University Of Mosul
College of Engineering

Department of Communications And
Intelligent Digital Systems Engineering



Computer Level 1
Academic Year: 2026-2027

Dr. Yazen S. Sheet

What is a Computer?



Definition

- A computer is an **electronic programmable machine** that:
- Accepts **data** (input)
- Processes it using **instructions**
- Produces **information** (output)
- Stores the results for future use

Key Characteristics

- **Speed:** millions of operations per second
- **Accuracy:** errors only occur from faulty input or hardware failure
- **Automation:** operates without constant human supervision
- **Versatility:** performs a wide range of tasks
- **Storage:** stores huge amounts of data
- **Types of Computers**
- **Supercomputers:** advanced scientific simulations
- **Servers:** manage networks, websites
- **Personal computers:** everyday use
- **Embedded systems:** inside appliances, vehicles, phones

The Computer System Model

A computer system includes:

1. Hardware

- Physical devices that make up the system.

2. Software

- Programs and instructions that tell hardware what to do.

3. Users

- People who operate or interact with the system.

4. Data

- Raw facts or signals processed by the computer.

System Interaction Model

Input → Processing → Output
↳ Storage throughout the process

Hardware: Internal & External

Internal Hardware Components

- **Motherboard:** the main circuit board connecting all components
- **CPU (Processor):** performs calculations and executes instructions
- **RAM:** temporary memory for active processes
- **ROM:** stores startup instructions (BIOS/EFI)
- **Cache memory:** extremely fast memory inside CPU
- **GPU:** handles image/video rendering
- **Network interface card:** enables internet/network access
- **Storage devices:** HDD/SSD for permanent data

External Hardware (Peripherals)

- **Input:** keyboard, mouse, scanner, microphone
- **Output:** monitor, printer, speakers
- **Communication:** modem, router, webcam
- **Storage:** USB flash drives, external hard drives

Why Hardware Matters

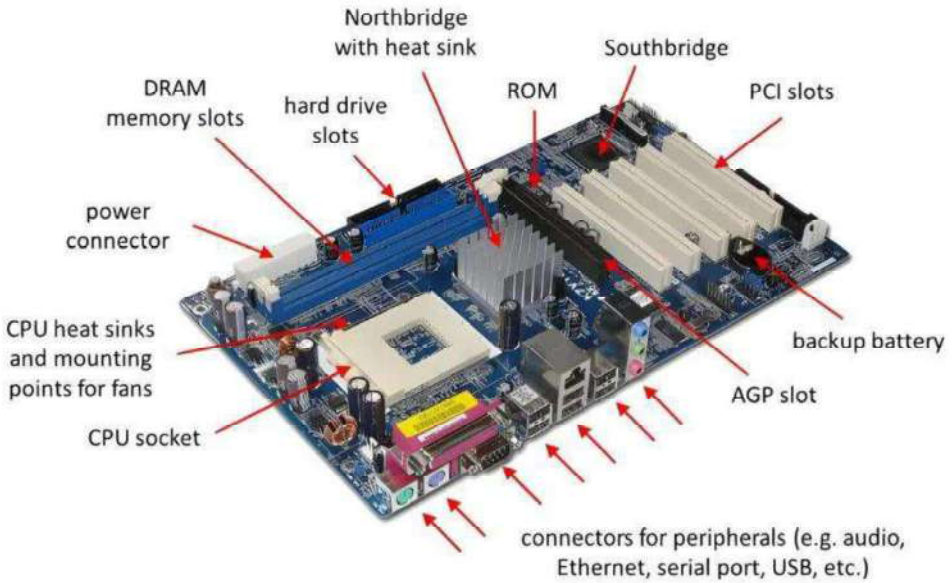
Hardware determines the computer's speed, capacity, connectivity, and capabilities.

Motherboard

Motherboard Functions

- Houses all essential components
- Provides electrical power distribution
- Uses **buses** to carry data/signals between parts
- Contains **chipset** that controls communication between CPU, memory, and storage
- Includes expansion ports for additional devices (PCIe, M.2, USB headers)

Motherboard



CPU



CPU (Central Processing Unit)

- Executes program instructions using the **instruction cycle**:
  - **Fetch → Decode → Execute → Store**

Contains:

- **ALU:** performs arithmetic (+, -, ×, ÷) and logic (AND, OR, NOT)
- **CU:** directs data flow and controls components
- **Registers:** small fast memory storage

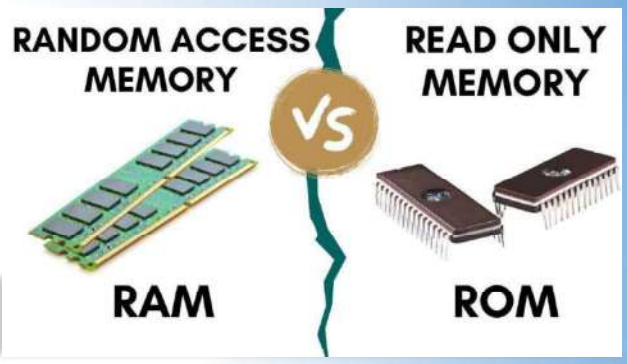
Clock speed: determines how many operations are done per second (GHz)

Cores & Threads: allow multitasking and parallel processing

Memory: RAM, ROM, and Cache

RAM (Random Access Memory)

- Temporary, volatile memory
- Used for running programs, open files, and real-time operations
- **More RAM = smoother multitasking & better performance**
- **Types of RAM**
- **DRAM:** used for main memory, slower
- **SRAM:** used in cache memory, extremely fast



Cache Memory

- Located inside CPU
- Stores frequently used instructions
- Greatly improves processing speed

ROM (Read Only Memory)

- Non-volatile
- Stores firmware used during system boot
- Includes POST (Power-On Self Test) instructions

Backing Storage: HDD, SSD, and Beyond

Why Backing Storage is Needed

- RAM is erased when power turns off
- Long-term storage needed for OS, apps, documents, media

HDD (Hard Disk Drive)

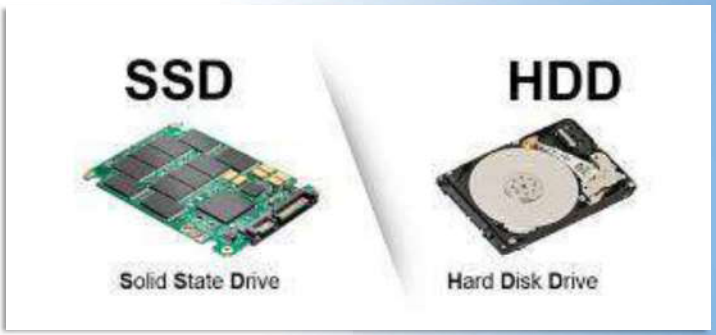
- Magnetic storage with spinning disks
- Advantages: large capacity, cheap
- Disadvantages: slower, mechanical parts prone to wear

SSD (Solid State Drive)

- Flash memory
- Advantages: very fast, durable, low power consumption
- Disadvantages: more expensive per GB

External Storage

- USB flash drives
- Memory cards
- External HDD/SSD
- Cloud storage (Internet-based)



Software: System vs. Application



Application Software

- Used by end users for tasks:
- Word processors
- Spreadsheet applications
- Database systems
- Media editors
- Browsers and mobile apps

System Software

- Controls the hardware:
- **Operating systems (OS):** manages memory, CPU, files, devices
- **Device drivers:** allows OS to communicate with hardware
- **Utilities:** antivirus, compression tools, disk cleanup
- **Compilers:** convert code into machine language
- **Linkers & Loaders:** prepare software for execution
- **Without system software, hardware cannot function.**

Operating System Functions

Major OS Responsibilities

- **Process Control:** manages applications and CPU scheduling
- **Memory Management:** allocates RAM to programs
- **File System Control:** organizes files, permissions
- **Device Management:** controls printers, scanners, USB devices
- **Security:** user accounts, firewalls, encryption
- **Error Detection & Handling:** prevents crashes
- **Network Management:** manages internet and local connections
- **User Interface:** GUI, CLI, touch, voice

Examples of OS

Windows, macOS, Linux, iOS, Android.

User Interfaces

Types of Interfaces

- **CLI (Command Line Interface)**
  - Fast, powerful
  - Requires command knowledge
  - Used by developers and IT professionals
- **GUI (Graphical User Interface)**
  - Windows, icons, buttons
  - Easy to learn
  - Most common interface
- **Touch Interfaces**
  - Used in smartphones, tablets, ATMs
  - Intuitive and interactive
- **Voice Interfaces**
  - Uses speech recognition (Siri, Alexa, Google Assistant)
  - Useful for accessibility
- **Gesture Interfaces**
  - Recognizes movement (Kinect, VR systems)

Understanding Data and Information

Data

Raw, unprocessed facts Comes in many forms:

- Numbers
- Text
- Audio signals
- Video frames
- Sensor readings

Information

Data processed to have meaning

Examples:

- A report card generated from student scores
- A sales summary generated from store data
- A medical diagnosis from patient readings

How Data Becomes Information

Data → Processing → Information

Processing may include:

- Sorting
- Classifying
- Calculating
- Graphing
- Comparing

Analogue vs Digital

Analogue Data

- Continuous
- Real-world signals
- Examples:
  - Human voice
  - Temperature variations
  - Light intensity

Digital Data

- Uses discrete values
- Stored in binary (0s and 1s)
- More reliable and easier to store/edit

Converters

- **ADC:** Analogue → Digital (microphone audio recorded as MP3)
- **DAC:** Digital → Analogue (music playback through speakers)
- These converters are essential for connecting real-world inputs to digital systems.

