

# Introduction to Computer - Handout for 100-Level Students

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# **1. Introduction to Computers**

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## **1.1 What is a Computer?**

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A computer is an electronic machine that can take in information (called data), process it, and then give out new information (called output). It can also store information for later use. Think of it like a very smart helper that can do many tasks very quickly and accurately. Computers follow instructions, which are called programs or software. Without these instructions, a computer cannot do anything. They are used everywhere today, from schools and hospitals to homes and businesses, helping people with many different tasks.

## **1.2 History of Computers (Generations of Computers)**

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The history of computers is a story of amazing progress, from simple counting tools to the powerful machines we use today. We can divide this history into different generations, each marked by major technological advancements.

### **First Generation (1940s-1950s): Vacuum Tubes**

The first computers were very large and used vacuum tubes for their main electronic components. These machines were huge, filling entire rooms, and used a lot of electricity.

They also produced a lot of heat and were very slow. Programming them was difficult, often done by physically changing wires and switches. Examples include ENIAC and UNIVAC. [1]

## **Second Generation (1950s-1960s): Transistors**

Transistors replaced vacuum tubes in the second generation of computers. Transistors were much smaller, faster, cheaper, and more energy-efficient than vacuum tubes. This made computers smaller and more reliable. During this period, programming languages like FORTRAN and COBOL were developed, making it easier to write instructions for computers. [2]

## **Third Generation (1960s-1970s): Integrated Circuits**

Integrated Circuits (ICs) were the key technology for the third generation. An IC is a small chip that contains many transistors and other electronic components. This made computers even smaller, faster, and more powerful. For the first time, computers became accessible to a wider audience, not just scientists and engineers. Operating systems were also developed, allowing computers to run many different programs at once. [3]

## **Fourth Generation (1970s-Present): Microprocessors**

The invention of the microprocessor brought about the fourth generation. A microprocessor is a single chip that contains the entire Central Processing Unit (CPU). This led to the development of personal computers (PCs), which were small enough for homes and offices. The internet also began to develop during this time, connecting computers around the world. Graphical User Interfaces (GUIs) made computers much easier to use. [4]

## **Fifth Generation (Present and Beyond): Artificial Intelligence**

The fifth generation of computers is still developing. It focuses on Artificial Intelligence (AI), which aims to make computers think and learn like humans. This includes technologies like voice recognition, expert systems, and robotics. The goal is to create computers that can respond to natural language input and solve complex problems on their own. [5]

## **1.3 Types of Computers**

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Computers come in many shapes and sizes, each designed for different purposes. Here are some common types:

## **Supercomputers**

These are the fastest and most powerful computers. They are used for very complex tasks that require massive calculations, such as weather forecasting, scientific research, and advanced engineering simulations. They are very expensive and take up a lot of space. [6]

## **Mainframe Computers**

Mainframes are large, powerful computers used by big organizations like banks, airlines, and government agencies. They can handle a huge amount of data and many users at the same time. They are known for their reliability and security. [7]

## **Minicomputers (Midrange Computers)**

Minicomputers are smaller and less powerful than mainframes but more powerful than personal computers. They are often used by medium-sized businesses for specific tasks like managing databases or controlling industrial processes. [8]

## **Personal Computers (PCs)**

These are the most common type of computers, designed for individual use. They include:

- **Desktop Computers:** These have a separate monitor, keyboard, mouse, and a main computer case. They are usually placed on a desk and are not easily moved.
- **Laptop Computers (Notebooks):** These are portable computers that combine all components into a single, compact unit. They are popular for their convenience and can be used almost anywhere.
- **Tablet Computers:** These are portable computers with a touchscreen interface, often without a physical keyboard. They are great for browsing the internet, reading, and playing games.
- **Smartphones:** While primarily phones, modern smartphones are powerful computers that can perform many tasks, including browsing the web, running applications, and playing media. [9]

## **Workstations**

Workstations are powerful desktop computers designed for specialized tasks that require high performance, such as graphic design, video editing, and engineering. They are more powerful than regular PCs but less powerful than minicomputers. [10]

## Embedded Computers

These are small, specialized computers built into other devices to control their functions. You can find them in cars, washing machines, smart TVs, and many other electronic devices. They are designed to perform a specific task efficiently. [11]

## 1.4 Characteristics of Computers

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Computers have several key characteristics that make them so useful and powerful:

- **Speed:** Computers can perform calculations and process data at incredibly high speeds, much faster than humans. They can complete millions of operations in a single second.
- **Accuracy:** When given correct instructions, computers perform tasks with very high accuracy. Errors usually happen because of human mistakes in programming or data entry, not because of the computer itself.
- **Diligence:** Computers can work continuously for long hours without getting tired or losing concentration. They perform repetitive tasks with the same speed and accuracy every time.
- **Versatility:** Computers are highly versatile machines. They can perform a wide range of tasks, from complex scientific calculations to playing games, writing documents, and managing finances. One computer can be used for many different purposes.
- **Storage Capacity:** Computers can store vast amounts of data and information. This data can be easily accessed and retrieved whenever needed. Modern storage devices can hold terabytes of information. [12]
- **Automation:** Once programmed, computers can perform tasks automatically without human intervention. This saves time and effort.
- **Reliability:** Modern computers are very reliable and rarely break down, especially if they are well-maintained and used correctly.

## 1.5 Uses of Computers in Society

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Computers have become an essential part of our daily lives and are used in almost every field. Here are some key areas:

## **Education**

Computers are widely used in education for teaching, learning, and administration. Students use computers for research, writing assignments, and online learning. Teachers use them to prepare lessons, create presentations, and manage student records. [13]

## **Business and Finance**

In business, computers are used for managing sales, inventory, payroll, and customer data. They help in financial transactions, stock market analysis, and online banking. E-commerce platforms rely heavily on computers for online shopping and sales. [14]

## **Healthcare**

Computers play a vital role in healthcare, from managing patient records and appointments to assisting in medical research and diagnostics. They are used in hospitals for monitoring patients, performing complex surgeries, and analyzing medical images. [15]

## **Entertainment**

Computers are at the heart of the entertainment industry. They are used for creating movies, animations, video games, and music. We use computers to stream videos, listen to music, and connect with friends on social media. [16]

## **Communication**

Computers have revolutionized communication. Email, instant messaging, video calls, and social media platforms all rely on computers and the internet, allowing people to connect instantly across the globe. [17]

## **Government**

Governments use computers for managing public records, national defense, law enforcement, and providing public services. They help in data analysis for policy-making and managing large-scale projects. [18]

## **Science and Research**

Scientists and researchers use supercomputers and powerful software to analyze complex data, simulate experiments, model natural phenomena, and develop new technologies. [19]

## **Manufacturing and Engineering**

Computers are used in manufacturing for designing products (CAD/CAM), controlling machinery, and managing production lines. In engineering, they help in designing structures, analyzing stress, and creating simulations. [20]

## **Transportation**

Computers are used in managing traffic systems, controlling air and rail transportation, and in navigation systems in cars and airplanes. They also play a role in logistics and supply chain management. [21]

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## 2. Computer Hardware

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Computer hardware refers to the physical parts of a computer system that you can see and touch. These are the electronic and mechanical components that make the computer work. Without hardware, software would have nothing to run on. Think of hardware as the body of the computer, and software as its brain and instructions.

### 2.1 Basic Components of a Computer System

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A typical computer system is made up of several essential hardware components that work together to perform tasks. These include input devices, output devices, the Central Processing Unit (CPU), memory, and storage devices.

#### Input Devices

Input devices are used to send data and instructions into the computer. They allow users to communicate with the computer. Here are some common examples:

- **Keyboard:** This is the most common input device, used for typing text, numbers, and commands into the computer. It has keys for letters, numbers, symbols, and special functions.
- **Mouse:** A pointing device used to control a cursor on the screen. It allows you to select items, open programs, and navigate through documents by clicking, dragging, and scrolling.
- **Microphone:** Used to input audio, such as voice commands, music, or sound recordings, into the computer.
- **Scanner:** Converts physical documents or images into digital format that can be stored and processed by the computer.
- **Webcam:** A digital camera connected to the computer, used for video calls, recording videos, and taking pictures.
- **Touchscreen:** Allows users to interact with the computer by touching the screen directly with their finger or a stylus. Common in smartphones, tablets, and some laptops.

## Output Devices

Output devices display or present the results of the computer's processing to the user. They allow the computer to communicate back to the user. Here are some common examples:

- **Monitor (Screen):** The most common output device, it displays visual information, such as text, images, and videos. Monitors come in various sizes and resolutions.
- **Printer:** Produces a hard copy of digital documents or images on paper. There are different types, such as inkjet and laser printers.
- **Speakers/Headphones:** Used to output audio from the computer, allowing you to hear music, sounds, and spoken words.
- **Projector:** Displays computer output onto a large screen or wall, often used for presentations or in classrooms.

