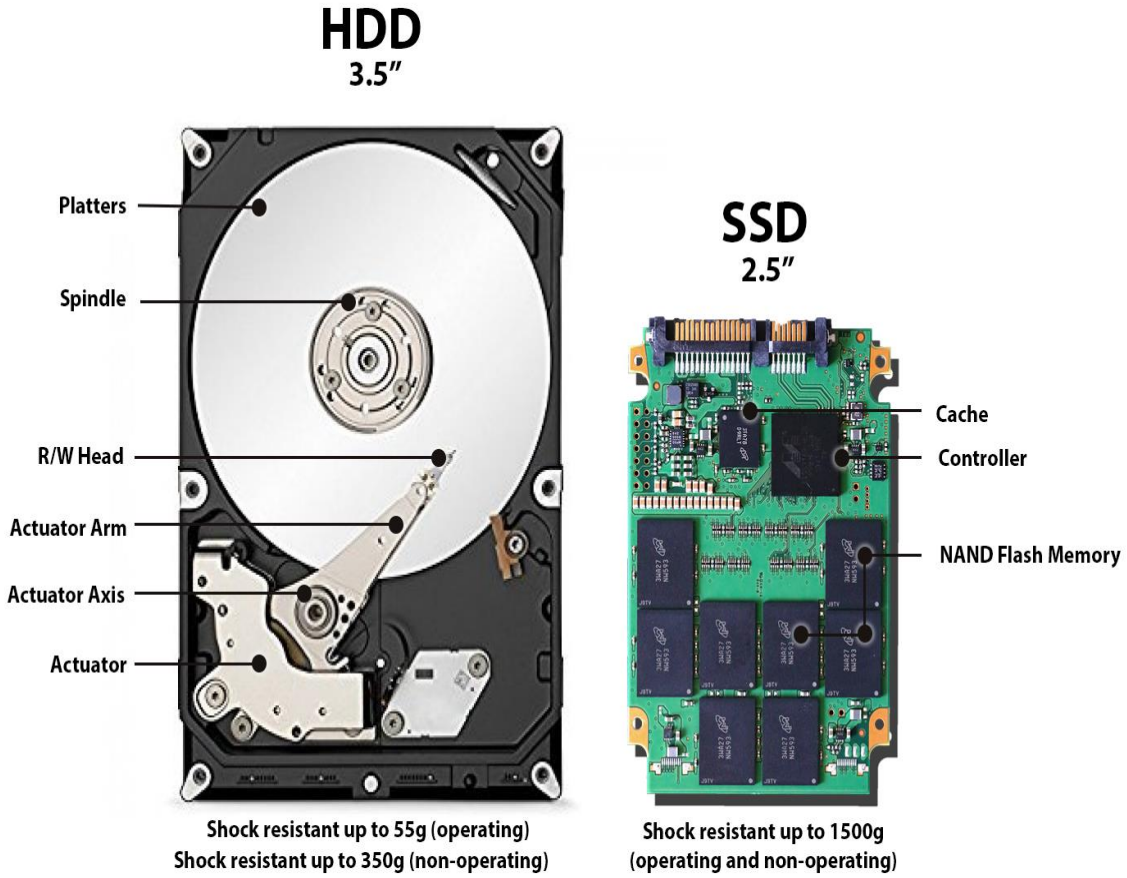
- Power Supply Unit (PSU): The PSU converts electricity from the outlet (AC) into the type of power the computer components can use (DC). It is the heart of the system that pumps power to every component.

- GPU (Graphics Processing Unit):The GPU is a special processor designed to handle graphics-related tasks. It processes images, videos, animations, and anything displayed on the screen. Modern GPUs are also used for AI, machine learning, and 3D rendering because they can perform many calculations in parallel.