Input Devices

Purpose

To convert raw data into machine-readable digital form.

Categories & Examples

1. Text Input Devices

- Keyboard
- Barcode scanners
- QR code readers

2. Pointing Devices

- Mouse
- Touchpad
- Stylus pens
- Trackballs

3. Image Input

- Flatbed scanners
- Digital cameras
- Document cameras

4. Sound Input

- Microphones
- Voice recorders

5. Sensor Input

- Temperature
- Motion
- Infrared
- Pressure
- Biometric scanners (fingerprint, retina scan)
- Used in science labs, smart homes, vehicles, robotics.

Output Devices

Visual Output

- Monitors (LCD, LED)
- Smartboards
- Projectors
- VR headsets

Printed Output

- Laser printers
- Inkjet printers
- Thermal printers (used in receipts)
- Plotters for engineering drawings

Audio Output

- Speakers
- Headphones
- Warning systems (alarms)

Specialized Output

- Braille embossers for visually impaired
- Robotic arms (in automated systems)

Devices that Act as Both Input & Output

Examples:

- **Touchscreens:** display + detect touch
- **Modems:** convert signals both ways
- **Network interface cards:** send and receive data
- **VR controllers:** track motion + send vibrations
- **Smart cards:** store data + transmit it when scanned

These devices enable more interactive and efficient communication with computers.

Connecting Peripherals to the CPU

Common Connection Methods

- **USB:** universal for input/output devices
- **HDMI:** audio/video output
- **Ethernet:** wired networking
- **Wi-Fi:** wireless data transmission
- **Bluetooth:** wireless short-range connections
- **Thunderbolt / USB-C:** high-speed data transfer
- **Audio ports:** microphones and speakers

Why Drivers Are Needed

Device drivers:

- Allow communication between OS and hardware
- Translate device instructions to OS commands
- Enable advanced features (resolution, duplex printing, scanning)

Without drivers, peripherals either malfunction or do not work at all.

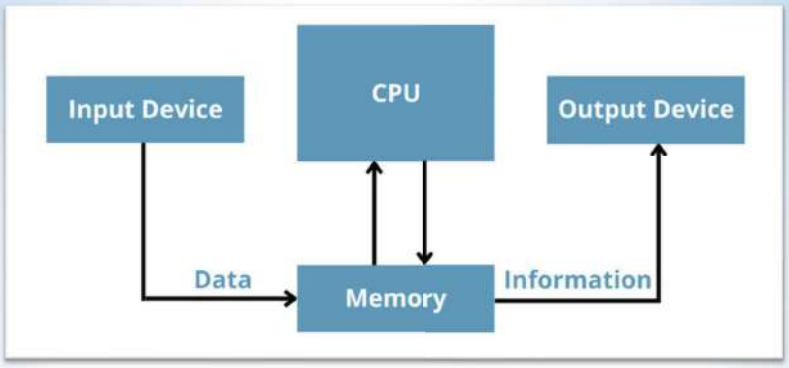
Safety & Data Integrity When Using Peripherals

- **Safe Practices**
- Install trusted drivers only
- Scan USB devices before opening
- Avoid connecting unknown hardware
- Perform regular backups
- Eject storage devices safely
- Update OS and drivers to fix security issues
- **Risks if Ignored**
- Malware infections
- Data corruption
- System instability
- Device malfunction

Summary

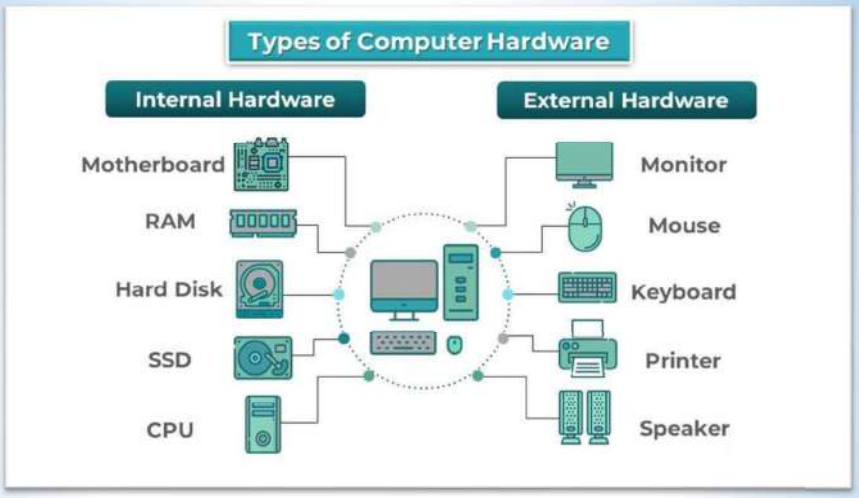
- A computer system consists of **hardware, software, users, and data**.
- The CPU controls all processing.
- RAM holds temporary data; ROM stores startup firmware.
- HDD/SSD provide permanent storage.
- OS manages hardware and software.
- Input devices feed data; output devices display results.
- Peripherals require drivers for proper communication.
- Analogue data needs conversion before being processed digitally.
- Understanding these fundamentals is essential for all ICT studies.

THE COMPUTER SYSTEM OVERVIEW



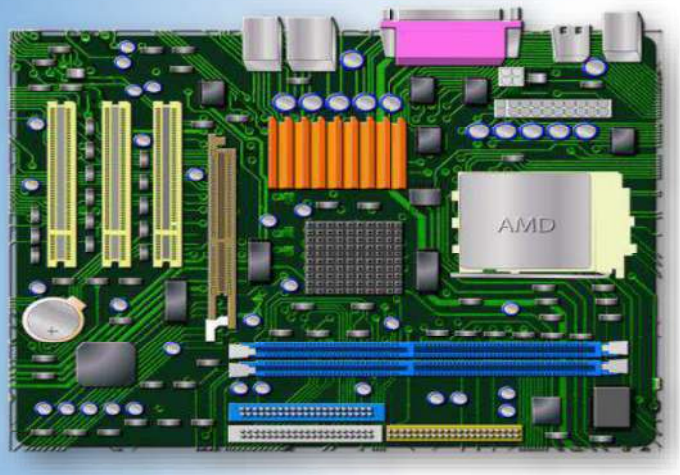
•A computer system is composed of **hardware**, **software**, **data**, and **users**.
•Hardware provides the **physical infrastructure**, software provides **control and logic**.
•The main components operate together through the **system bus**.
•Cooperation between these units enables the Input–Process–Output (IPO) cycle.

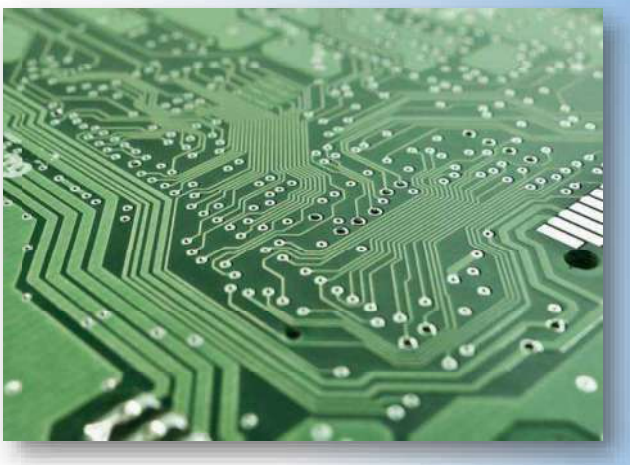
HARDWARE: INTERNAL VS. EXTERNAL



- **Internal hardware:** devices inside the casing (motherboard, CPU, RAM, ROM, HDD/SSD, NIC).
- **External hardware:** peripherals like keyboard, monitor, printer.
- Internal parts perform **core functions**; external parts provide **user interaction**.
- Internal hardware cannot usually be seen, but it forms the heart of the system.

