Computer fundamentals

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Computer

- **Instruction execution and storage of information**
- **Common Operating Machine Purposely Used for Technological and Educational Research**

Computer History

- **Abacus**
- **Pascaline**
- **Difference Engine**
- **Analytical Engine**
- **Census Tabulator (Punch Cards) -> IMS**
- **Turing Machine**
- **Colossus (Vacuum Tubes, Boolean Logic)**
- **ENIAC**
- **EDVAC (1000 Instructions per Second)**
    - COBOL Programming Language (Assembly to Machine Code)
- **Transistors**
- **Integrated Circuit**
- **GUI, Mouse, Floppy Disk, DRAM**
- **BASIC Language**
- **C Language**

Types of Computers

- **Mini Computer** – Single Circuit Board
- **Mainframe Computer** – High speed, large storage, manages workload for 100+ users (used in commercial organizations)
- **Microcomputer** – Personal computers, mobile phones, laptops
- **Supercomputer** – Used in scientific research
- **Embedded Computer** – Found in ATMs, cars, appliances

Components of a Computer

- **Input Devices** – Keyboard, Mouse, Scanner
- **Output Devices** – Monitor, Speaker, Printer
- **CPU (Central Processing Unit)** – Registers, Cache, ALU, Control Unit
- **Memory** – RAM, ROM, etc.

Types of Memory

Primary Memory (RAM – Main Memory, In-Memory Storage)

- **SRAM** – Fast, costly (Cache, Storage Buffer), Flip-flop (High & Low), 6 Transistors
- **DRAM** – Slower, needs refresh (Capacitor & Transistor, 8ms refresh rate)
- **SDRAM** – Synchronous DRAM (Clock & RAM are system-synchronized)
- **DDR** – Double Data Rate

Secondary Memory (ROM – Permanent Storage)

- **MROM** – Masked ROM
- **PROM** – Programmable ROM
- **EPROM** – Erasable Programmable ROM (UV Light)
- **EEPROM** – Electrically Erasable Programmable ROM
- **Flash Memory** – Block-level erasure (Used in SSDs)

Tertiary Memory

Storage Devices

- **Hard Disk (HDD)** – Magnetic, rotates at 7200 RPM
- **SSD (Solid-State Drive)** – Flash memory, Floating Gate Transistors
- **CD/DVD** – Optical storage

Cloud Storage (Data Centers) – Types:

- **AWS, Azure, Google Cloud**
  - **Public Cloud**
  - **Private Cloud**
  - **Hybrid Cloud**
  - **IaaS (Infrastructure as a Service)**
  - **PaaS (Platform as a Service)**
  - **SaaS (Software as a Service)**

Working of a Computer

- **CPU** reads instructions from RAM using **Control Bus, Address Bus, Data Bus**
- **Instruction Cycle** – Fetch → Decode (CU) → Execute (ALU) → Store (MU)

Keyboard Working

- Multiple layers → Key pressed → Signal sent to PCB (Printed Circuit Board) → Processed by microprocessors, resistors, capacitors, or sensors

Scanner Working

- Light reflected from the document → Sent to light-sensitive sensors → Converted into an electrical signal → Converted into a digital format

System Software

1. **Operating System (OS):** Windows, Linux, macOS, Android
2. **Compiler:** GCC, Javac, Python Interpreter
3. **Utility Software:**
   - BIOS
   - Compression Software
   - Backup Software
   - Antivirus Software
   - File Manager

Application Software

- **General-Purpose Software:** MS Word, Chrome, VLC Media Player
- **Specific-Purpose Software:** Photoshop, AutoCAD

Operating System

- Manages system resources, acts as an interface between the user and hardware

User → Shell → OS → Kernel ← Resources
Application → System Call → Kernel
Kernel → API → Application

Components:

- **Shell** – Interface between User & OS
- **Kernel** – Interface between OS & Hardware (Handles System Calls, I/O, Memory Management)

Types of Operating Systems

- **Batch OS** – Payroll processing systems, where salaries are calculated in bulk
- **Time-Sharing OS** – Shared hosting services, multiple users run programs concurrently
- **Distributed OS** – Google Drive (Data stored & processed across multiple servers)

- **Network OS** – Email servers (e.g., Microsoft Exchange) managing network communication
- **Real-Time OS** – Air traffic control systems requiring immediate response
- **Multiprogramming OS** – Banking ATMs handling multiple user transactions
- **Multitasking OS** – Running multiple applications (Web browser, music player, text editor)

Multiprogramming vs Multitasking

- **Multiprogramming** – Context switching
- **Multitasking** – Context switching + Time sharing

Interrupts & System Calls

Interrupts:

- Software triggers an interrupt (System Call)

System Calls:

- Process Creation & Management
- Main Memory Management
- File Management

BIOS (Basic Input Output System)

- Initializes hardware (Video card, CPU, RAM, Keyboard, Mouse)
- Loads the OS

Drivers

1. **Monitor Driver** – OS sends instructions to GPU, which sends signals to the monitor
2. **Speaker Driver** – Audio driver converts digital signals to analog sound
3. **Printer Driver** – Converts data into printer-recognizable instructions

Driver Functions

- **Translate Commands**
- **Enable Compatibility**
- **Optimize Performance**
- **Handle Errors**