

INTRODUCTION TO INFORMATION TECHNOLOGY

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Introduction to
**Information
Technology**

Study Material Prepared by.....

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OBJECTIVES:

- **To know about the importance characteristics of computers**
- **To learn the architecture of computers.**
- **To know about the basics of computer networks.**
- **To know about the multimedia and its applications**

INTRODUCTION TO INFORMATION TECHNOLOGY

Syllabus

Objective :

To Provide the Basic Concepts in Information Technology

Unit I

Introduction to Computers - Generation of Computers - Classification of Digital Computer - Anatomy of Digital Computer.

Unit II

Architecture of Computer - CPU and Memory - Secondary Storage Devices - Input Devices - Output Devices.

Unit III

Introduction to Computer Software - Programming Language - Operating Systems - Introduction to Database Management System - Data Mining and On-line Analytical Processing.

Unit IV

Computer Networks - WWW and Internet - Email - Intranets - Mobile Computing and Business on the Internet.

Unit V

Introduction to Multimedia - Multimedia Applications - Computers at Home, Education, Entertainment, Science, Medicine and Engineering - Introduction to Computer Security - Computer Viruses, Bombs, Worms.

Text Book:

1. Fundamentals of Information Technology ,Alexis Leon And Mathews Leon, Vikas Publishing House Pvt. Ltd, 2009

Reference Book:

1. Information Technology - The Breaking Wave, Dennis P. Curtin ,Kim foley, KunalSen and Cathleen Morin, Tata-McGraw Hill Publications, 2005

UNIT- 1

What is a Computer?

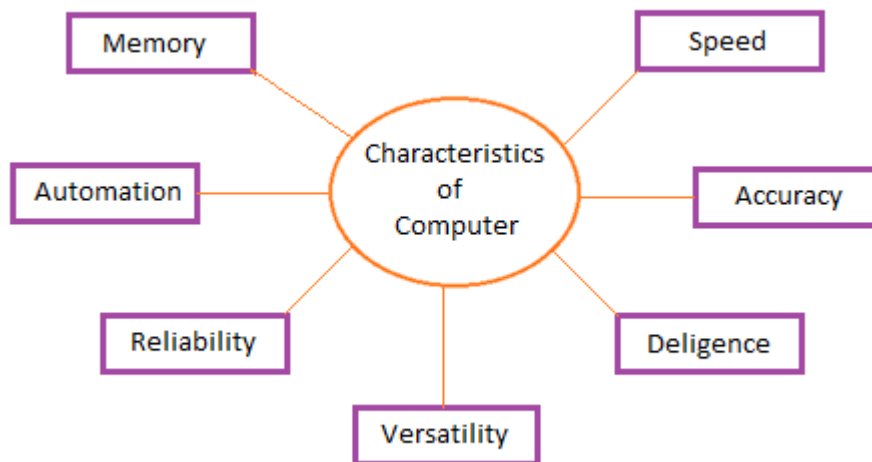
A **computer** is an electronic device that accepts data from the user, processes it, produces results, displays them to the users, and stores the results for future usage.

Data is a collection of unorganized facts & figures and does not provide any further information regarding patterns, context, etc. Hence data means "unstructured facts and figures".

Information is a structured data i.e. organized meaningful and processed data. To process the data and convert into information, a computer is used.

Characteristics of Computer System

The characteristics of the computer system are as follows –



Speed

A computer works with much higher speed and accuracy compared to humans while performing mathematical calculations. Computers can process millions (1,000,000) of instructions per second. The time taken by computers for their operations is microseconds and nanoseconds.

Accuracy

Computers perform calculations with 100% accuracy. Errors may occur due to data inconsistency or inaccuracy.

Diligence

A computer can perform millions of tasks or calculations with the same consistency and accuracy. It doesn't feel any fatigue or lack of concentration. Its memory also makes it superior to that of human beings.

Versatility

Versatility refers to the capability of a computer to perform different kinds of works with same accuracy and efficiency.

Reliability

A computer is reliable as it gives consistent result for similar set of data i.e., if we give same set of input any number of times, we will get the same result.

Automation

Computer performs all the tasks automatically i.e. it performs tasks without manual intervention.

Memory

A computer has built-in memory called primary memory where it stores data. Secondary storage are removable devices such as CDs, pen drives, etc., which are also used to store data.

Classification of Computers based on the Basis of Size and Capacity

1. Super Computer

A Supercomputer is the very **fastest** and **powerful**, and **expensive** type of computer for processing data. Supercomputers' size and [storage capacity](#) are also huge (can occupy huge premises) designed to process vast amounts of data in a short time with high productivity.

These are specially made to perform **multi-specific tasks**. Therefore, many CPUs work in parallel order on these supercomputers. This function of a Supercomputer is called Multiprocessing or Parallel Processing.