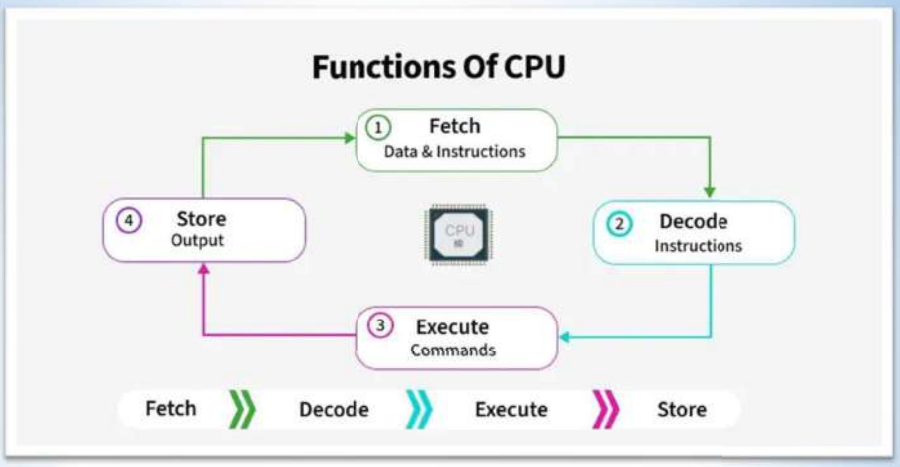
THE MOTHERBOARD





- Printed circuit board that connects **all** hardware components.
- Consists of non-conductive board with **copper/aluminium tracks** linking components.
- Houses sockets for CPU, RAM, expansion cards, power connectors.
- Acts as a **hub** for communication and power distribution.

THE CENTRAL PROCESSING UNIT (CPU)

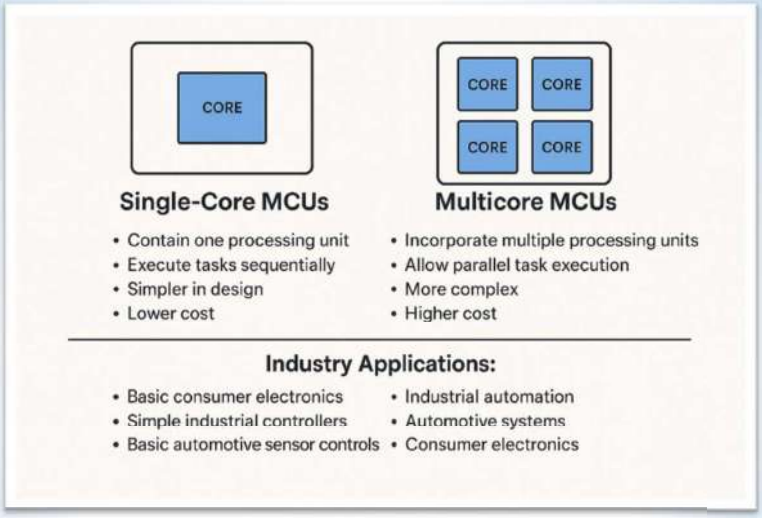


•Executes program instructions from hardware and software.
•Now manufactured as a **microprocessor** (single integrated circuit).

Main sections:

•**Arithmetic & Logic Unit (ALU):** performs calculations and logic comparisons.
•**Control Unit (CU):** directs data flow and manages instruction execution.
•**Registers:** small, ultra-fast memory cells inside CPU.
•Operates through **Fetch** → **Decode** → **Execute** → **Store** cycle.

CPU AS MICROPROCESSOR



- Earlier CPUs used many separate circuits; now integrated into one chip.
- Found not only in PCs but in embedded systems (cars, washing machines, phones).
- Speed determined by **clock frequency (GHz)** and **number of cores**.
- Multi-core processors allow **parallel processing** for multitasking.

INTERNAL MEMORY: RAM AND ROM

RAM (Random Access Memory):
•Temporary, **volatile** memory for data and programs in use.
•Read/write capable.

ROM (Read-Only Memory):
•Permanent, **non-volatile** memory storing firmware and configuration.
•Cannot be changed easily.
•Data in RAM is lost when power off; ROM content remains.

How Memory Works in Startup

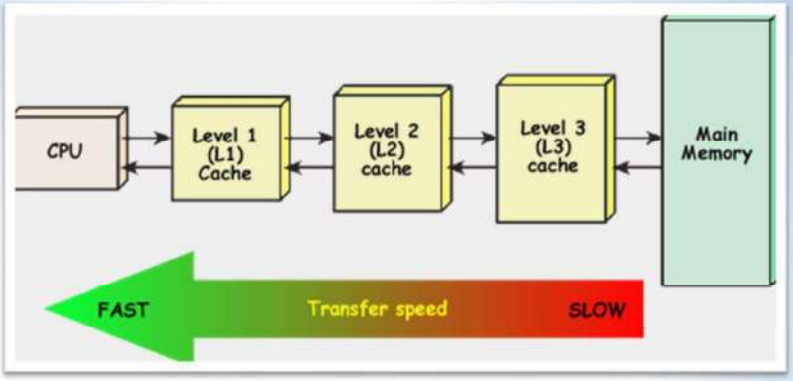


- On power-up, CPU executes a program stored in **ROM** called **BIOS**.
- BIOS performs a **hardware check** (POST) and loads the **operating system** into RAM.
- A small chip called **CMOS** stores system date/time and configuration using a tiny battery.

RAM VS ROM COMPARISON

Feature	RAM	ROM
Volatility	Volatile	Non-volatile
Read/Write	Read & write	Read-only
Function	Stores data/programs in use	Stores BIOS & configuration
Data Loss on Power Off	Yes	No
Speed	Very fast	Slower
Expandable	Yes	Usually fixed

CACHE MEMORY



- High-speed memory between CPU and RAM.
- Stores **frequently used** data and instructions.
- Levels:
  L1: inside CPU core, fastest, smallest.
  L2: near CPU, slightly slower, larger.
  L3: shared among cores.
- Reduces CPU waiting time dramatically.

BACKING STORAGE



- Used for **permanent, large-capacity** storage.
- Typical devices: **HDD, SSD, Blu-ray, USB, cloud storage**.
- **Fixed storage:** built inside (HDD/SSD).
- **Removable storage:** external drives or discs for backup.
- Slower than RAM but **non-volatile** and **cheaper per byte**.

INPUT DEVICES

•Allow users to send data to computer.
•Examples: keyboard, mouse, scanner, camera, sensors, microphone.
•Classified as:
Manual Input – controlled by user (keyboard).
Direct Data Entry – automatic (barcode reader, sensor).

OUTPUT DEVICES

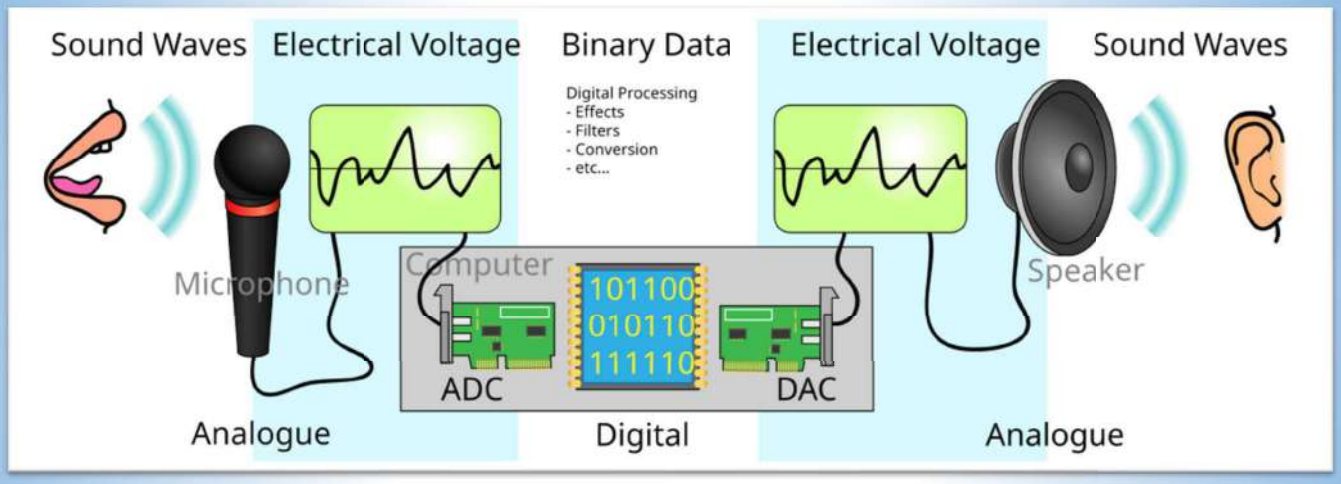
•Display or present results from computer processing.
•Examples: monitor, printer, speaker, projector, plotter.
•Controlled entirely by computer signals.
•Simpler than input devices**—**they only **convert data to human-readable form**

COMBINED I/O DEVICES



- Perform both input and output:
  Touchscreens, network cards, modems, smart cards, VR controllers.
- Enable **interactive communication** between user and system.
- Often rely on **device drivers** to function correctly.