## Central Processing Unit (CPU)

The CPU, often called the

'brain' of the computer, is the most important component. It performs all the calculations, executes instructions, and manages the flow of information. The speed of a CPU is measured in gigahertz (GHz), and a higher GHz generally means a faster computer. The CPU has several key parts:

- **Arithmetic Logic Unit (ALU):** This part performs all arithmetic operations (like addition, subtraction, multiplication, and division) and logical operations (like comparing numbers).
- **Control Unit (CU):** This unit manages and coordinates all the components of the computer. It fetches instructions from memory, decodes them, and directs the operations of the other units.
- **Registers:** These are small, high-speed storage locations within the CPU that temporarily hold data and instructions during processing.

## Memory (RAM, ROM)

Computer memory is used to store data and instructions that the CPU needs to access quickly. There are two main types of memory:

- **Random Access Memory (RAM):** RAM is a temporary storage area that the CPU uses to hold data and programs that are currently being used. It is called 'random access' because the CPU can quickly access any piece of data directly. RAM is volatile, meaning

that all the data stored in it is lost when the computer is turned off. More RAM generally means the computer can run more programs at once and perform tasks faster.

- **Read-Only Memory (ROM):** ROM is a type of memory that stores permanent instructions that the computer needs to start up (like the BIOS or UEFI). The data in ROM cannot be easily changed or erased, and it is non-volatile, meaning its contents are not lost when the power is turned off.

## Storage Devices (HDD, SSD, USB, Cloud)

Storage devices are used to keep data and programs permanently, even when the computer is turned off. Unlike RAM, storage is non-volatile. Here are some common types:

- **Hard Disk Drive (HDD):** Traditional storage devices that use spinning magnetic platters to store data. They offer large storage capacities at a relatively low cost but are slower and more fragile than SSDs.
- **Solid State Drive (SSD):** Newer storage devices that use flash memory to store data. They are much faster, more durable, and more energy-efficient than HDDs, but generally more expensive per gigabyte.
- **USB Flash Drive (Pen Drive):** Small, portable storage devices that use flash memory. They are convenient for transferring files between computers.
- **Cloud Storage:** Storing data on remote servers accessed over the internet. Examples include Google Drive, Dropbox, and Microsoft OneDrive. This allows access to data from any device with an internet connection and provides backup.

## 2.2 Motherboard and its Components

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The motherboard is the main circuit board of a computer. It is a large printed circuit board that connects all the other components of the computer, allowing them to communicate with each other. Think of it as the central nervous system of the computer. Key components found on the motherboard include:

- **CPU Socket:** This is where the Central Processing Unit (CPU) is installed.
- **RAM Slots:** These slots hold the RAM modules (memory sticks).
- **Expansion Slots (PCIe, PCI):** These slots allow you to add expansion cards, such as graphics cards, sound cards, or network cards, to enhance the computer's capabilities.
- **Chipset:** A set of integrated circuits that manage the flow of data between the CPU, memory, and peripherals. It acts as a traffic controller.

- **BIOS/UEFI Chip:** Contains the firmware (basic input/output system or Unified Extensible Firmware Interface) that starts up the computer and manages basic hardware functions.
- **SATA Ports:** Used to connect storage devices like HDDs and SSDs.
- **USB Headers:** Internal connectors for front panel USB ports.

## 2.3 Ports and Connectors

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Ports and connectors are physical interfaces on the computer that allow you to connect external devices (peripherals). They enable communication between the computer and devices like monitors, keyboards, mice, printers, and external drives. Here are some common types:

- **USB (Universal Serial Bus) Ports:** The most common type of port, used to connect a wide variety of devices, including keyboards, mice, printers, flash drives, and smartphones. USB comes in different versions (e.g., USB 2.0, 3.0, 3.1, USB-C), with varying speeds and capabilities.
- **HDMI (High-Definition Multimedia Interface):** Used to transmit high-definition video and audio signals from the computer to a monitor, TV, or projector.
- **DisplayPort:** Another digital display interface, often found on computers and monitors, offering similar capabilities to HDMI.
- **VGA (Video Graphics Array):** An older analog video output port, still found on some older monitors and projectors.
- **Ethernet Port (RJ-45):** Used to connect the computer to a wired network (LAN) using an Ethernet cable, providing internet access.
- **Audio Jacks:** Typically include ports for headphones, microphones, and line-in/line-out for connecting audio devices.
- **Power Connector:** Used to connect the power supply unit to the computer.

## 3. Computer Software

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Software is a set of instructions, data, or programs used to operate computers and execute specific tasks. Unlike hardware, software is intangible, meaning you cannot touch it. It is the brain and personality of the computer, telling the hardware what to do. Without software, hardware is just a collection of inert components.

## 3.1 What is Software?

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Software is essentially a collection of programs, procedures, and routines that enable a computer to perform a specific task or set of tasks. It is written by programmers using various programming languages. Software can be thought of as the bridge between the user and the computer hardware, translating human commands into machine-understandable instructions.

## 3.2 Types of Software

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Software can be broadly categorized into two main types: System Software and Application Software.

### System Software

System software is designed to control and manage the basic operations of a computer system. It provides a platform for application software to run and interacts directly with the computer hardware. Key types of system software include:

- **Operating Systems (OS):** The most important type of system software. It manages all the hardware and software resources of the computer. It acts as an intermediary between the user and the computer hardware. Examples include Windows, macOS, Linux, Android, and iOS.
- **Utility Programs:** These are small programs that help to maintain and optimize the computer's performance. Examples include antivirus software, disk cleanup tools, file compression utilities, and backup software.
- **Device Drivers:** These are special programs that allow the operating system to communicate with specific hardware devices (like printers, graphics cards, or webcams). Each hardware device needs a specific driver to function correctly.

### Application Software

Application software (often just called 'apps') is designed to perform specific tasks for the user. These programs are built on top of the operating system and use the computer's resources to help users complete their work or entertain themselves. Examples include:

- **Word Processors:** Used for creating, editing, and formatting text documents.  
Examples: Microsoft Word, Google Docs.

- **Spreadsheet Software:** Used for organizing, analyzing, and storing data in tabular form. Examples: Microsoft Excel, Google Sheets.
- **Presentation Software:** Used for creating slideshows for presentations. Examples: Microsoft PowerPoint, Google Slides.
- **Web Browsers:** Used to access and view websites on the internet. Examples: Google Chrome, Mozilla Firefox, Microsoft Edge.
- **Multimedia Software:** Used for playing, editing, or creating audio and video files. Examples: VLC Media Player, Adobe Photoshop (for images), Adobe Premiere Pro (for video).
- **Database Management Systems (DBMS):** Used for creating, managing, and retrieving information from databases. Examples: Microsoft Access, MySQL.

### 3.3 Programming Languages (Brief Introduction)

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Programming languages are special languages used by humans to write instructions for computers. These instructions are then translated into a language that the computer can understand (machine code). There are many different programming languages, each with its strengths and uses. Some popular examples include:

- **Python:** A very popular and easy-to-learn language, used for web development, data analysis, artificial intelligence, and more.
- **Java:** A widely used language for developing enterprise-level applications, Android mobile apps, and large systems.
- **C++:** A powerful and efficient language used for game development, operating systems, and high-performance applications.
- **JavaScript:** Primarily used for making websites interactive and dynamic. It also plays a role in web and mobile application development.

## 4. Operating Systems

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An operating system (OS) is the most important software that runs on a computer. It manages all the computer's hardware and software resources and provides common services for computer programs. Without an operating system, a computer is just a useless piece of hardware.

## 4.1 What is an Operating System?

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An operating system is a master control program that acts as an intermediary between the user of a computer and the computer hardware. Its main purpose is to make the computer system convenient to use and to manage the computer hardware in an efficient manner. When you turn on your computer, the operating system is the first software to load, and it stays in memory until you turn off the computer.

## 4.2 Functions of an Operating System

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The operating system performs several critical functions to ensure the smooth operation of the computer:

- **Memory Management:** The OS manages the computer's main memory (RAM). It decides which programs get memory, when, and how much. It also allocates and deallocates memory space to programs as needed.
- **Process Management:** The OS manages the execution of all programs (processes). It decides which process gets the CPU, when, and for how long. It handles the creation, scheduling, and termination of processes.
- **Device Management:** The OS manages all the input/output (I/O) devices connected to the computer, such as printers, scanners, and hard drives. It ensures that these devices work correctly and that programs can access them when needed.
- **File Management:** The OS organizes and manages files and folders on storage devices. It allows users to create, delete, copy, move, and rename files and directories. It also controls access to files.
- **Security:** The OS provides security features to protect the computer system from unauthorized access. This includes password protection, user authentication, and access control for files and resources.
- **User Interface (UI):** The OS provides a way for users to interact with the computer. This can be a Graphical User Interface (GUI) with icons, menus, and windows (like Windows or macOS), or a Command Line Interface (CLI) where users type commands (like some versions of Linux).
- **Error Handling:** The OS detects and responds to errors, such as hardware failures, software errors, or power outages. It tries to recover from errors and inform the user.