A supercomputer's design is complicated, like it can be heterogeneous, combining computers of different architectures, is significantly surpassed most existing personal computers. This made this machine an **ultra-high-performance** supercomputer.

Each part of a supercomputer is responsible for its own specific task, such as structuring and solving the most complex problems requiring an incredible amount of calculations.

Applications: The **uses of supercomputers** are dedicated to –

- In research and study of energy and nuclear weapons and designing the aircraft, airplanes, and flight simulators.
- Climate research and Weather Forecasting and Prediction of Natural Disasters.
- Spaceship and Satellite Launching.
- Used in scientific research laboratories.
- Used in Chemical and Biological research and for highly calculation complex tasks.

Examples: [IBM Roadburner](#), [IBM Blue Gene](#), [Intel ASI Red](#), [PARAM-1000](#), and [CRAY-XMP-14](#).

Good to Know ~ World's first supercomputer is the **Control Data Corporation** [\(CDC\) 6600](#) invented by Seymour Cray.

2. Mainframe Computer

Mainframe computers are **multi-programming, high-performance** computers, and multi-user, which means they can handle the workload of more than 100 users at a time on the computer.

The storage capacity of the mainframe is enormous, with a high-speed data process as well. As well as handling hundreds of input and output devices at a time.

The mainframe is a highly efficient computer capable of **simultaneously solving complex calculations and continuously for a long time**. These computers have several microprocessors that have the ability to function the data at too high performance and speed.

Uses of Mainframe Computer

Mainframe computers are mainly used by departmental and commercial organizations like Banks, Companies, Scientific research centers, and governmental departments like railways. These computers can work for 24 hours. Hundreds of users can work on these computations simultaneously.

Using the mainframe completes the tasks, Such as keeping details of payments, research centres, advertising, sending bills and notices, paying employees, ticket booking, maintaining details of purchases by users, keeping detailed tax details, etc.

Examples: IBM Es000 series, ICL39 Series, and CDC 6600.

3. Mini Computer

Minicomputer is a **digital and multi-user** computer system with the connection of more than one CPU. Thus, many people can work on these computers simultaneously instead of a single person. Also, it can process with other accessories like a printer, plotter, etc.

Minicomputers are the medium type of computers that have more functionality power and are expensive than microcomputers. On the other hand, the size, storage, and speed of minicomputers are **large but less than** the mainframe and supercomputers.

Minicomputers are made for performing multiple computing tasks at a single point of time, instead of assigning many microcomputers for a single task, which will be time-consuming and expensive.

In general, a minicomputer is a multi-threaded system (several processes at a time) capable of supporting from one to up to 200 users simultaneously: these computers are currently used to *store large databases, multi-user applications, and the automation industry*.

The uses of Minicomputers

The minicomputers are used as real-time applications in Industries, bookings, and Research Centres. Banks also use minicomputers for preparing payroll for employees' salaries, records, tracking of financial accounts, etc. As well as in the field of [Higher Education](#) and Engineering.

Examples: PDP 11 and IBM (8000 Series).

Good to Know ~ *PDP-1* was the [world's first minicomputer](#), small and interactive, introduced in 1960 by the Digital Equipment Corporation.

4. Micro Computer

Today we are using many computers at home is also the most common microcomputer. With this invention of the microprocessors in the year 1970, it became possible to use computers for people personally at a low cost and reasonable price known as Digital **Personal Computer**.

The design of microcomputers is minimal in size and storage capacity. These computers consist of many parts like *Input and Output devices, Software, operating systems, networks, and Servers* all these need to connect to form a complete Personal Digital Computer.

There is not only a PC or laptop are examples of microcomputers. Other examples of the microcomputer are smartphone, Tablet, PDA, server, palmtop, and workstation.

This can be installed in any work area or even at home for personal use.

The primary purpose of microcomputers is to keep and process the everyday tasks and needs of the people. Only one person can work on a [single PC](#) at a time, but its operating system is **multitasking**. The PC can be [connected to the Internet to take benefits](#) and enhance the user experience.

The uses of Micro Computer

PC is being widely used in many fields like home, office, data collection, [business](#), education, entertainment, publishing, etc.

It keeps the details and prepares letters for correspondence in small businesses, creating bills, accounting, word processing, and operation of the filing systems in a large company.

Some of the major PC manufacturers are IBM, Lenovo, Apple, HCL, HP, etc.

Examples: Desktops, tablets, smartphones, and Laptops.

The fast development of microcomputers with technology. As a result, today, microcomputers coming in the form of a book, a phone, and even a clock in the name of a digital clock.

Computers on the Basis Purpose

1. General Purpose

General computers can do various **everyday tasks** such as writing a word processing letter, Document preparation, recording, financial analysis, Printing documents, creating databases, and calculations with accuracy and consistency.