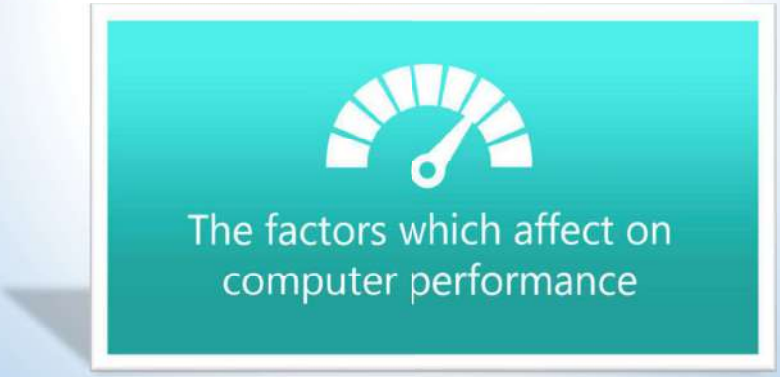
Analogue and Digital Data Conversion



- **Analogue → Digital:** uses **ADC (Analogue to Digital Converter)** for microphones/sensors.
- **Digital → Analogue:** uses **DAC (Digital to Analogue Converter)** for speakers/motors.
- Enables computers to interact with real-world signals

PERFORMANCE DETERMINANTS

- Processor speed (GHz) and number of cores.
- RAM size and speed.
- Cache capacity.
- Data bus width.
- Storage type (SSD > HDD).
- Efficiency of OS and software code.



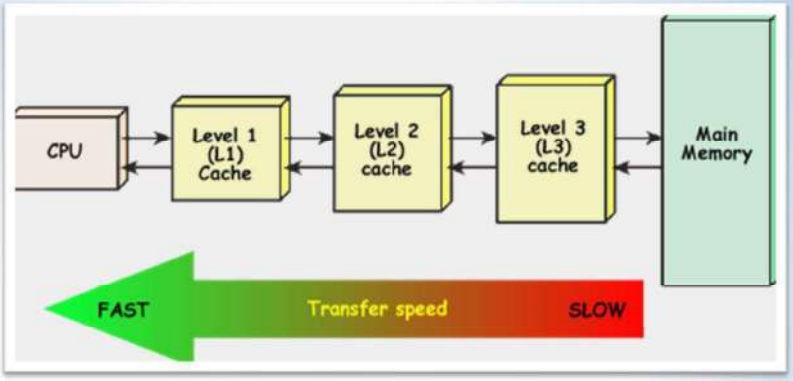
SUMMARY

- Hardware includes **internal components** (CPU, RAM, ROM, HDD/SSD, NIC, GPU).
- CPU coordinates all operations.
- Memory forms a hierarchy (registers → cache → RAM → storage).
- Input/output devices provide interaction.
- Backing storage ensures data permanence.

RAM VS ROM COMPARISON

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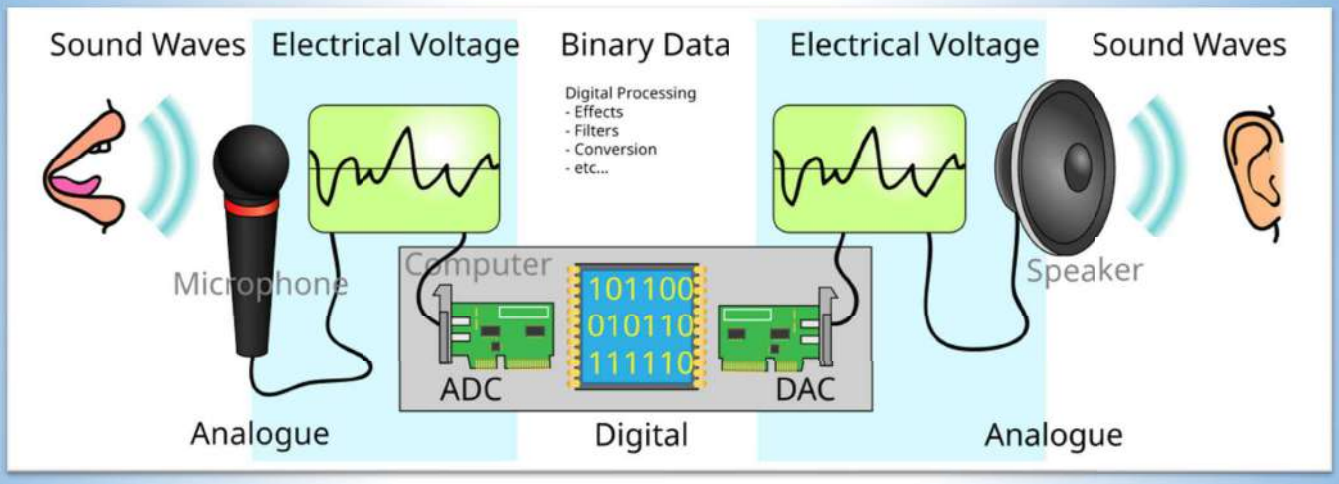
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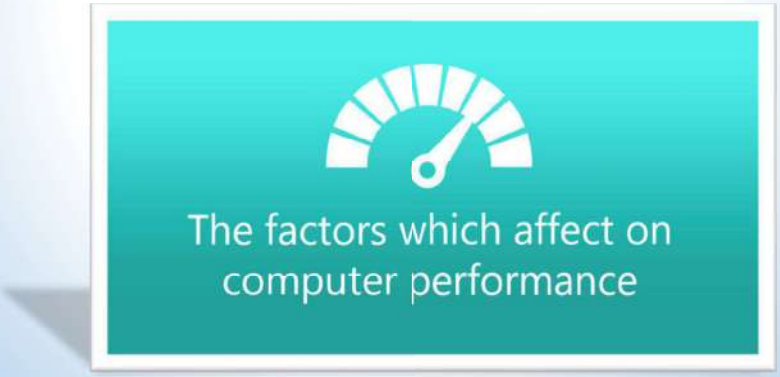
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BASIC CPU COMPONENTS

The Central Processing Unit contains several internal components responsible for executing instructions and processing data. These include:

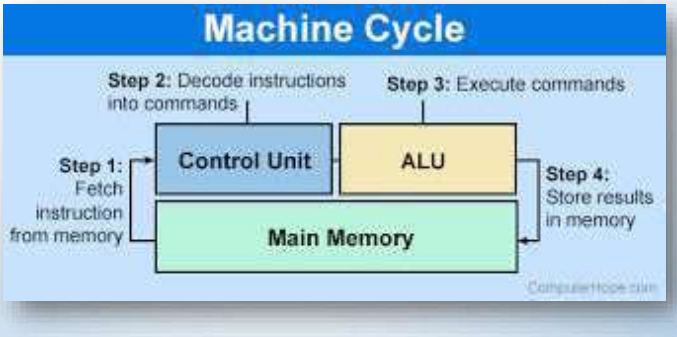
- **Control Unit (CU)** – directs the operation of the CPU
- **Arithmetic and Logic Unit (ALU)** – handles all arithmetic and logical operations such as: AND , OR , NOT , XOR.
- **Registers** – small high-speed storage locations
- **Internal Clock** – synchronizes CPU operations
- **Buses** – move data and control signals
- **Cache Memory** – provides ultra-fast access to frequently used instructions

CONTROL UNIT (CU)

Main Instruction Cycle

- **Fetch:** Retrieves the instruction from main memory (RAM).
- **Decode:** Interprets the instruction and identifies the required operation.
- **Execute:**
  - Sends the appropriate control signals to the ALU, memory, and I/O devices.
  - Coordinates data movement during the operation.
- **Store:** Writes the result into the correct register or memory location.

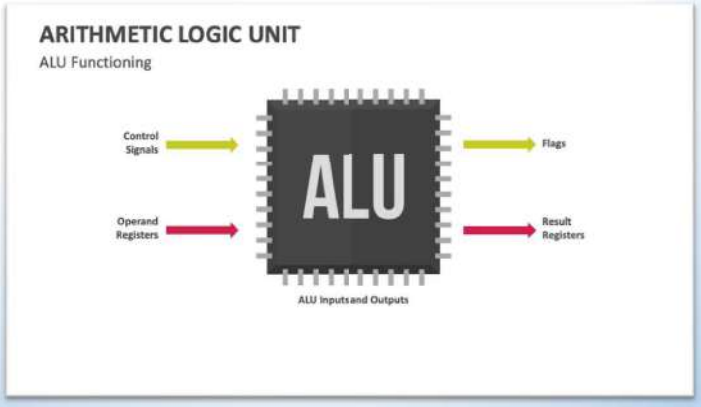
The CU acts as the “manager” of the CPU.



Arithmetic and Logic Unit (ALU)

The ALU performs:

- **Arithmetic operations:** addition, subtraction, multiplication
- **Logical operations:** AND, OR, NOT, comparisons
- **Shifting operations:** bit shifting and rotation
- Works closely with registers for high-speed data manipulation
- Executes the computational portion of instructions



CPU REGISTERS

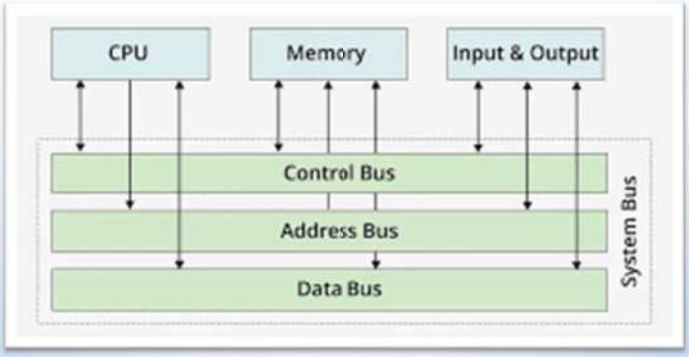


Registers are:

- Extremely fast memory inside the CPU
- Used to store data currently being processed
- Typically hold:
  - Instruction Register (IR)
  - Program Counter (PC)
  - Memory Address Register (MAR)
  - Memory Data Register (MDR)
- They significantly enhance CPU execution speed.