- Cooling System: Computers generate heat especially the CPU and GPU.The cooling system prevents overheating to keep the computer running safely and efficiently/
  - **Two main types**:
    - Air cooling fans move hot air out
    - Liquid cooling uses coolant to absorb heat

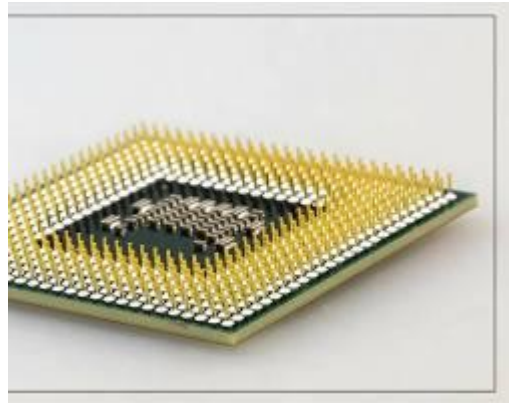
Basic Components of a Computer

- Data Storage:
  - Hard Disk Drives (HDDs): Traditional magnetic storage, slower than SSDs but more affordable with larger capacities.
  - Solid State Drives (SSDs): Flash-based storage offering faster speeds and durability than HDDs, but generally more expensive per GB.
- Input/Output Devices: Such as keyboards, monitors, and printers that let you interact with the computer.



Processors (CPUs) and their types

- There are many different types of processors, each with its own strengths and weaknesses. Some of the most common types of processors include:
  - Intel processors
  - AMD processors
  - ARM processors



Intel processors

- **Intel** is one of the most popular manufacturers of processors. Intel processors (CPUs) are central processing units made by Intel that perform calculations, run programs, and control all computer operations:
  - Intel Core i3: Budget processors for basic tasks, light gaming, and office work with fewer cores and threads.
  - Intel Core i5: Mid-range processors suitable for gaming, multitasking, and productivity tasks with a balance of performance and price.
  - Intel Core i7: High-performance processors, suitable for demanding applications like gaming, video editing, and design work, used for heavy multitasking.

Intel processors

- Intel Core i9: Top-tier consumer processors, very high performance for professionals and power users. Needed for 3D rendering, machine learning, advanced gaming.

AMD processors

- AMD (Advanced Micro Devices) is another popular manufacturer of processors. AMD processors are known for their affordability and performance. Some of the most popular AMD processors include:

- **AMD Ryzen**

- **Ryzen 3/5/7/9:** Competes directly with Intel's Core i3/i5/i7/i9 for desktops and laptops. Known for offering high core and thread counts, excellent multi-threading performance, and strong value.
- **Ryzen Threadripper:** A high-end desktop (HEDT) platform for enthusiasts, content creators, and workstation users.

ARM processors

- ARM (Advanced RISC Machine) processors are a type of processor that is designed for low-power devices. ARM processors are often used in mobile devices, such as smartphones and tablets. Some of the most popular ARM processors include:

- Apple A-series processors
- Qualcomm Snapdragon processors
- Samsung Exynos processors

Concept of Computing, Data, and Information

- The **concept of computing** refers to the fundamental ideas, processes, and technologies that allow computers to receive data, process it, store it, and produce useful output.
- It explains **how computers work, how we interact with them**, and **how they solve problems**.
- Computing combines **hardware, software, data,** and **people** working together to perform tasks efficiently and accurately.