The size, storage capacity, and cost of such computers are mainly less. The ability of these computers is limited in performing specialized tasks. Still, it has **versatility and useful** for serving people's basic needs at home or in the workplace in the environment.

Examples:

Desktops, laptops, smartphones, and tablets are used on daily basis for general purposes.

2. Special Purpose

These computers are designed to perform a particular or specialized task. The size, storage capacity, and cost of such computers mainly depend on the nature and size of the work. The function of these computers is consistent with any particular task.

The special computer **needs specific and input and devices** as well as a [compatible motherboard with the processor](#) to conduct work efficiently.

These computers are used for special purposes in *weather forecasting, space research, agriculture, engineering, meteorology, satellite operation, traffic control, and research in chemical sciences.*

Examples:

- Automatic teller machines (ATM),
- Washing machines,
- Surveillance equipment,
- Weather-forecasting simulators,
- Traffic-control computers,
- Defense-oriented applications,
- Oil-exploration systems,
- Military planes controlling computers.

Computers on the Basis of Hardware Design and Data Handling.

1. Analog Computer

An analog computer performs tasks using continuous data (*the physical amount that changes continuously*). Analog computers are used primarily to measure physical units like the voltage, pressure, electric current, temperature, and convert them into digits.

It is also used to measure and perform arithmetic calculations of numbers, the length of an object, or the amount of voltage that passes through a point in an electrical circuit. Analog computers obtain all their data from some measurement way.

Analog computers are mainly used in the fields of science and engineering. Analog computers are slow and equipped to measure things rather than countable or check.

The efficiency of this computer increases when we get the result of the data in graphs, etc. Analog Computers **cannot** store statistics.

They are used in the fields of **technology, science, research, engineering**, etc. Because quantities like **voltage, pressure, electric current, temperature** are used more in these areas, these types of computers give only approximate estimates.

Examples:

An analog computer installed on a petrol pump measures the amount of petrol coming out of the pump and appears in liters. And calculates its value. These quantities vary continuously while measuring the amount, such as the temperature of a human body changes consistently.

A simple clock, the **vehicle's speedometer, Voltmeter**, etc. are examples of analog computing.

2. Digital Computer

As its name suggests, a digital computer represents the digital computer's letters, numerical values, or any other special symbols. This computer is the computer that calculates the number for [processing the data](#).

They run on electronic signs, and the binary numeral method Binary System 0 or 1 is used for calculation. Their speed is fast.

It can perform arithmetic operations such as **addition, occurrence, subtraction, multiplication, or division and all types of logical(mathematical) operations**. Today, most of the computers available in the market are digital computers.

Digital computers are built to bring the solution of equations to an almost unlimited precision, but in a bit slow manner compared to analog computers. To some extent, they all have similar components for [receiving, processing, sorting, and transmitting data](#) and use a relatively small number of essential functions to perform their tasks.

Digital computers use discrete electrical signals for operation rather than continuous electrical signals as analog computers have, making them the most common form of computers today because of their **versatility, speed, and [power](#)**.

The desktop or Laptop at our home is one the common and best example of a digital computer.

Other [Examples](#) of Digital Computers

- Personal Desktop Computers,
- Calculators,
- Laptops, Smartphones, and Tablets,
- [Chromebooks](#),
- Digital watch,
- Accounting machines,
- Workstations,
- Digital clock, etc.
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3. Hybrid Computer

A hybrid computer is a combined complex computer unit built using both *analog and digital* properties and united by a single control system. The purpose of designing hybrid computers is to provide functions and features that can be found on both analog and digital devices.

[Applications](#) of hybrid Computer:

Hybrid computers are most commonly used in vast industries, research centres, organizations, and manufacturing firms (where many equations need to be solved).

Also, the solutions and uses of hybrid computers have proved to be much more detailed, accurate, and useful. Hybrid computers are used in scientific calculations, for nations' defence and radar systems as well.

[Examples:](#)

Auto Gasoline pump is the example of a hybrid computer, this device is installed on a petrol pump do not only to measure the amount of petrol but also to calculates its value, in this way It is capable of both functions i.e **hybrid function**.

Generations of Computers

The modern computer took its shape with the arrival of your time. It had been around 16th century when the evolution of the computer started. The initial computer faced many changes, obviously for the betterment. It continuously improved itself in terms of speed, accuracy, size, and price to urge the

form of the fashionable day computer. This long period is often conveniently divided into the subsequent phases called computer generations:

- **First Generation Computers (1940-1956)**
- **Second Generation Computers (1956-1963)**
- **Third Generation Computers (1964-1971)**
- **Fourth Generation Computers (1971-Present)**
- **Fifth Generation Computers (Present and Beyond)**

Before there are graphing calculators, spreadsheets, and computer algebra systems, mathematicians and inventors searched for solutions to ease the burden of calculation.