CPU BUSES

- The CPU communicates internally and externally using buses:
- **Data Bus:** transfers data
- **Address Bus:** identifies memory locations
- **Control Bus:** carries control and timing signals
- Buses ensure coordinated operation between CPU, memory, and I/O devices.

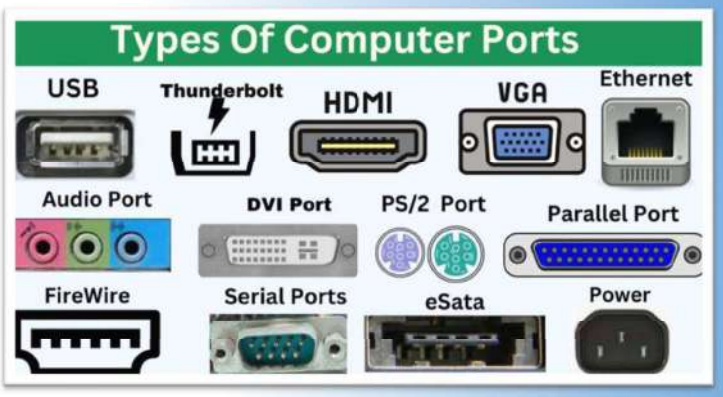


COMPUTER PORTS

Ports: are physical interfaces used to connect peripherals to the computer.

Common ports include:

- **USB Ports:** for storage devices, keyboards, mice, cameras
- **HDMI Port:** high-definition audio/video output
- **VGA / DisplayPort:** older display connectors
- **Ethernet (RJ-45):** network connectivity
- **Audio Jacks:** microphones and speakers
- **Power Port:** provides electrical power
- **Thunderbolt/USB-C:** very high speed, modern devices



TYPES OF PORTS

Serial Port

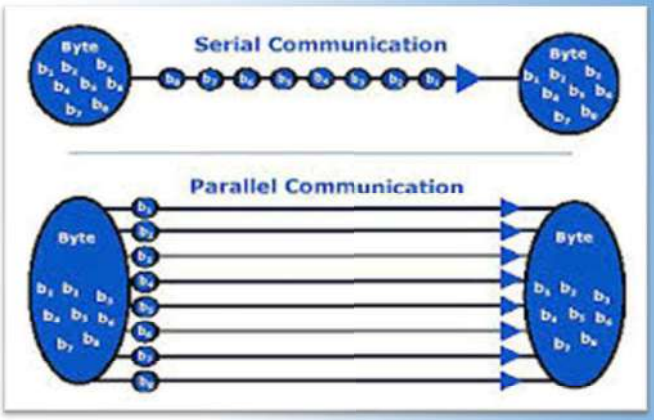
- Transfers data one bit at a time
- Used historically for modems & old mice

Parallel Port

- Transfers multiple bits simultaneously
- Used for older printers

Modern Ports

- USB superseded both serial and parallel ports
- Faster, universal, supports hot-swapping
- Used for most modern peripherals



PERSONAL COMPUTER

A Personal Computer (PC) is:

- A general-purpose machine
- Designed for individual users
- Suitable for productivity, communication, learning, and entertainment
- Built using standard hardware components
- Runs a general-purpose operating system (Windows, Linux, macOS)
- PCs vary in size, power, and performance.

Personal Computer Features

Typical features of a PC include:

- **CPU:** microprocessor as main processing unit
- **Memory:** RAM for running programs
- **Storage:** HDD/SSD
- **Input Devices:** keyboard, mouse, webcam
- **Output Devices:** monitor, speakers, printer
- **Ports:** USB, network, audio
- **Operating System:** provides user interface and manages resources

TYPES OF PERSONAL COMPUTERS

- Personal computers come in several forms:
- **1. Desktop Computers**
- Stationary use
- Large monitor
- Easily upgradable
- **2. Laptop Computers**
- Portable
- Integrated screen, keyboard, battery
- Typically less upgradable
- **3. Tablets**
- Touch-based
- Lightweight and portable
- Lower processing power
- **4. Workstations**
- High-performance systems
- Used for graphics, engineering, and scientific tasks
- **5. All-in-One PCs**
- Hardware built inside the monitor
- Saves space

Choosing a Personal Computer

Important factors include:

- **Processing power (CPU cores & speed)**
- **RAM capacity**
- **Storage size and type (SSD vs HDD)**
- **Graphics capabilities**
- **Port availability**
- **Battery life (for laptops)**
- **Build quality & upgradability**
- **Budget and intended use case**



SUMMARY

This section expanded computer components by adding:

- Internal CPU subcomponents
- Computer ports and connectors
- Personal computer structure
- Features of a modern PC
- Types of personal computers
- Practical considerations when selecting a PC

This content forms a **continuation** of the previous two lectures and completes the **Computer Components** unit of the chapter.

Operating System (OS)

OS Definition : Software that manages computer hardware and runs applications.

Core Functions

- Process management
- Memory management
- File management
- Device management (drivers)
- Security & permissions

Types and Examples of Operating Systems

Types of OS

- Single-user / single-task
- Single-user / multi-tasking
- Multi-user systems
- Mobile OS
- Embedded OS

Common Examples

- Windows
- macOS
- Linux
- Android
- iOS

User Interface (UI)

Definition

- The method by which users interact with a computer.

Types

- **CLI**: text-based, requires commands.
- **GUI**: graphical, easy and visual.

Graphical User Interface (GUI)

WIMP Model

- Windows
- Icons
- Menus
- Pointer

GUI Elements

- Windows
- Icons
- Menus
- Pointer/Cursor

Desktop Environment

Includes:

- Desktop background
- Icons
- Taskbar/Dock
- File Explorer / Finder

Used to manage and organize files visually.

Basic Mouse Techniques

- Point
- Click
- Double-click
- Right-click
- Drag-and-drop
- Scroll

Used for navigating and interacting with GUI elements.

SUMMARY

This lecture explained:

- What an OS is and what it manages
- Types and examples of OS
- UI and differences between CLI & GUI
- GUI structure and WIMP elements
- Mouse operations used in GUI environments

USE OF COMMON ICONS

Icons: The Visual Language of the GUI

•**Definition & Classification:**

•**Icon:** A small graphical representation of an object (file, folder, application) or a function.

•**Categories:**

1. **Application Icons:** To launch specific software (.exe files).
2. **File Icons:** Indicate the file type and associated default program (e.g., .pdf, .jpg).
3. **System Icons:** Fixed functions necessary for OS operation (e.g., **Recycle Bin**, **Network**, **This PC**).

•**Shortcut Icons:** Distinguished by a **small arrow** symbol. They are quick links to the original item, not duplicates of the item itself.







STATUS BAR

The Status Bar: Providing Real-Time Contextual Information

•**Location:** Typically found at the bottom of an application window or the screen.

•**Primary Role:** To display immediate, contextual information about the application's current state or the user's action.

•**Detailed Examples:**

•**In Text Processors:** Displays the current page number, total word count, and insertion mode (e.g., Insert/Overwrite).

•**In Web Browsers:** Shows the target URL of a hyperlink when the mouse hovers over it (a crucial security feature).

•**In File Explorer:** Displays the total number of selected items and their combined size.



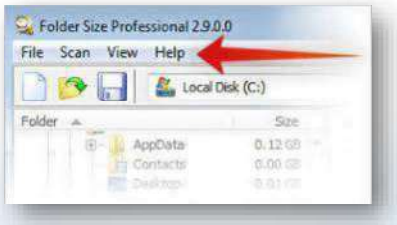
USING MENU AND MENU-SELECTION

Menus: Organized Access to Program Commands

- **Menu Bar:** A fixed horizontal bar at the top of the window containing primary command categories.
- **Common Menu Items: File**, **Edit**, **View**, **Help**.
- **The Drop-down Menu Mechanism:**
- Clicking a category (e.g., **File**) reveals a vertical list of related commands.
- **Selection:** An action is initiated by clicking the command or using the accompanying keyboard shortcut (e.g., Ctrl+P for Print).

Types of Menus:

- **Standard Menus:** Found in the menu bar.
- **Context Menus (Right-Click Menus):** Displayed upon right-clicking an object, offering actions relevant *only* to that specific item.



CONCEPT OF FOLDERS AND DIRECTORIES

Hierarchical Organization of Data

Folder (Container):

•**Definition:** A virtual container on the storage drive used to group and organize files and other folders (Subfolders).