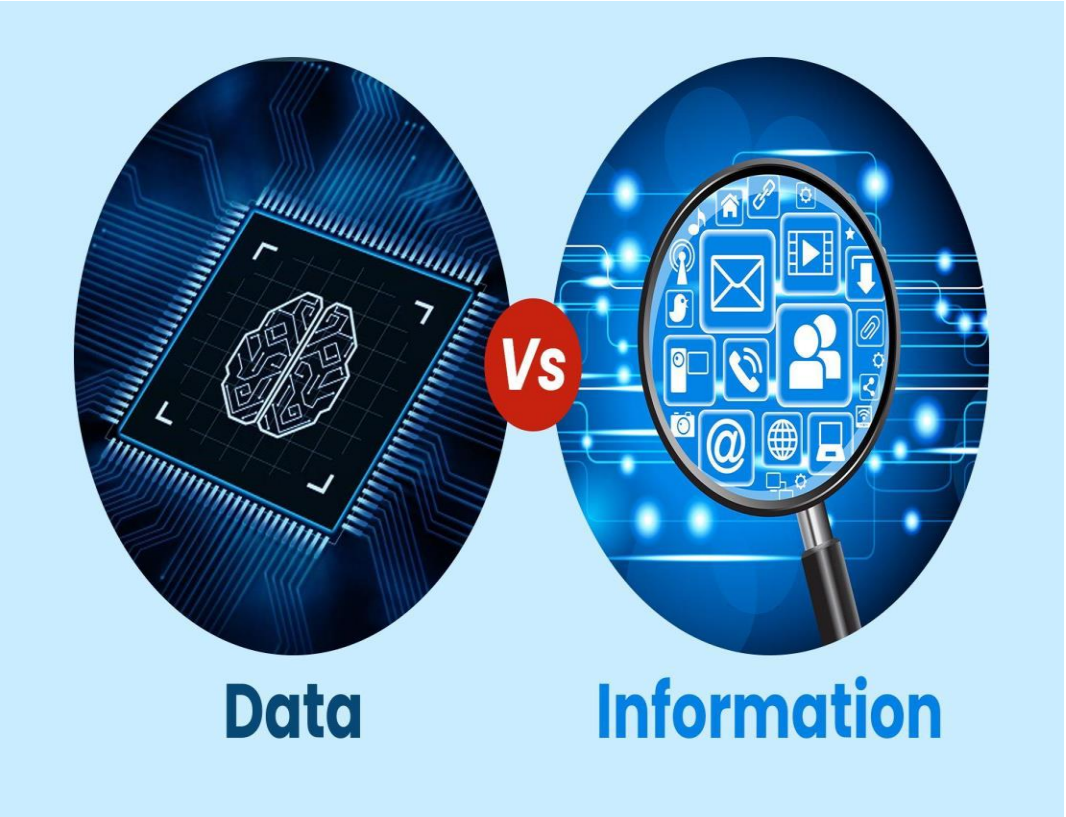
Concept of Computing, Data, and Information

- **In the medical field**, computing plays a critical role in enhancing patient care, diagnostics, and research. Here are some examples:
- **MRI and CT Scans:** Computers process raw scan data from MRI (Magnetic Resonance Imaging) or CT (Computed Tomography) machines to generate detailed images of the body's internal structures. This helps doctors diagnose conditions like tumors, fractures, and vascular diseases.
- **Image Analysis:** Advanced computing algorithms, including machine learning, can analyze medical images to detect abnormalities, such as early signs of cancer or brain disorders, that might be difficult for the human eye to spot.

Concept of Computing, Data, and Information

- Data: is the raw, unorganized facts (e.g., figures, text, or images heart rate, blood pressure reading).

- Information: Processed data that is organized and meaningful, aiding decision-making in various contexts.



Concept of Computing, Data, and Information

1. Heart Rate (**Data:** 72 beats per minute)
   - Information: "The patient's heart rate is within a normal range for adults (60-100 bpm), indicating stable cardiac function at this time.

2. Temperature Measurement (**Data:** 98.6°F)
   - Information: The patient's temperature is within the typical range, indicating no current fever or infection.

Data representations

- Computers can only understand **two states** — ON and OFF.

Therefore, they represent all data using **binary digits (bits)**:

- **1** = ON (electric current present)
- **0** = OFF (no current)

- All letters, numbers, images, and sounds are ultimately represented as sequences of **0s and 1s**.
- **A bit is a single binary digit, with either a 1 (on) or 0 (off) value.**
- **Eight bits** can combine to make a byte, which is an 8-digit binary number.

Data representations

Table: Common Quantities of Bytes

Unit	Symbol	Size
Bit	B	Smallest unit (0 or 1)
Byte	B	8 bits
Kilobyte	KB	1,024 bytes
Megabyte	MB	1,024 KB
Gigabyte	GB	1,024 MB
Terabyte	TB	1,024 GB
Petabyte	PB	1,024 TB

Numbering systems

❑ Numbering systems

- Computers use several numbering systems to represent and process data.

Number System	Base	Digits Used	Example
Binary	2	0, 1	1011
Decimal	10	0–9	57
Octal	8	0–7	47
Hexadecimal	16	0–9, A–F	9F

Decimal 13 = Binary **1101**

Decimal 255 = Hexadecimal **FF**

Peripherals Devices in Computer

- **Peripheral devices** are external devices connected to a computer to input, output, or store data.
- They are not part of the core computer system (CPU, RAM, motherboard) but enhance its functionality.