## 4.3 Types of Operating Systems

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There are many different operating systems, each designed for specific types of devices or uses. Some of the most common ones include:

- **Microsoft Windows:** The most popular operating system for personal computers worldwide. It is known for its user-friendly graphical interface and wide software compatibility.
- **macOS (formerly OS X):** The operating system developed by Apple for its Macintosh computers. It is known for its elegant design, strong security, and integration with Apple's ecosystem.
- **Linux:** An open-source operating system that is highly customizable and free to use. It is popular among developers, servers, and embedded systems. Many different versions (distributions) of Linux exist, such as Ubuntu, Fedora, and Debian.
- **Android:** A mobile operating system developed by Google, primarily used for smartphones and tablets. It is the most widely used mobile OS globally.
- **iOS:** A mobile operating system developed by Apple for its iPhone and iPad devices. It is known for its simplicity, security, and smooth performance.

## 4.4 Basic Operating System Operations (File Management, User Interface)

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Understanding basic OS operations is crucial for any computer user.

### File Management

File management involves organizing and handling files and folders on your computer. The operating system provides tools to:

- **Create:** Make new files and folders.
- **Save:** Store files on a storage device.
- **Open:** Access and view the content of files.
- **Copy/Cut/Paste:** Duplicate or move files and folders from one location to another.
- **Delete:** Remove unwanted files and folders.
- **Rename:** Change the name of a file or folder.
- **Search:** Find files or folders on your computer.

These operations are typically performed using a file explorer or file manager application provided by the OS (e.g., File Explorer in Windows, Finder in macOS).

## User Interface (UI)

The user interface is how you interact with the operating system. The two main types are:

- **Graphical User Interface (GUI):** This is the most common type, using visual elements like icons, windows, menus, and pointers (controlled by a mouse) to allow users to interact with the computer. It is intuitive and easy to learn.
- **Command Line Interface (CLI):** This interface requires users to type text commands to interact with the computer. It is more powerful for certain tasks and is often used by advanced users and programmers.

# 5. Data Representation and Storage

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Computers process and store information in a way that is different from how humans understand it. They use a system based on electricity being either on or off. This section explains how data is represented and measured in a computer.

## 5.1 Bits and Bytes

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At its most basic level, a computer understands only two states: on or off. These two states are represented by **binary digits**, or **bits**.

- **Bit:** The smallest unit of data in a computer. A bit can have a value of either 0 (off) or 1 (on).

Because a single bit can only represent two possibilities, computers group bits together to represent more complex information. The most common grouping is a **byte**.

- **Byte:** A group of 8 bits. A byte is the fundamental unit of data storage and processing in most computer systems. With 8 bits, a byte can represent 256 different values ( $2^8$ ), which is enough to represent a single character (like a letter, number, or symbol) or a small number.

For example: \* The letter 'A' might be represented as 01000001 in binary. \* The number 5 might be represented as 00000101 in binary.

## 5.2 Number Systems (Binary, Decimal)

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Humans primarily use the **decimal number system** (base-10), which uses ten digits (0-9). Computers, however, use the **binary number system** (base-2), which uses only two digits (0 and 1).

- **Decimal System (Base-10):** Each position in a decimal number represents a power of 10. For example, the number 123 means  $(1 * 10^2) + (2 * 10^1) + (3 * 10^0)$ .
- **Binary System (Base-2):** Each position in a binary number represents a power of 2. For example, the binary number 1011 means  $(1 * 2^3) + (0 * 2^2) + (1 * 2^1) + (1 * 2^0) = 8 + 0 + 2 + 1 = 11$  in decimal.

Understanding binary is important because it is the fundamental language of computers. All data, whether it's text, images, audio, or video, is ultimately stored and processed as binary code.

## 5.3 Units of Storage (KB, MB, GB, TB)

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Because data is stored in bits and bytes, we need larger units to measure the vast amounts of information computers handle. These units are based on powers of 1024 (which is  $2^{10}$ ), not 1000, due to the binary nature of computers. However, for simplicity, they are often approximated as powers of 1000 in everyday language.

Here are the common units of storage:

- **Kilobyte (KB):** Approximately one thousand bytes. More precisely,  $1 \text{ KB} = 1024 \text{ bytes}$ .
- **Megabyte (MB):** Approximately one million bytes. More precisely,  $1 \text{ MB} = 1024 \text{ KB} = 1,048,576 \text{ bytes}$ .
- **Gigabyte (GB):** Approximately one billion bytes. More precisely,  $1 \text{ GB} = 1024 \text{ MB} = 1,073,741,824 \text{ bytes}$ .
- **Terabyte (TB):** Approximately one trillion bytes. More precisely,  $1 \text{ TB} = 1024 \text{ GB} = 1,099,511,627,776 \text{ bytes}$ .

To give you an idea of scale: \* A typical text document might be a few KBs. \* A high-quality photo might be a few MBs. \* A movie might be several GBs. \* A large hard drive can store several TBs of data.

# 6. Computer Networks and the Internet

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Computer networks allow computers to share data and resources with each other. The Internet is the largest and most well-known computer network, connecting billions of devices worldwide.

## 6.1 What is a Computer Network?

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A computer network is a group of two or more interconnected computers and other devices that can share resources (like printers and files) and exchange data. The purpose of a network is to enable communication and resource sharing among connected devices.

## 6.2 Types of Networks (LAN, WAN)

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Networks can be classified based on their size and geographical area:

- **Local Area Network (LAN):** A network that connects computers and devices within a small, limited geographical area, such as a home, office building, or school campus. LANs are typically fast and secure.
- **Wide Area Network (WAN):** A network that covers a large geographical area, connecting multiple LANs over long distances. The Internet is the most famous example of a WAN. WANs often use public telecommunication lines.

Other types of networks include:

- **Metropolitan Area Network (MAN):** A network that covers a city or a large campus, larger than a LAN but smaller than a WAN.
- **Personal Area Network (PAN):** A very small network used for connecting personal devices, such as a smartphone to a Bluetooth headset.

## 6.3 Network Devices (Routers, Switches)

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Several devices are essential for creating and managing computer networks:

- **Router:** A device that connects different networks and forwards data packets between them. Routers are crucial for connecting a local network to the Internet.

- **Switch:** A device that connects multiple devices within a single LAN. It learns the addresses of connected devices and sends data only to the intended recipient, making the network more efficient.
- **Modem:** A device that converts digital signals from a computer into analog signals for transmission over telephone lines or cable, and vice versa. It is necessary for connecting to the Internet via an Internet Service Provider (ISP).

## 6.4 Introduction to the Internet

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The Internet is a global system of interconnected computer networks that uses the Internet Protocol (IP) suite to communicate between networks and devices. It is a vast public network that allows users to share information and communicate from anywhere in the world.

## 6.5 World Wide Web (WWW)

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The World Wide Web, often called simply 'the Web,' is a system of interconnected documents and other web resources that are accessed via the Internet. It uses HTTP (Hypertext Transfer Protocol) to transmit data and is navigated using web browsers. The Web is just one of the many services available on the Internet.

## 6.6 Web Browsers and Search Engines

---

- **Web Browser:** A software application used to access and display web pages on the World Wide Web. Examples include Google Chrome, Mozilla Firefox, Microsoft Edge, and Apple Safari.
- **Search Engine:** A software system designed to carry out web searches, meaning to search the World Wide Web in a systematic way for particular information specified in a textual web search query. Examples include Google, Bing, and Yahoo Search.

## 6.7 Email and Online Communication

---

- **Email (Electronic Mail):** A method of exchanging digital messages from an author to one or more recipients. It is one of the most widely used features of the Internet for personal and professional communication.
- **Online Communication:** Includes various forms of communication over the internet, such as instant messaging (WhatsApp, Telegram), video conferencing (Zoom, Google

Meet), and social media platforms (Facebook, Twitter, Instagram).

## 7. Computer Security and Ethics

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As computers and the Internet become more integrated into our lives, understanding computer security and ethical behavior is crucial. This section covers basic concepts to keep your data safe and use technology responsibly.

### 7.1 Introduction to Computer Security

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Computer security, also known as cybersecurity, refers to the protection of computer systems and networks from information disclosure, theft of or damage to their hardware, software, or electronic data, as well as from the disruption or misdirection of the services they provide. The goal is to ensure the **Confidentiality, Integrity, and Availability (CIA)** of information.