•**Structure:** Folders allow for deep, logical organization, starting from the root of a drive (e.g., C:).

Directory (Path):

•**Technical Term:** Refers to the full, unique path specifying the location of a file or folder within the file system hierarchy.

•**Path Example:** C:\Program Files\Microsoft Office\Excel.exe

•**Importance:** This hierarchical structure is essential for efficient data retrieval, preventing file clashes, and simplifying backup and security management.

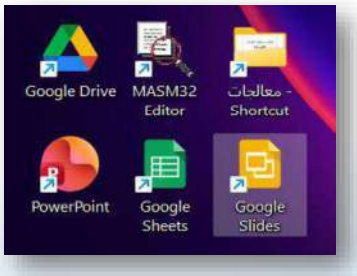
Aspect	Folder	Directory
Used in	Graphical user interfaces (GUI)	Command-line interfaces (CLI)
Representation	Visual (icon-based)	Text-based (path or structure)
Meaning	A user-friendly term for directory	The actual structure in the file system
Example	“Documents” folder on Desktop	“C:\Users\Karam\Documents” path

CREATING SHORT CUTS

Shortcuts: Enhancing Work Efficiency

- **Technical Definition:** A small file that holds the address (path) of the original item.
- **Key Features and Advantages:**
- **Speed:** Provides instant access to frequently used applications or deeply nested folders.
- **Minimal Storage:** Since it is just a link, it consumes negligible disk space.
- **Identification:** Always visually marked by the small arrow icon.
- **Creation Method (Common in Windows):**

1. Locate the original file/folder/program.
2. Right-click on the item and select **Create shortcut** (or **Send to > Desktop (create shortcut)**).
3. Move the newly created shortcut to a convenient location like the desktop or Taskbar.



OPENING AND CLOSING OF DIFFERENT WINDOWS

Window Management for Multitasking

•**Window:** The designated rectangular area on the screen that displays the contents of an application or document. It is the core unit of the GUI workspace.

•**Opening and Closing Operations:**

•**Opening:** Typically performed by double-clicking the corresponding icon or item.

•**Closing:** Using the **Close (\times)** icon located in the upper right (Windows/Linux) or upper left (macOS) corner of the title bar.

Standard Window Controls:

•**Minimize (-):** Hides the window to the Taskbar, freeing up screen space while keeping the application running.

•**Maximize (\square):** Enlarges the window to full screen.

•**Restore Down:** Returns the window to its previous size and position.

•**Function:** Enables effective multitasking by allowing users to view and interact with multiple applications concurrently.

CONCLUSION AND Q&A

Summary of GUI Interaction

- The GUI simplifies complex OS commands into intuitive visual actions.
- Icons and Menus are the primary tools for command execution.
- Folders and Directories provide essential structural organization.
- Windows and Shortcuts allow for efficient multitasking and quick access.
- **Discussion Point:** How have touch-based interfaces (like tablets and smartphones) adapted these classical GUI concepts to suit a finger-based interaction model?

SUMMARY

This lecture explained:

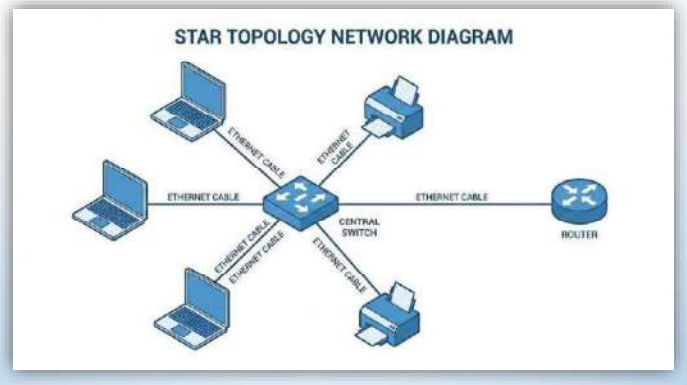
- What an OS is and what it manages
- Types and examples of OS
- UI and differences between CLI & GUI
- GUI structure and WIMP elements
- Mouse operations used in GUI environments

COMPUTER NETWORK BASICS

Definition: A collection of autonomous computers and devices interconnected to facilitate data exchange and resource sharing.

Key Components:

- **Nodes (End Devices):** Computers, Servers, Smartphones, IoT devices.
- **Intermediary Devices:** Switches, Routers, Wireless Access Points.
- **Transmission Media:** Physical paths like Copper wires (Ethernet), Fiber Optics, or Wireless (Radio waves).
- **Protocols:** Standardized sets of rules (e.g., TCP/IP) that govern how data is formatted and transmitted.

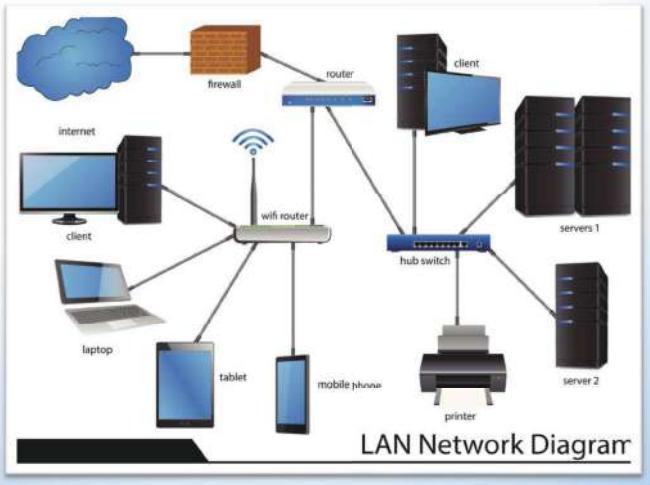


LOCAL AREA NETWORK (LAN)

Definition: A network that connects devices within a limited geographical area.

Characteristics:

- **Scope:** Typically confined to a single room, office, building, or campus.
- **Speed:** High data transfer rates.
- **Ownership:** Private; owned and managed by a single organization/individual.
- **Technologies:** Primarily uses **Ethernet (IEEE 802.3)** for wired and **Wi-Fi (IEEE 802.11)** for wireless.
- **Latency:** Very low delay (Low).

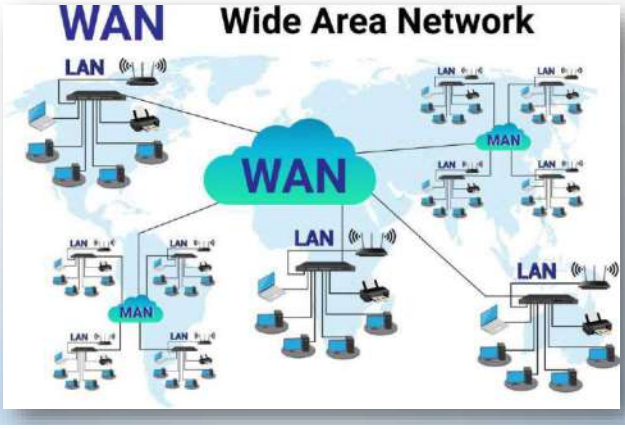


Wide Area Network (WAN)

Definition: A network that spans a large geographical distance, often connecting multiple LANs.

Characteristics:

- **Scope:** Can span cities, countries, or continents.
- **The Ultimate Example:** The **Internet** is the world's largest public WAN.
- **Technologies:** Leased lines, Fiber optic undersea cables, Satellites, and Microwave links.
- **Management:** Usually managed by multiple entities (Telecommunication companies/Service Providers).
- **Complexity:** Higher latency and lower speeds compared to LAN due to the distance.



Comparison Table: LAN vs. WAN

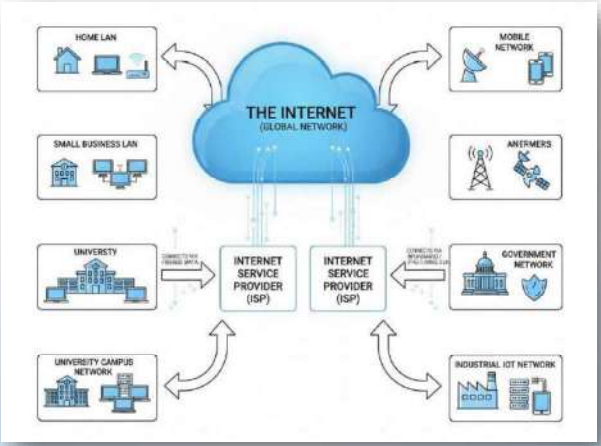
Feature	LAN (Local Area Network)	WAN (Wide Area Network)
Geographic Area	Small (Home, Office)	Large (Country, Continent)
Data Speed	Very High	Lower / Variable
Ownership	Private	Multiple Entities / Public
Error Rate	Low	Higher (due to distance)
Cost	Low Setup Cost	High Setup/Maintenance Cost

CONCEPT OF THE INTERNET

Definition: The Internet is a global system of interconnected computer networks ("A Network of Networks") using the **TCP/IP** protocol suite.