Categories of Peripheral Devices

Peripherals are most commonly grouped into three categories based on their primary function: **Input**, **Output**, and **Input/Output (Storage)**.

1. Input Devices

These devices allow the user to send data, commands, or information **into** the computer.

- **Keyboard:** The primary device for inputting text and commands.
- **Mouse / Trackpad:** A pointing device that controls the cursor on the screen.
- **Microphone:** Captures audio input for communication, recording, or voice commands.
- **Webcam / Camera:** Captures digital images and video.
- **Scanner:** Digitizes physical documents or photos into a digital format.
- **Game Controller / Joystick:** Provides input for gaming and simulations.
- **Barcode / QR Scanner:** Reads barcodes or QR codes to input data quickly.

Categories of Peripheral Devices

2. Output Devices

These devices receive data **from** the computer and present it to the user in a human-perceivable form.

- **Monitor / Display:** The primary output device, showing a visual interface.
- **Printer:** Produces a physical hard copy of digital documents and images.
- **Speakers / Headphones:** Output audio, such as music, system sounds, and voice.
- **Projector:** Projects the computer's display onto a large screen or wall.

Categories of Peripheral Devices

3. Input/Output (I/O) & Storage Devices

These devices can both send and receive data from the computer. They are often used for storage and data transfer.

- **External Hard Drive (HDD/SSD):** Provides additional storage space for backups and files.
- **USB Flash Drive:** A portable storage device for transferring files between computers.
- **Optical Disc Drive (CD/DVD/Blu-ray):** Can read data from discs (input) and write data to them (output).
- **Network Interface Card (NIC):** Allows the computer to connect to a network (like the internet), both receiving and sending data.
- **Memory Card Reader:** Reads and writes data to memory cards from cameras, phones, etc.

How Do Peripherals Connect?

- Peripherals connect to the computer through various ports and wireless technologies:

- **USB (Universal Serial Bus):** The most common standard for connecting a vast range of devices (keyboards, mice, printers, external drives).
- **HDMI (High-Definition Multimedia Interface), DisplayPort, VGA:** Primarily used to connect monitors and projectors.
- **3.5mm Audio Jack:** For connecting headphones, microphones, and speakers.
- **Ethernet (RJ-45):** A wired connection for networking.

How Do Peripherals Connect?

- **Thunderbolt:** A high-speed interface (common on modern Macs and PCs) that combines data transfer, video output, and power delivery. It often uses a USB-C connector.
- **Wireless Connections:**
  - **Bluetooth:** For short-range connections with devices like wireless mice, keyboards, headphones, and speakers.
  - **Wi-Fi:** For wirelessly connecting to a network.

Summary

- This lecture covered computer fundamentals. A computer is an electronic device that follows the input-processing-output-storage cycle, using physical **hardware** (like the CPU, RAM, and storage) and non-physical **software** (system and application programs).

- It explained how raw **data** is processed into meaningful **information**, represented internally in binary.

- The lecture also categorized **peripheral devices** as input, output, or storage devices that expand a computer's functionality.

End-of-Session Questions

1. A patient's blood test results show a glucose level of 95 mg/dL. Is this an example of **Data** or **Information**? What additional context would be needed to transform it into the other?
2. What is the primary function of the **Central Processing Unit (CPU)**, and how does it differ from the role of **RAM**?
3. Your computer is running slowly while you have a web browser, a word processor, and a video call open simultaneously. Would upgrading the **CPU** or adding more **RAM** likely have a bigger impact on performance in this scenario? Justify your choice.

End-of-Session Questions

4. Categorize the following devices as **Input**, **Output**, or **Input/Output**:

   a) A barcode scanner used to input patient ID codes.

   b) The hospital's MRI machine that produces detailed images.

   c) A USB flash drive used to transfer a patient's medical records.

5. Why is an operating system like Windows or macOS classified as System Software rather than Application Software?

Textbooks

Computer Organization and Design: The Hardware/Software Interface" by David A. Patterson and John L. Hennessy.