### 7.2 Types of Threats (Viruses, Malware, Phishing)

---

Computers and networks face various threats. Some common ones include:

- **Viruses:** Malicious programs that attach themselves to legitimate programs and spread to other computers when the infected program is executed. They can damage files, slow down systems, or even crash computers.
- **Malware (Malicious Software):** A broad term that includes viruses, worms, Trojans, ransomware, spyware, and adware. Malware is designed to disrupt, damage, or gain unauthorized access to a computer system.
- **Phishing:** A type of online fraud where attackers try to trick individuals into revealing sensitive information (like usernames, passwords, and credit card details) by pretending to be a trustworthy entity in an electronic communication, such as an email or text message.
- **Ransomware:** A type of malware that encrypts a victim's files and demands a ransom payment to restore access.
- **Spyware:** Software that secretly observes the user's activities without their permission and reports them to others.

## 7.3 Basic Security Practices (Antivirus, Passwords)

---

To protect your computer and data, follow these basic security practices:

- **Use Antivirus Software:** Install and regularly update reputable antivirus software to detect and remove malware.
- **Use Strong, Unique Passwords:** Create complex passwords that combine uppercase and lowercase letters, numbers, and symbols. Avoid using easily guessable information. Use different passwords for different accounts.
- **Enable Two-Factor Authentication (2FA):** Whenever possible, enable 2FA, which adds an extra layer of security by requiring a second form of verification (like a code from your phone) in addition to your password.
- **Keep Software Updated:** Regularly update your operating system, web browser, and other software. Updates often include security patches that fix vulnerabilities.
- **Be Careful with Emails and Links:** Do not open suspicious emails or click on links from unknown senders. Be wary of attachments.
- **Backup Your Data:** Regularly back up important files to an external hard drive or cloud storage to prevent data loss in case of a system failure or attack.
- **Use a Firewall:** A firewall monitors incoming and outgoing network traffic and blocks unauthorized access to your computer.

## 7.4 Computer Ethics and Responsible Use

---

Computer ethics are a set of moral principles that regulate the use of computers. Responsible use of technology means understanding the impact of your actions and behaving in a way that is respectful, legal, and ethical.

- **Respect Privacy:** Do not access or share someone else's private information without their permission.
- **Respect Intellectual Property:** Do not illegally download or distribute copyrighted material (music, movies, software). Give credit to original creators.
- **Avoid Cyberbullying:** Do not use technology to harass, threaten, or intimidate others.
- **Be Truthful Online:** Do not spread false information or engage in deceptive practices.
- **Do Not Damage Systems:** Do not intentionally create or spread malware, or try to damage computer systems.

- **Think Before You Post:** Remember that anything you post online can be permanent and seen by many people.

## 7.5 Cybersecurity Basics

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Cybersecurity is the practice of protecting systems, networks, and programs from digital attacks. It's a broader concept than just computer security, encompassing the entire digital landscape. For a beginner, understanding that cybersecurity is about protecting information in the digital world is key. It involves using technology, processes, and controls to protect systems, networks, programs, devices, and data from cyberattacks.

# 8. Problem Solving and Algorithms

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Computers are powerful tools for solving problems, but they need clear, step-by-step instructions. This section introduces the fundamental concepts of problem-solving using algorithms.

## 8.1 Introduction to Problem Solving

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Problem-solving in computing involves finding a solution to a specific problem by breaking it down into smaller, manageable steps that a computer can follow. It's not just about writing code; it's about thinking logically and systematically to arrive at an efficient solution.

## 8.2 What is an Algorithm?

---

An **algorithm** is a set of well-defined, step-by-step instructions for solving a problem or performing a task. It's like a recipe: it tells you exactly what to do, in what order, to achieve a desired outcome. Algorithms must be:

- **Clear and Unambiguous:** Each step must be precisely defined, with no room for confusion.
- **Finite:** The algorithm must end after a finite number of steps.
- **Effective:** Each step must be simple enough to be carried out, either by a person or a machine.

- **Input/Output:** An algorithm takes zero or more inputs and produces one or more outputs.

Algorithms are not limited to computers; you use algorithms in your daily life without realizing it (e.g., following instructions to assemble furniture, or a recipe to cook a meal).

## 8.3 Flowcharts and Pseudocode (Basic Concepts)

---

To design and represent algorithms before writing actual computer code, two common tools are used:

### Flowcharts

A flowchart is a visual representation of an algorithm or process, using standard symbols to show the sequence of steps and decisions. It helps in understanding the logic of a program or system.

Common Flowchart Symbols:

- **Oval (Terminal):** Represents the start or end of a process.
- **Rectangle (Process):** Represents a step in the process, an action or operation.
- **Diamond (Decision):** Represents a point where a decision is made, usually a yes/no question, with different paths for each answer.
- **Parallelogram (Input/Output):** Represents data entering or leaving the system.
- **Arrows (Flowlines):** Show the direction of the flow of control.

### Pseudocode

Pseudocode is a plain language description of the steps in an algorithm or program. It is not a real programming language but uses a simplified, structured English-like syntax to describe the logic. It helps programmers plan their code before writing it in a specific language.

Example of Pseudocode for adding two numbers:

```
START
    READ number1
    READ number2
    CALCULATE sum = number1 + number2
    PRINT sum
END
```

Both flowcharts and pseudocode are valuable tools for planning and communicating algorithms, making it easier to translate them into actual computer programs.

# 9. Introduction to Web and Mobile Application Development (Basic Concepts)

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In today's digital world, web and mobile applications are everywhere. This section provides a very basic introduction to what they are and how they are generally created.

## 9.1 Web Application Development

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A **web application** is a software program that runs on a web server and is accessed by users through a web browser over the Internet. Unlike traditional desktop applications that are installed on your computer, web apps don't need to be installed; you just need a web browser and an internet connection.

Examples of web applications include online banking systems, social media platforms (like Facebook, Twitter), online shopping sites (like Amazon), and web-based email services (like Gmail).

Key concepts in web development:

- **Frontend:** This is the part of the web application that users see and interact with. It includes the design, layout, and all the interactive elements. Technologies used for frontend development include HTML (for structure), CSS (for styling), and JavaScript (for interactivity).
- **Backend:** This is the 'server-side' of the web application, which users don't directly see. It handles data storage, processing, and communication with databases. Backend languages include Python, Java, PHP, and Node.js.
- **Database:** Used to store and manage the data for the web application (e.g., user information, product details).

## 9.2 Mobile Application Development

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A **mobile application** (or mobile app) is a software application designed to run on mobile devices such as smartphones and tablet computers. Mobile apps are typically downloaded

from app stores (like Google Play Store or Apple App Store) and installed directly on the device.

Examples of mobile applications include WhatsApp, Instagram, mobile games, and banking apps.

Key concepts in mobile development:

- **Native Apps:** These apps are built specifically for a particular mobile operating system (e.g., Android using Java/Kotlin, iOS using Swift/Objective-C). They offer the best performance and access to device features but require separate development for each platform.
- **Cross-Platform Apps:** These apps are developed once and can run on multiple mobile operating systems (e.g., using frameworks like React Native or Flutter). They save development time but might have some limitations compared to native apps.

Both web and mobile development involve understanding user needs, designing interfaces, writing code, and testing to ensure the application works correctly and provides a good user experience.

## 10. Emerging Technologies (Brief Overview)

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The field of computer science is constantly evolving, with new technologies emerging rapidly. Here's a brief look at some important emerging areas that are shaping the future.

### 10.1 Artificial Intelligence (AI)

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**Artificial Intelligence (AI)** is a broad field of computer science that aims to create machines that can perform tasks that typically require human intelligence. This includes learning, problem-solving, decision-making, understanding language, and recognizing patterns.

Key areas within AI:

- **Machine Learning (ML):** A subset of AI that allows systems to learn from data without being explicitly programmed. It involves training algorithms on large datasets to make predictions or decisions.
- **Deep Learning (DL):** A subset of machine learning that uses artificial neural networks with multiple layers to learn complex patterns from data, often used in image and speech recognition.

- **Natural Language Processing (NLP):** Enables computers to understand, interpret, and generate human language. Used in virtual assistants (like Siri, Alexa), translation tools, and chatbots.

AI is being applied in many fields, including healthcare (diagnostics), finance (fraud detection), transportation (self-driving cars), and entertainment (recommendation systems).

## 10.2 Cloud Computing

---

**Cloud computing** is the delivery of computing services—including servers, storage, databases, networking, software, analytics, and intelligence—over the Internet (the “cloud”). Instead of owning their own computing infrastructure or data centers, companies can rent access to applications, storage, and processing power from a third-party provider.

Key characteristics of cloud computing:

- **On-demand self-service:** Users can provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.
- **Broad network access:** Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, laptops, and PDAs).
- **Resource pooling:** The provider’s computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand.
- **Rapid elasticity:** Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time.
- **Measured service:** Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer.