How it Functions:

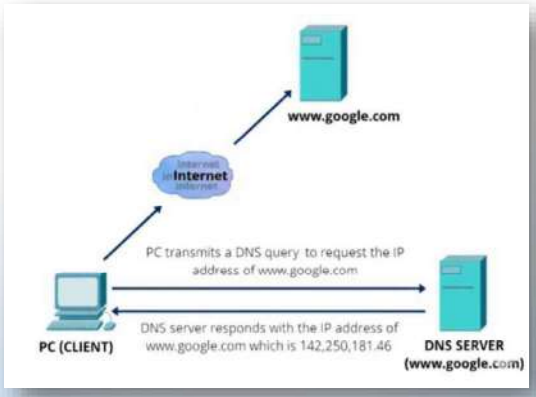
- **Interconnectivity:** Thousands of smaller networks (ISP, University, Government) link together.
- **The Backbone:** High-speed fiber-optic lines owned by Tier-1 ISPs that carry the bulk of global traffic.
- **Packet Switching:** Data is broken into small "packets," sent across various paths, and reassembled at the destination.



INTERNET ADDRESSING (IP AND DNS)

To communicate, every device on the internet needs a unique identity.

1. **IP Address (Internet Protocol):**
   - A numerical label assigned to each device (e.g., 192.0.2.1).
   - **IPv4** (32-bit) vs. **IPv6** (128-bit).
2. **DNS (Domain Name System):**
   - The "Phonebook of the Internet."
   - Translates human-friendly names (e.g., google.com) into machine-readable IP addresses.



APPLICATIONS OF THE INTERNET

The Internet provides the infrastructure for various services:

- **World Wide Web (WWW):** Browsing websites using HTTP/HTTPS.
- **E-mail:** Communication via SMTP/IMAP protocols.
- **File Transfer:** Moving large data via FTP (File Transfer Protocol).
- **Streaming & VoIP:** Real-time audio/video (Netflix, Zoom).
- **Cloud Computing:** On-demand access to storage and processing (AWS, Google Drive).
- **Internet of Things (IoT):** Connected smart devices (Smart homes, Industrial sensors).

CONNECTING TO THE INTERNET

Essential Components for Connectivity:

1. **ISP (Internet Service Provider):** A company that provides you with access to the internet (e.g., AT&T, Vodafone).
2. **Modem:** Converts signals from the ISP (Analog/Optical) into digital data for your devices.
3. **Router:** Directs the data traffic to specific devices within your local network (LAN).

Common Connection Types:

- **Fiber Optics:** Fastest and most reliable.
- **DSL / Cable:** Using existing phone or TV lines.
- **Wireless:** 4G/5G Cellular and Satellite (Starlink).

Introduction to Web Browsers

Definition: A software application used to locate, retrieve, and display content on the World Wide Web.

Core Functions:

- **HTTP Request:** The browser asks a server for a page.
- **Rendering Engine:** Translates HTML, CSS, and JavaScript into a visual webpage.
- **Security:** Handles encryption (SSL/TLS) for safe browsing (HTTPS).

Popular Browsers:

- Google Chrome (Blink Engine)
- Mozilla Firefox (Gecko Engine)
- Safari (WebKit Engine)
- Microsoft Edge

SUMMARY

- **Networks** allow for efficient resource and data sharing.
- **LANs** are for local, fast communication; **WANs** connect the world.
- **The Internet** is a vast infrastructure of interconnected networks.
- **Web Browsers** act as the primary interface between the user and the vast information on the web.

Web Architecture & Global Addressing.

Agenda:

- World Wide Web (WWW) vs. The Internet.
- Web Browsers: Architecture & Engines.
- URL Anatomy & DNS Hierarchy.
- The Dual Identity: MAC Address vs. IP Address.
- Network Address Translation (NAT) & IPv6.
- Information Retrieval: How Search Engines Work.

The World Wide Web (WWW)

- **Definition:** A global information space where documents and other web resources are identified by URLs, interlinked by hypertext, and accessible via the Internet.

The Three Pillars of the Web

To function, the WWW relies on three fundamental technologies:

1. **HTML (HyperText Markup Language):** The **structure** and content of the page.
2. **HTTP/HTTPS (HyperText Transfer Protocol):** The **communication rules** for data exchange.
3. **URL/URI (Uniform Resource Locator):** The **unique address** to find any resource.

Architectural Model: Client-Server

- **The Client:** A web browser (e.g., Chrome, Safari) that sends a **Request**.
- **The Server:** A remote computer that stores files and sends a **Response** back.

Anatomy of a URL

- **URL (Uniform Resource Locator):** The global "coordinate" for a specific resource.
- **Example:** https://www.example.org/wiki/Internet
  - **Protocol (https):** Defines the set of rules for data transfer. **HTTPS** ensures an encrypted, secure connection.
  - **Subdomain (www):** A prefix used to organize or categorize different sections of a website.
  - **Domain Name (example):** The unique, human-readable identity of the website.
  - **Top-Level Domain - TLD (.org):** Indicates the type of organization (e.g., .org for non-profits, .com for commercial).
  - **Path (/wiki/Internet):** Specifies the exact location of a folder or file on the web server.

DOMAIN NAME SYSTEM (DNS)

The Translator: translating human-friendly names (URLs) into machine-readable IP addresses.

Hierarchical Breakdown: https://uomosul.edu.iq

- The system resolves the address from **Right to Left** to narrow down the location of the server:

Part of Address	Technical Name	Meaning / Description	Analogy
.iq	**ccTLD**	**Iraq:** The Country-specific Top-Level Domain.	The Country
.edu	**SLD**	**Education:** The second-level domain for academic institutions.	The City / Sector
uomosul	**Domain Name**	**University of Mosul:** The unique identity of the entity.	The Building
https://	**Protocol**	The secure set of rules used for data transfer.	The Delivery Method

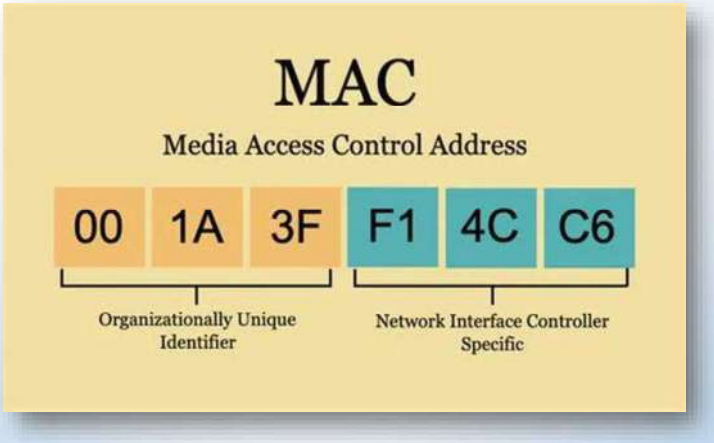
Comprehensive Examples of Domain Levels

- **Key Insight:** Each part of a domain name acts as a folder or a category. Depending on the type of organization, the **SLD** and **Third-Level** roles may change.

Website Type	Level 1 (TLD)	Level 2 (SLD)	Level 3 (Entity)	Level 4+ (Subdomain)	Full Address
Global Commercial	.com	google	*(Optional)*	mail	mail.google.com
Global Non-Profit	.org	wikipedia	*(Optional)*	en (English)	en.wikipedia.org
Local Government	.iq (Iraq)	.gov (Category)	(Prime Minister)	portal	portal.pmo.gov.iq
Local Education	.iq (Iraq)	.edu (Category)	uomosul	elearning	elearning.uomosul.edu.iq
Regional Business	.sa (KSA)	.com (Category)	stc	business	business.stc.com.sa

THE MAC ADDRESS

- **Definition: Media Access Control** (Physical Address).
- **Nature:** Permanent and unique; burned into the hardware (Network Interface Card - NIC).
- **Format:** 48-bit hexadecimal (e.g., 00-B0-D0-63-C2-26).
- **Role:** Used for identification within the **local network (LAN)**.



THE IP ADDRESS

•**Definition:** A unique numerical label assigned to each device (e.g., computer, smartphone, printer) connected to a network that uses the Internet Protocol for communication. It serves two main functions: **Host identification** and **Location addressing**.