Below are the 8 mechanical calculators before modern computers were invented.

1. Abacus (ca. 2700 BC)
2. Pascal's Calculator (1652)
3. Stepped Reckoner (1694)
4. Arithmometer (1820)
5. Comptometer (1887) and Comptograph (1889)
6. The Difference Engine (1822)
7. Analytical Engine (1834)
8. The Millionaire (1893)

First Generation Computers: Vacuum Tubes (1940-1956)

The technology behind the primary generation computers was a fragile glass device, which was called vacuum tubes. These computers were very heavy and really large in size. These weren't very reliable and programming on them was a really tedious task as they used high-level programming language and used no OS. First-generation computers were used for calculation, storage, and control purpose. They were too bulky and large that they needed a full room and consume rot of electricity.

Main first generation computers are:

- **ENIAC:** Electronic Numerical Integrator and Computer, built by J. Presper Eckert and John V. Mauchly was a general-purpose computer. It had been very heavy, large, and contained 18,000 vacuum tubes.
- **EDVAC:** Electronic Discrete Variable Automatic Computer was designed by von Neumann. It could store data also as instruction and thus the speed was enhanced.
- **UNIVAC:** Universal Automatic Computer was developed in 1952 by Eckert and Mauchly.

Main characteristics of first generation computers are:

Main electronic component	Vacuum tube.
Programming language	Machine language.
Main memory	Magnetic tapes and magnetic drums.
Input/output devices	Paper tape and punched cards.
Speed and size	Very slow and very large in size (often taking up entire room).
Examples of the first generation	IBM 650, IBM 701, ENIAC, UNIVAC1, etc.

Second Generation Computers: Transistors (1956-1963)

Second-generation computers used the technology of transistors rather than bulky vacuum tubes. Another feature was the core storage. A transistor may be a device composed of semiconductor material that amplifies a sign or opens or closes a circuit.

Transistors were invented in Bell Labs. The use of transistors made it possible to perform powerfully and with due speed. It reduced the dimensions and price and thankfully the warmth too, which was generated by vacuum tubes. Central Processing Unit (CPU), memory, programming language and input, and output units also came into the force within the second generation.

Programming language was shifted from high level to programming language and made programming comparatively a simple task for programmers. Languages used for programming during this era were FORTRAN (1956), ALGOL (1958), and COBOL (1959).

Main characteristics of second generation computers are:-

Main electronic component	Transistor.
Programming language	Machine language and assembly language.
Memory	Magnetic core and magnetic tape/disk.
Input/output devices	Magnetic tape and punched cards.
Power and size	Smaller in size, low power consumption, and generated less heat (in

comparison with the first generation computers).

Examples of second generation	PDP-8, IBM1400 series, IBM 7090 and 7094, UNIVAC 1107, CDC 3600 etc.
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Third Generation Computers: Integrated Circuits. (1964-1971)

During the third generation, technology envisaged a shift from huge transistors to integrated circuits, also referred to as IC. Here a variety of transistors were placed on silicon chips, called semiconductors. The most feature of this era's computer was the speed and reliability. IC was made from silicon and also called silicon chips.

A single IC, has many transistors, registers, and capacitors built on one thin slice of silicon. The value size was reduced and memory space and dealing efficiency were increased during this generation. Programming was now wiped out Higher level languages like BASIC (Beginners All-purpose Symbolic Instruction Code). Minicomputers find their shape during this era.

Main characteristics of third generation computers are:

Main electronic component	Integrated circuits (ICs)
Programming language	High-level language
Memory	Large magnetic core, magnetic tape/disk
Input / output devices	Magnetic tape, monitor, keyboard, printer, etc.

Examples of third generation IBM 360, IBM 370, PDP-11, NCR 395, B6500, UNIVAC 1108, etc.

Fourth Generation Computers: Micro-processors (1971-Present)

In 1971 First microprocessors were used, the large scale of integration LSI circuits built on one chip called microprocessors. The most advantage of this technology is that one microprocessor can contain all the circuits required to perform arithmetic, logic, and control functions on one chip.

The computers using microchips were called microcomputers. This generation provided the even smaller size of computers, with larger capacities. That's not enough, then Very Large Scale Integrated (VLSI) circuits replaced LSI circuits. The Intel 4004chip, developed in 1971, located all the components of the pc from the central processing unit and memory to input/ output controls on one chip and allowed the dimensions to reduce drastically.

Technologies like multiprocessing, multiprogramming, time-sharing, operating speed, and virtual memory made it a more user-friendly and customary device. The concept of private computers and computer networks came into being within the fourth generation.