Common cloud service models:

- **Infrastructure as a Service (IaaS):** Provides virtualized computing resources over the internet. Users manage the operating system and applications, while the provider manages the infrastructure (servers, storage, networking). Examples: Amazon Web Services (AWS) EC2, Microsoft Azure Virtual Machines.
- **Platform as a Service (PaaS):** Provides a platform allowing customers to develop, run, and manage applications without the complexity of building and maintaining the infrastructure typically associated with developing and launching an app. Examples: Google App Engine, AWS Elastic Beanstalk.
- **Software as a Service (SaaS):** Delivers software applications over the internet, on a subscription basis. Users access the software via a web browser or mobile app, and the provider manages all the underlying infrastructure and software. Examples: Gmail, Salesforce, Dropbox.

Cloud computing offers benefits like cost savings, increased flexibility, scalability, and reliability.

## 10.3 Big Data

---

**Big Data** refers to extremely large and complex datasets that cannot be easily processed or analyzed using traditional data processing applications. These datasets are characterized by three Vs:

- **Volume:** The sheer amount of data generated every second from various sources like social media, sensors, transactions, etc.
- **Velocity:** The speed at which data is generated, collected, and processed. In many cases, data needs to be analyzed in real-time.
- **Variety:** The diverse types of data, which can be structured (like in databases), semi-structured (like XML files), or unstructured (like text, images, audio, video).

Big Data is used to uncover hidden patterns, unknown correlations, market trends, customer preferences, and other useful information that can help organizations make more informed business decisions. It is applied in areas like personalized marketing, fraud detection, scientific discovery, and smart city planning.

Tools and technologies for Big Data include Hadoop, Spark, and various NoSQL databases, which are designed to handle the scale and complexity of these massive datasets.

# Glossary of Terms

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**Algorithm:** A set of well-defined, step-by-step instructions for solving a problem or performing a task.

**Application Software:** Programs designed to perform specific tasks for the user, such as word processing or web browsing.

**Artificial Intelligence (AI):** A field of computer science that aims to create machines that can perform tasks typically requiring human intelligence.

**Binary:** A number system that uses only two digits, 0 and 1.

**Bit:** The smallest unit of data in a computer, representing either 0 or 1.

**Byte:** A group of 8 bits, typically representing a single character.

**Central Processing Unit (CPU):** The 'brain' of the computer, responsible for executing instructions and performing calculations.

**Cloud Computing:** The delivery of computing services (servers, storage, databases, networking, software, analytics, intelligence) over the Internet.

**Computer Hardware:** The physical parts of a computer system that you can see and touch.

**Computer Network:** A group of two or more interconnected computers and other devices that can share resources and exchange data.

**Cybersecurity:** The practice of protecting computer systems, networks, and programs from digital attacks.

**Data:** Raw facts, figures, or symbols that are processed by a computer.

**Desktop Computer:** A personal computer with a separate monitor, keyboard, mouse, and main computer case, typically placed on a desk.

**Device Driver:** A special program that allows the operating system to communicate with a specific hardware device.

**Email (Electronic Mail):** A method of exchanging digital messages over the Internet.

**Embedded Computer:** A small, specialized computer built into other devices to control their functions.

**Ethernet Port:** A port used to connect a computer to a wired network using an Ethernet cable.

**Flowchart:** A visual representation of an algorithm or process using standard symbols.

**Gigabyte (GB):** A unit of digital information equal to 1024 megabytes (approximately one billion bytes).

**Graphical User Interface (GUI):** A type of user interface that allows users to interact with electronic devices through graphical icons and visual indicators.

**Hard Disk Drive (HDD):** A traditional storage device that uses spinning magnetic platters to store data.

**HDMI (High-Definition Multimedia Interface):** A port used to transmit high-definition video and audio signals.

**Input Device:** A device used to send data and instructions into the computer (e.g., keyboard, mouse).

**Integrated Circuit (IC):** A small chip that contains many transistors and other electronic components.

**Internet:** A global system of interconnected computer networks.

**Kilobyte (KB):** A unit of digital information equal to 1024 bytes (approximately one thousand bytes).

**Laptop Computer:** A portable computer that combines all components into a single, compact unit.

**Local Area Network (LAN):** A network that connects computers and devices within a small, limited geographical area.

**Malware:** Malicious software designed to disrupt, damage, or gain unauthorized access to a computer system.

**Megabyte (MB):** A unit of digital information equal to 1024 kilobytes (approximately one million bytes).

**Memory (RAM/ROM):** Temporary (RAM) or permanent (ROM) storage used by the CPU to access data quickly.

**Microprocessor:** A single chip that contains the entire Central Processing Unit (CPU).

**Motherboard:** The main circuit board of a computer that connects all other components.

**Operating System (OS):** The most important software that manages all the computer's hardware and software resources.

**Output Device:** A device that displays or presents the results of the computer's processing to the user (e.g., monitor, printer).

**Phishing:** A type of online fraud where attackers try to trick individuals into revealing sensitive information.

**Programming Language:** A special language used by humans to write instructions for computers.

**Pseudocode:** A plain language description of the steps in an algorithm or program.

**Random Access Memory (RAM):** Volatile memory used for temporary storage of data and programs currently in use.

**Read-Only Memory (ROM):** Non-volatile memory that stores permanent instructions for the computer to start up.

**Router:** A device that connects different networks and forwards data packets between them.

**Software:** A set of instructions, data, or programs used to operate computers and execute specific tasks.

**Solid State Drive (SSD):** A newer storage device that uses flash memory to store data, known for speed and durability.

**Storage Device:** Used to keep data and programs permanently (e.g., HDD, SSD, USB).

**Supercomputer:** The fastest and most powerful type of computer, used for complex calculations.

**System Software:** Software designed to control and manage the basic operations of a computer system.

**Tablet Computer:** A portable computer with a touchscreen interface, often without a physical keyboard.

**Terabyte (TB):** A unit of digital information equal to 1024 gigabytes (approximately one trillion bytes).

**Transistor:** A semiconductor device used to amplify or switch electronic signals and electrical power.

**USB (Universal Serial Bus) Port:** A common port used to connect a wide variety of external devices.

**Utility Programs:** Small programs that help to maintain and optimize the computer's performance.

**Vacuum Tube:** An early electronic component used in the first generation of computers.

**Virus:** A malicious program that attaches itself to legitimate programs and spreads to other computers.

**Web Browser:** A software application used to access and display web pages on the World Wide Web.

**Webcam:** A digital camera connected to the computer, used for video calls and recording videos.

**Wide Area Network (WAN):** A network that covers a large geographical area, connecting multiple LANs over long distances.

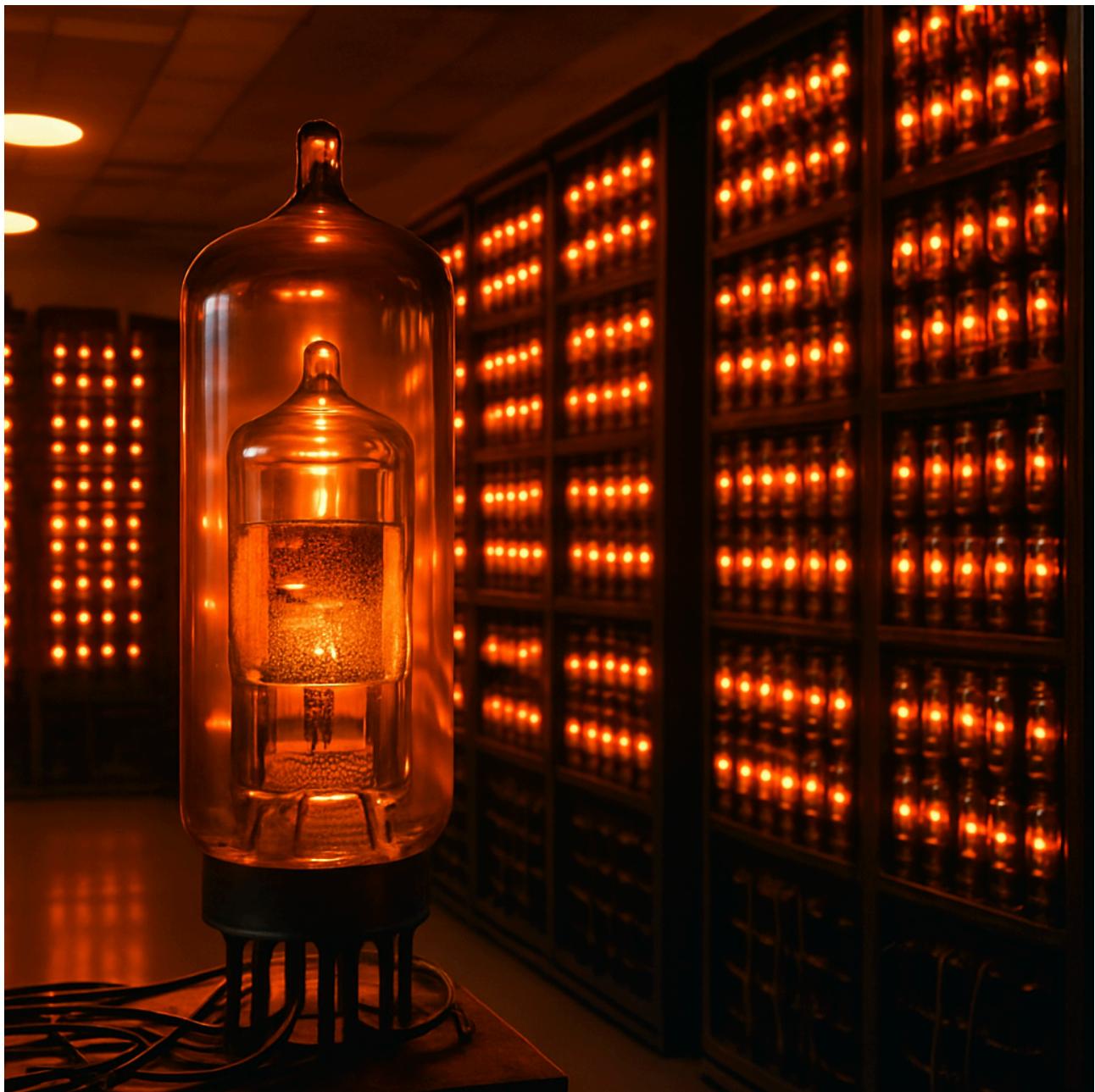
**World Wide Web (WWW):** A system of interconnected documents and other web resources accessed via the Internet.