IPv4 vs. IPv6:

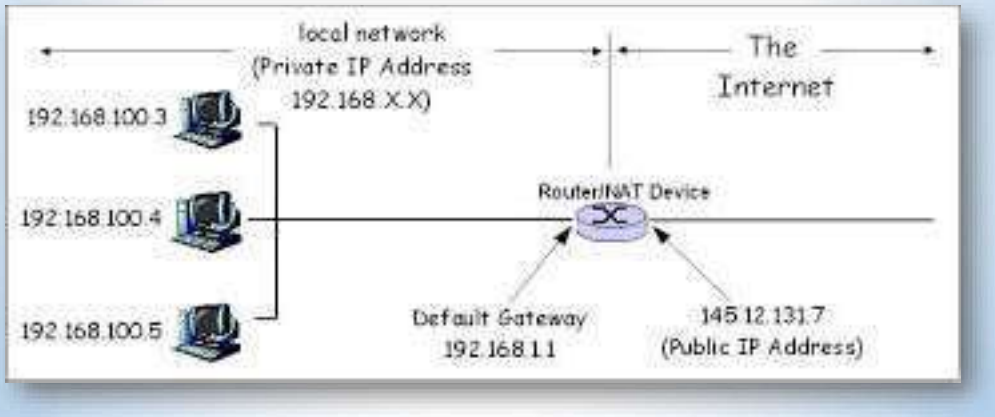
Feature	IPv4	IPv6
Address Size	32 bits	128 bits
Address Format	Dotted Decimal (e.g., 192.168.1.1)	Hexadecimal (e.g., 2001:0db8::8a2e)
Address Space	~ 4.3 Billion addresses	~ 340 10^38 addresses
NAT Support	Required (due to address shortage)	Not needed (vast address space)

Comparison: MAC vs. IP Address

Feature	MAC Address	IP Address
Analogy	Your Fingerprint / ID Number	Your Mailing Address
Assignment	Manufacturer	Network (ISP/Router)
Size	48 bit	32 bit or 128 bit
Flexibility	Fixed / Permanent	Dynamic / Changes with location

PUBLIC VS. PRIVATE IPS & NAT

- **Private IP:** Used inside your local network (LAN) only.
- **Public IP:** The single IP visible to the whole world.
- **NAT (Network Address Translation):** A method used by routers to translate multiple private IPs into one single public IP to save address space.



SEARCH ENGINES: FINDING INFORMATION

Definition: A web-based tool used to search for and retrieve information from the World Wide Web.

How They Work (The Process)

- Search engines operate in three core stages:
- **Crawling:** "Spiders" or "Bots" scan the web to find new and updated content.
- **Indexing:** Storing and organizing discovered content in a massive database.
- **Ranking:** Using **Algorithms** to show the most relevant results to the user.

Key Components

- **The Crawler (Spider):** The discovery software.
- **The Index:** The digital library of the internet.
- **Search Algorithm:** The "brain" that sorts results (e.g., Google's PageRank).

Notable Examples

- **Google:** The world's most used search engine.
- **Bing:** Microsoft’s engine (integrated with AI).
- **DuckDuckGo:** Focused on **User Privacy**.

SUMMARY

- **WWW** is a software service.
- **Browsers** are the interface.
- **URLs** provide the location.
- **DNS** provides the translation.
- **MAC** identifies your device.
- **IP** identifies your location.

EMAIL FUNDAMENTALS & TECHNICAL PROTOCOLS

Introduction to **E-mail (Electronic Mail)**

Core Delivery Protocols:

•**SMTP (Simple Mail Transfer Protocol):** The standard protocol used for **sending** messages from a client to a server.

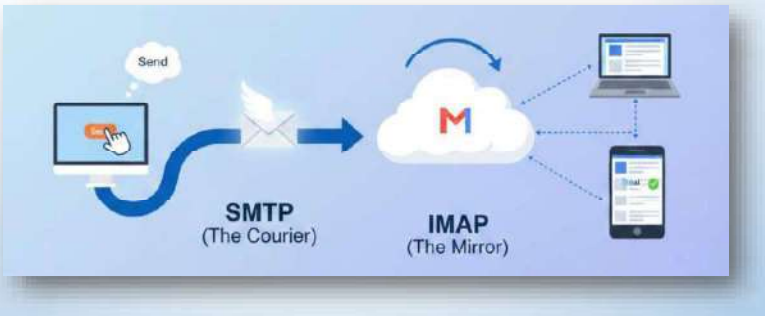
•**IMAP (Internet Message Access Protocol):** A modern protocol that allows you to **sync** and access your email from multiple devices (phone, laptop, tablet).

•**POP3 (Post Office Protocol version 3):** An older protocol designed to **download** emails to a single local device and typically delete them from the server.

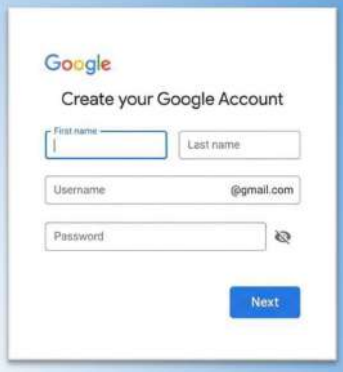
Account Sources:

•**Webmail:** Browser-based services like Gmail or Outlook.com.

•**ISP (Internet Service Provider):** Companies (like Zain) that provide email accounts as part of a connectivity package.



ACCOUNT ACQUISITION & SECURITY



Getting an Account & Implementing **MFA**

Registration Process:

•Selecting a unique username and a domain (e.g., user@domain.com).
•Setting up recovery options (Secondary email or phone number).

Security Acronyms to Know:

•**MFA (Multi-Factor Authentication):** A security system that requires more than one method of authentication to verify the user's identity (e.g., Password + SMS Code).
•**2FA (Two-Factor Authentication):** A specific type of **MFA** that uses exactly two layers of security.
•**Password Integrity:** The importance of complex characters to prevent unauthorized access.

EMAIL OPERATIONS & RECIPIENT FIELDS

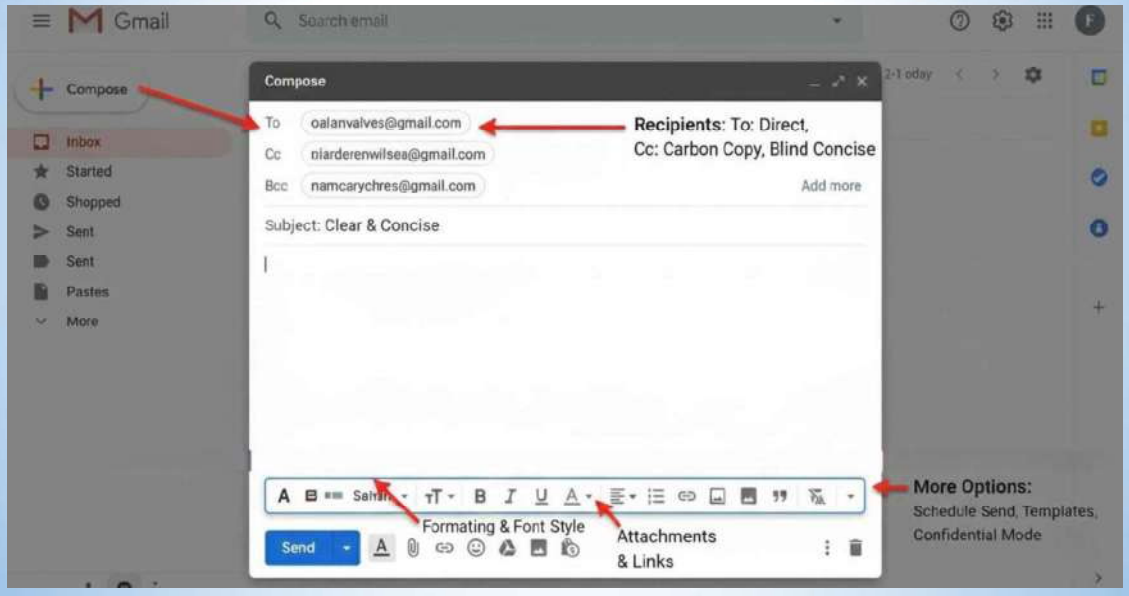
Sending, Receiving, and Managing Correspondence

Understanding Recipient Types:

•**To:** The primary recipient(s) who are expected to take action.
•**CC (Carbon Copy):** Sending a copy to others for informational purposes without expecting a direct reply. (Originates from physical carbon paper).
•**BCC (Blind Carbon Copy):** Sending a copy to others where their addresses are **hidden** from other recipients. Used for privacy and preventing **Spam**.

The "Sent" Folder:

•Accessing a historical log of all outgoing communication for tracking and professional auditing.
•**Subject Line:** Essential for clarity and future searchability.


Gmail
Search email
Compose
Inbox
Started
Shopped
Sent
Sent
Pastes
More
Compose
To oalanvalves@gmail.com
Cc niarderenwilsea@gmail.com
Bcc namcarychres@gmail.com
Add more
Subject: Clear & Concise
Send
Recipients: To: Direct, Cc: Carbon Copy, Blind Concise
Formating & Font Style
Attachments & Links
More Options:
Schedule Send, Templates, Confidential Mode

MODERN DOCUMENT COLLABORATION

From Attachments to Cloud Collaboration

Digital Attachments:

•Sending files directly (e.g., PDFs, Images). Note: Most services have a size limit (usually 25MB).
•**Cloud Integration:**
•**URL (Uniform Resource Locator):** Sharing a web link to a live document instead of an attachment.

Collaboration Benefits:

•**Real-time Editing:** Multiple users working on one file simultaneously via services like Google Docs or Microsoft 365.
•**Version Control:** Avoiding multiple "Final" versions by maintaining one single source of truth in the cloud.
•**Permissions:** Managing access levels (Viewer vs. Editor).