Main characteristics of fourth generation computers are:

Main electronic component	Very large-scale integration (VLSI) and the microprocessor (VLSI has thousands of transistors on a single microchip).
Memory	semiconductor memory (such as RAM, ROM, etc.)
Input/output devices	pointing devices, optical scanning, keyboard, monitor, printer, etc.
Examples of fourth generation	IBM PC, STAR 1000, APPLE II, Apple Macintosh, Alter 8800, etc.

Fifth Generation Computers

The technology behind the fifth generation of computers is AI. It allows computers to behave like humans. It is often seen in programs like voice recognition, area of medicines, and entertainment. Within the field of games playing also it's shown remarkable performance where computers are capable of beating human competitors.

The speed is highest, size is that the smallest and area of use has remarkably increased within the fifth generation computers. Though not a hundred percent AI has been achieved to date but keeping in sight the present developments, it is often said that this dream also will become a reality very soon.

In order to summarize the features of varied generations of computers, it is often said that a big improvement has been seen as far because the speed and accuracy of functioning care, but if we mention the dimensions, it's being small over the years. The value is additionally diminishing and reliability is in fact increasing.

Main characteristics of fifth generation computers are:

Main electronic component	Based on artificial intelligence, uses the Ultra Large-Scale Integration (ULSI) technology and parallel processing method (ULSI has millions of transistors on a single microchip and Parallel processing method use two or more microprocessors to run tasks simultaneously).
Language	Understand natural language (human language).
Size	Portable and small in size.

Input / output device Trackpad (or touchpad), touchscreen, pen, speech input (recognize voice/speech), light scanner, printer, keyboard, monitor, mouse, etc.

Example of fifth generation Desktops, laptops, tablets, smartphones, etc.

UNIT - II

Anatomy of a Digital Computer

The computer system consists of three main components:

1. Input/Output (I/O) Unit,
2. Central Processing Unit (CPU), and
3. Memory Unit.

The I/O unit consists of the input unit and the output unit. CPU performs calculations and processing on the input data, to generate the output. The memory unit is used to store the data, the instructions and the output information. The following figure illustrates the typical interaction among the different components of the computer.

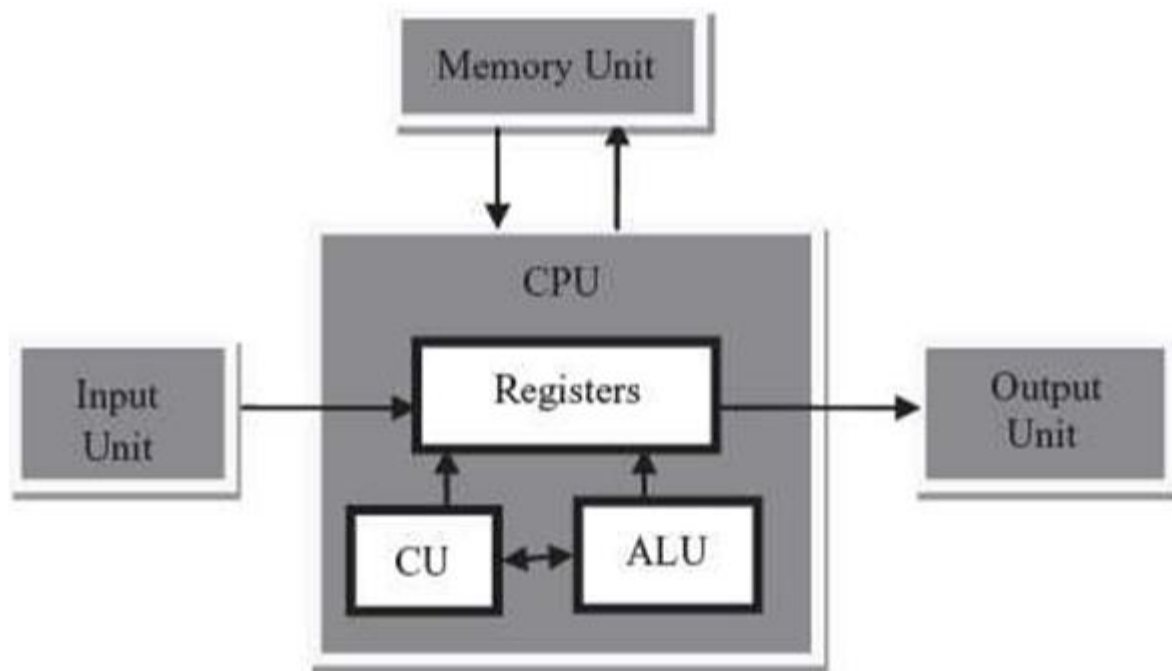


Fig.: Interaction among the different components of computer

Input/Output Unit

The user interacts with the computer via the I/O unit. The Input unit accepts data from the user and the Output unit provides the processed data i.e. the information to the user. The Input unit converts the data that it accepts from the user, into a form that is understandable by the computer. Similarly, the Output unit provides the output in a form that is understandable by the user. The input is provided to the computer using input devices like keyboard, trackball and mouse. Some of the commonly used output devices are monitor and printer.