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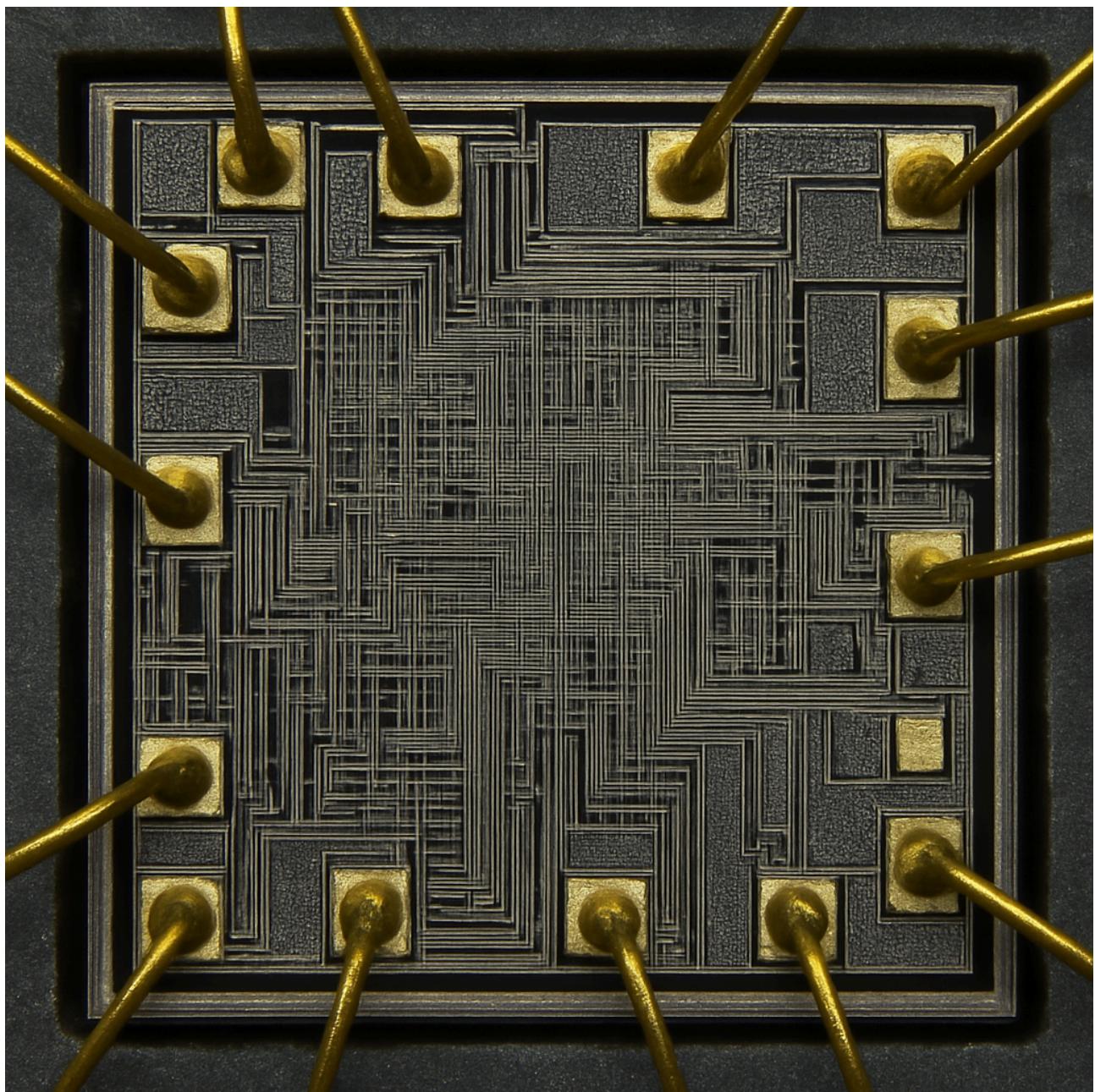
## First Generation (1940s-1950s): Vacuum Tubes



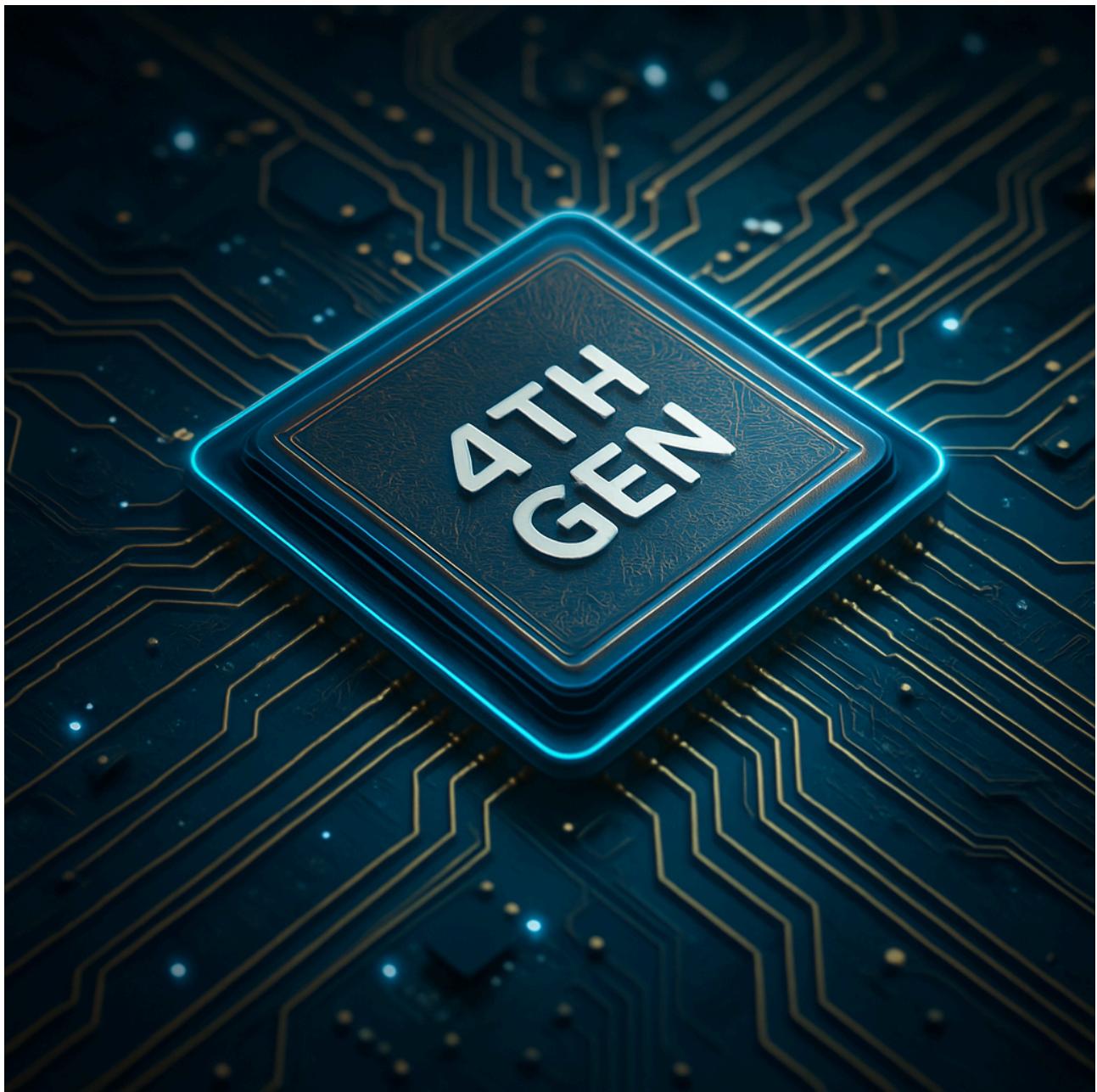
## Second Generation (1950s-1960s): Transistors



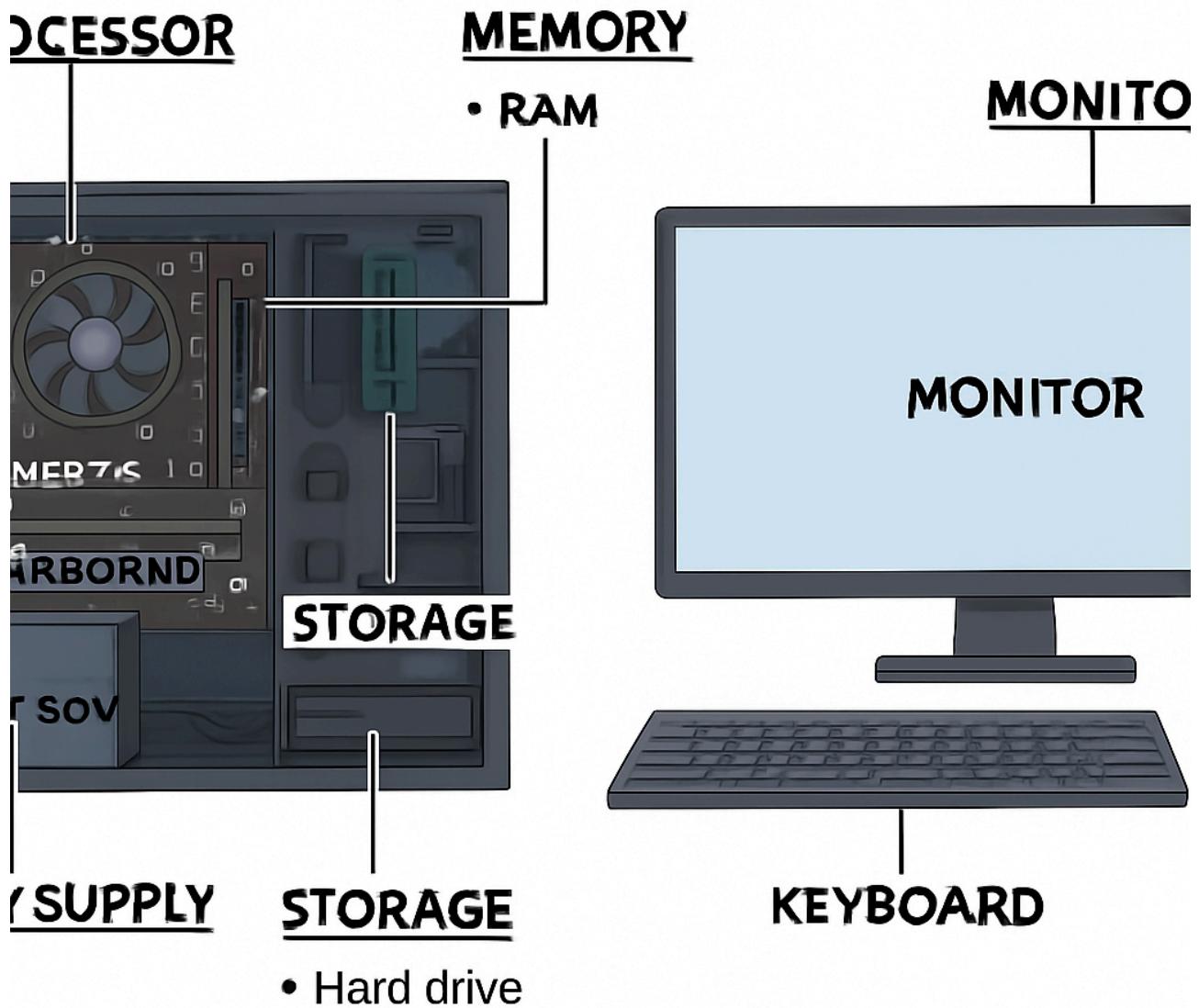
### Third Generation (1960s-1970s): Integrated Circuits



## Fourth Generation (1970s-Present): Microprocessors



## Basic Components of a Computer System



## Input Devices



## Input Devices



Output Devices

# Output Devices



Printer



Speakers



Printer

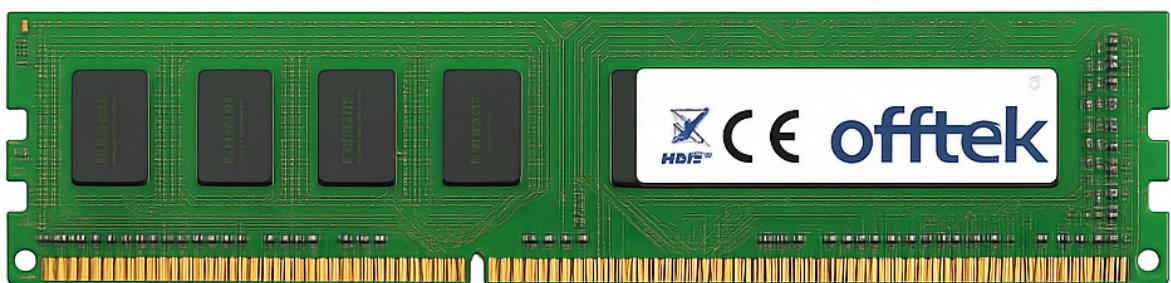


Multimedia  
Projector

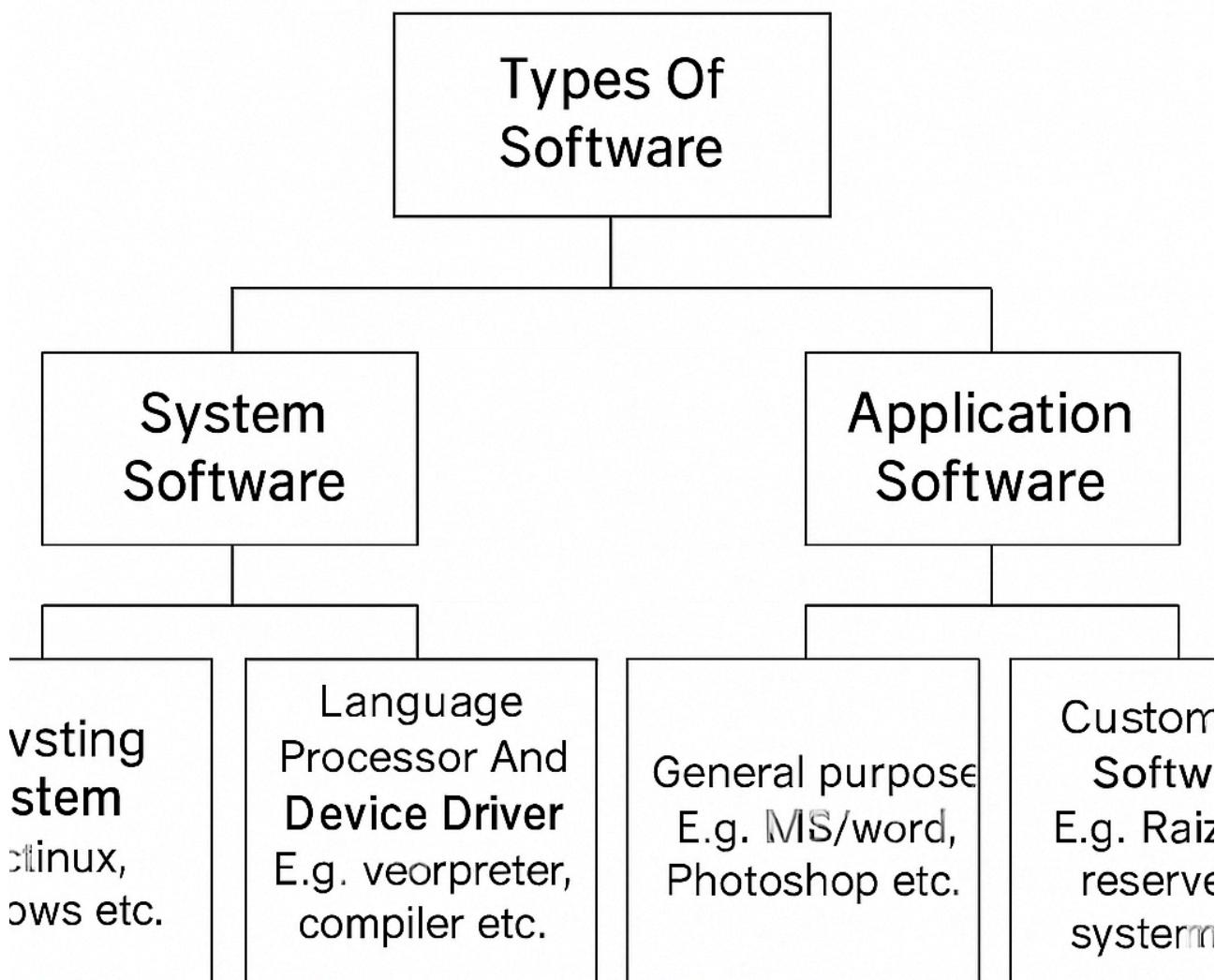
## Central Processing Unit (CPU)