Central Processing Unit (CPU)

CPU controls, coordinates and supervises the operations of the computer. It is responsible for processing of the input data. CPU consists of Arithmetic Logic Unit (ALU) and Control Unit (CU).

- ALU performs all the arithmetic and logic operations on the input data.
- CU controls the overall operations of the computer i.e. it checks the sequence of execution of instructions, and, controls and coordinates the overall functioning of the units of computer.

Additionally, CPU also has a set of registers for temporary storage of data, instructions, addresses and intermediate results of calculation.

Memory Unit

Memory unit stores the data, instructions, intermediate results and output, temporarily, during the processing of data. This memory is also called the main memory or primary memory of the computer. The input data that is to be processed is brought into the main memory before processing. The instructions required for processing of data and any intermediate results are also stored in the main memory. The output is stored in memory before being transferred to the output

device. CPU can work with the information stored in the main memory. Another kind of storage unit is also referred to as the secondary memory of the computer. The data, the programs and the output are stored permanently in the storage unit of the computer. Magnetic disks, optical disks and magnetic tapes are examples of secondary memory.

History and Evolution of Computers

As we know in 19 century **Charles Babbage** the famous Mathematics professor had its beginning. He designed [Analytical Engine](#) (*first mechanical computer*) successor of the Difference Engine (*automatic mechanical calculator*) which is known as a basic **framework for today's computer**. It is classified into generations and each generation is the improved and modified version of it.

In 1822, British mathematician and inventor Charles Babbage (1791-1871) built the steam-powered automatic mechanical calculator what he called "**Difference Engine**" or "Differential Engine". It was more than simple calculator. Which is capable of computing several set of number and in result it gives hard copies. Ada Lovelace helped Charles Babbage in development of difference engine. It computes polynomial equations and print mathematical tables automatically.

In 1837, Charles Babbage built the first description of a general mechanical computer, which was the successor of the Difference Engine what he called [analytical engine](#), but never completing while Babbage was alive. It was programmed to using integrated [memory](#) and punch cards.

In 1991, Henry Babbage, Charles Babbage's youngest son complete a portion of the machine that perform basic calculations.

Who Invented the First Electronic Digital Computer?

At university of Pennsylvania **J. Presper Eckert** and **John Mauchly** invented **ENIAC** (*Electronic Numerical Integrator and Computer*) in November of 1945, it was design and construction was financed by the US military. It was occupied 1800 square feet, 200 kilowatts of electric power, 70,000 resistors, 10,000 capacitors and 18,000 vacuum tubes where used and its weight was almost 50 tones. Although ABC computer was the first [digital computer](#) but many still consider the **ENIAC was the first [digital computer](#)**, because it was first operational electronic digital computer. It was used for weather prediction, atomic-energy calculations, thermal ignition, and other scientific uses.

Who invented the first programmable computer and where?

In 1938, German civil engineer, **Konrad Zuse** built world's first freely programmable binary driven mechanical computer **what he called Z1**. Konrad Zuse has considered the inventor of the modern computer. It was programmable via punched tape or punched tape reader.

Z1 original name was "V1" for **VersuchsModell 1**, after World War 2 it renamed "Z1". It consisted of about 1000 kg weight with thin metal sheets with 20000 parts.

Who invented the first commercial Computer?

In 1951, the **first commercial computer** that handle both numerical and alphabetic and produced in the US what he called **UNIVAC I** (*Universal Automatic Computer I*). It was designed by **J. Presper Eckert** and **John Mauchly**, Who was the **inventors of ENIAC**. It was a vacuum tube, limited speed of memory computer that was used by US military and its input and storage was magnetic tape or a magnetic drum.

UNIVAC I was consume 125 kW of electric power, 5,000 vacuum tubes, 1,905 operations per second, and 18,000 vacuum tubes where used and its weight was almost 16,000 pounds.

When was the first personal computer invented?

The **first personal computer** was introduced in 1975. Ed Robert coined the term “personal computer” and PC appeared in a 3 November 1962 when Altair 8800 was introduced. Early computers generally called microcomputers.