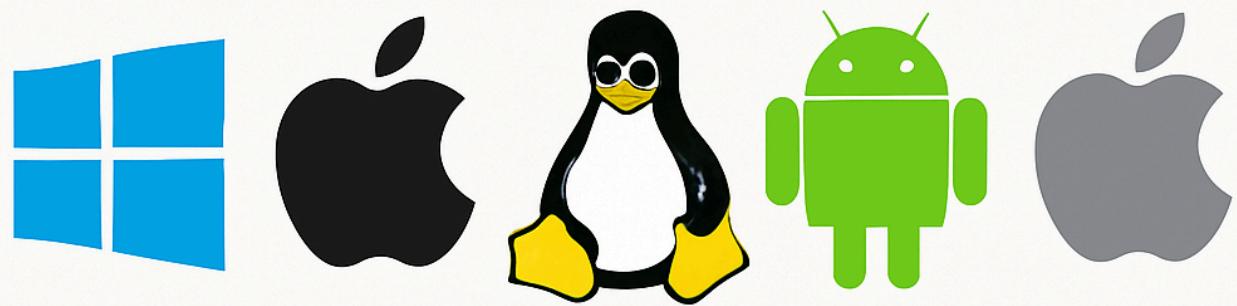
## Memory (RAM)



## Types of Software

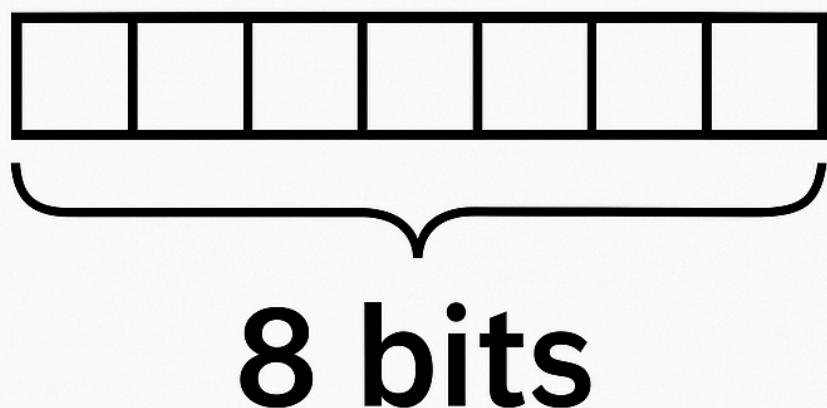


## Types of Operating Systems



## Bits and Bytes

# Bit

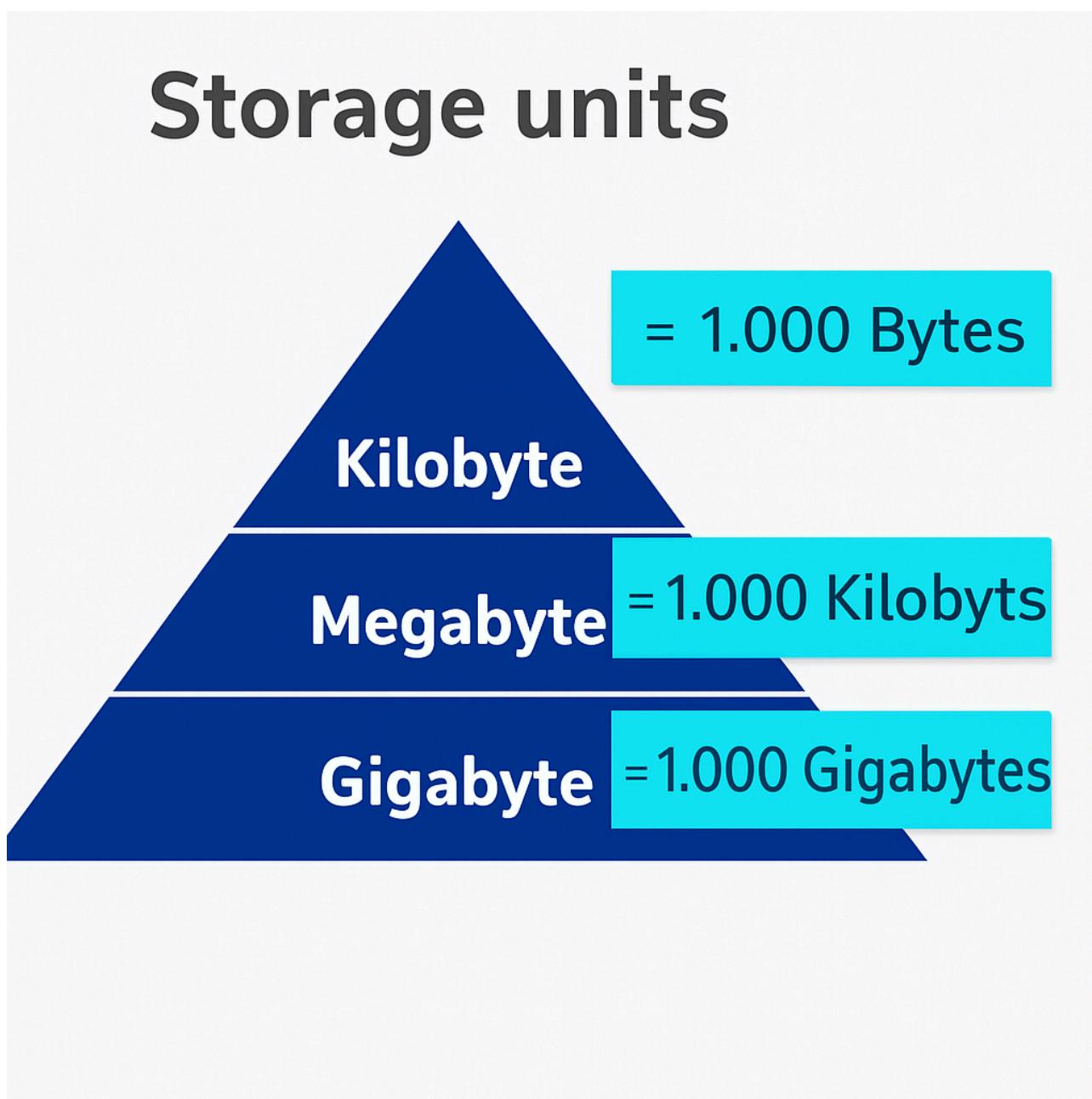


# 1 Byte

## Binary Code

00111	01101011	01010000	0109110	10001101	01010100	0100
01101	01011101	01010100	0100101	11005107	01010901	0100
00101	01101011	01010101	0100111	10001111	01010190	0101
00101	01001101	10011100	0107100	01001111	01010101	0100
00101	01010117	01000111	1000101	01000111	01010101	0100
00101	01046397	01099917	1010111	01001091	01050991	0101
09911	01091011	01019110	0010111	01000691	01010100	0110
00911	01011011	01091111	1000001	01091091	01010101	0107
01001	01001919	01009911	0101100	01090091	01010100	0111
09101	01101911	01099991	0101091	01001091	01010001	0111
01010	01011011	01110900	0101007	01001100	01010101	0001
01000	01091101	01111300	0100111	01010101	01100101	0114
00111	01110910	01001000	0110030	01010107	01001101	0111
01091	01101091	01100027	1100111	01011001	01013101	0118
09001	01019107	01010100	0102111	01001091	01010101	0118
01101	01013110	01110109	0100110	01010603	00130901	0111
09101	01010111	01100901	0110000	01010100	01010301	0101
01001	01101001	01100001	0100021	01090100	01110001	0111
00210	01010107	01119011	0101030	01119101	01910101	0111
01001	01101000	01010001	0111100	01101001	01110101	0111

# Storage units



Kilobyte

= 1.000 Bytes

Megabyte = 1.000 Kilobyts

Gigabyte = 1.000 Gigabytes