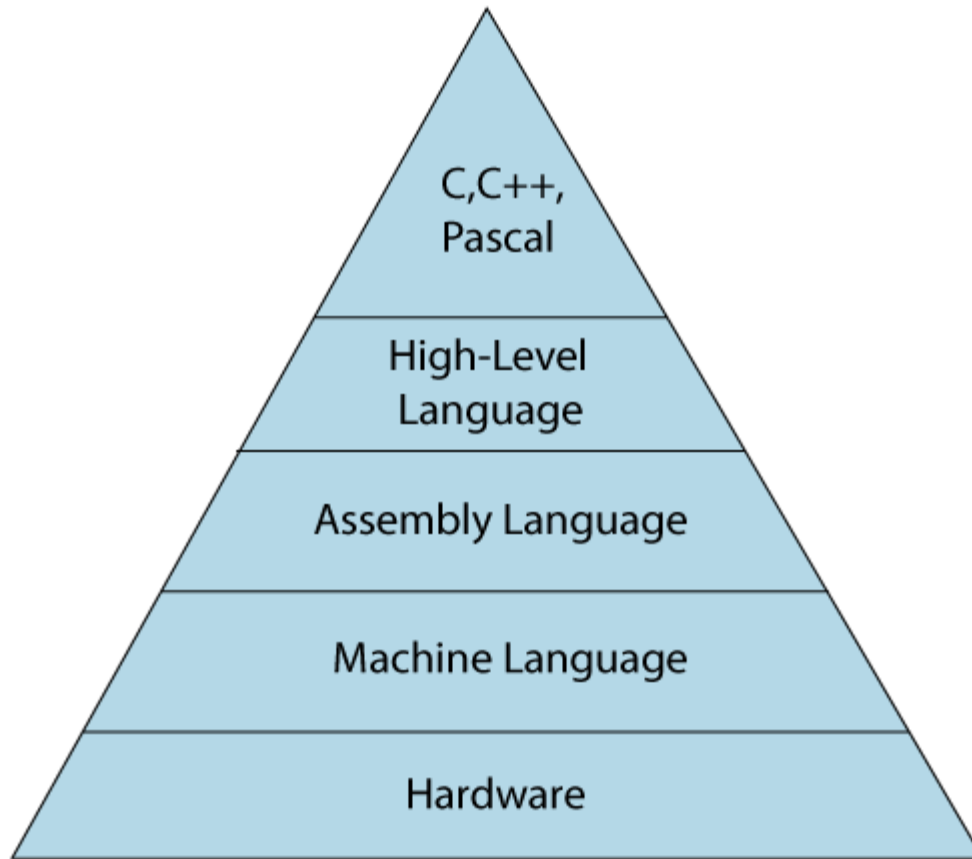
What is a programming language?

A programming language defines a set of instructions that are compiled together to perform a specific task by the CPU (Central Processing Unit). The programming language mainly refers to high-level languages such as C, C++, Pascal, Ada, COBOL, etc.

Each programming language contains a unique set of keywords and syntax, which are used to create a set of instructions. Thousands of programming languages have been developed till now, but each language has its specific purpose. These languages vary in the level of abstraction they provide from the hardware. Some programming languages provide less or no abstraction while some provide higher abstraction. Based on the levels of abstraction, they can be classified into two categories:

- Low-level language
- High-level language

The image which is given below describes the abstraction level from hardware. As we can observe from the below image that the machine language provides no abstraction, assembly language provides less abstraction whereas high-level language provides a higher level of abstraction.



Low-level language

The low-level language is a programming language that provides no abstraction from the hardware, and it is represented in 0 or 1 forms, which are the machine instructions. The languages that come under this category are the Machine level language and Assembly language.

Machine-level language

The machine-level language is a language that consists of a set of instructions that are in the binary form 0 or 1. As we know that computers can understand only machine instructions, which are in binary digits, i.e., 0 and 1, so the instructions given to the computer can be only in binary codes. Creating a program in a machine-level language is a very difficult task as it is not easy for the programmers to write the program in machine instructions. It is error-prone as it is not easy to understand, and its maintenance is also very high. A machine-level language is not portable as each computer has its machine instructions, so if we write a program in one computer will no longer be valid in another computer.

The different processor architectures use different machine codes, for example, a PowerPC processor contains RISC architecture, which requires different code than intel x86 processor, which has a CISC architecture.

Assembly Language

The assembly language contains some human-readable commands such as mov, add, sub, etc. The problems which we were facing in machine-level language are reduced to some extent by using an extended form of machine-level language known as assembly language. Since assembly language instructions are written in English words like mov, add, sub, so it is easier to write and understand.

As we know that computers can only understand the machine-level instructions, so we require a translator that converts the assembly code into machine code. The translator used for translating the code is known as an assembler.

The assembly language code is not portable because the data is stored in computer registers, and the computer has to know the different sets of registers.

The assembly code is not faster than machine code because the assembly language comes above the machine language in the hierarchy, so it means that assembly language has some abstraction from the hardware while machine language has zero abstraction.

RISC and CISC Processors

RISC Processor

It is known as Reduced Instruction Set Computer. It is a type of microprocessor that has a limited number of instructions. They can execute their instructions very fast because instructions are very small and simple.

RISC chips require fewer transistors which make them cheaper to design and produce. In RISC, the instruction set contains simple and basic instructions from which more complex instruction can be produced. Most instructions complete in one cycle, which allows the processor to handle many instructions at same time.

In this instructions are register based and data transfer takes place from register to register.

CISC Processor

- It is known as Complex Instruction Set Computer.
- It was first developed by Intel.
- It contains large number of complex instructions.
- In this instructions are not register based.
- Instructions cannot be completed in one machine cycle.
- Data transfer is from memory to memory.
- Micro programmed control unit is found in CISC.

- Also they have variable instruction formats.

Difference Between CISC and RISC

Architectural Characteristics	Complex Instruction Set Computer(CISC)	Reduced Instruction Set Computer(RISC)
Instruction size and format	Large set of instructions with variable formats (16-64 bits per instruction).	Small set of instructions with fixed format (32 bit).
Data transfer	Memory to memory.	Register to register.
CPU control	Most micro coded using control memory (ROM) but modern CISC use hardwired control.	Mostly hardwired without control memory.
Instruction type	Not register based instructions.	Register based instructions.
Memory access	More memory access.	Less memory access.
Clocks	Includes multi-clocks.	Includes single clock.
Instruction nature	Instructions are complex.	Instructions are reduced and simple.

INSIDE A COMPUTER CABINET

The computer cabinet encloses the components that are required for the running of the computer. The components inside a computer cabinet include the power supply, motherboard, memory chips, expansion slots, ports and interface, processor, cables and storage devices.

Motherboard

The computer is built up around a *motherboard*. The motherboard is the most important component in the PC. It is a large Printed Circuit Board (PCB), having many chips, connectors and other electronics mounted on it. The motherboard is the hub, which is used to connect all the essential components of a computer. The RAM, hard drive, disk drives and optical drives are all plugged into interfaces on the motherboard. The motherboard contains the processor, memory chips, interfaces and sockets, etc.

The motherboard may be characterized by the form factor, chipset and type of processor socket used. *Form factor* refers to the motherboard's geometry, dimensions, arrangement and electrical requirements. Different standards have been developed to build motherboards, which can be used in different brands of cases. Advanced Technology Extended (ATX) is the most common design of motherboard for desktop computers. *Chipset* is a circuit, which controls the majority of resources (including the bus interface

with the processor, cache memory and RAM, expansion cards, etc.) Chipset's job is to coordinate data transfers between the various components of the computer (including the processor and memory). As the chipset is integrated into the motherboard, it is important to choose a motherboard, which includes a recent chipset, in order to maximize the computer's upgradeability. The *processor socket* may be a rectangular connector into which the processor is mounted vertically (slot), or a square-shaped connector with many small connectors into which the processor is directly inserted (socket). The Basic Input Output System (BIOS) and Complementary Metal-Oxide Semiconductor (CMOS) are present on the motherboard.

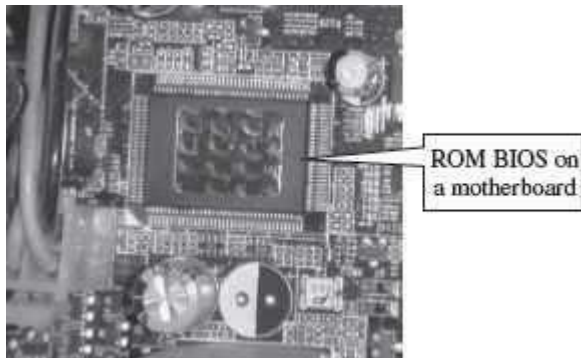


Figure 2.14 ROM BIOS

- **BIOS** It is the basic program used as an interface between the operating system and the motherboard. The BIOS ([Figure 2.14](#)) is stored in the ROM and cannot be rewritten. When the computer is switched on, it needs instructions to start. BIOS contain the instructions for the starting up of the computer. The BIOS runs when the computer is switched on. It performs a Power On Self Test (POST) that checks that the hardware is functioning properly and the hardware devices are present. It checks whether the operating system is present on the hard drive. BIOS invokes the bootstrap loader to load the operating system into memory. BIOS can be configured using an interface named BIOS setup, which can be accessed when the computer is booting up (*by pressing the DEL key*).
- **CMOS Chip** BIOS ROMs are accompanied by a smaller CMOS (CMOS is a type of memory technology) memory chip. When the computer is turned off, the power supply stops providing electricity to the motherboard. When the computer is turned on again, the system still displays the correct clock time. This is because the CMOS chip saves some system information, such as time, system date and essential system settings. CMOS is kept powered by a button battery located on the motherboard ([Figure 2.15](#)). The CMOS chip is working even when the computer power is switched off. Information of the hardware installed in the computer (such as the number of tracks or sectors on each hard drive) is stored in the CMOS chip.

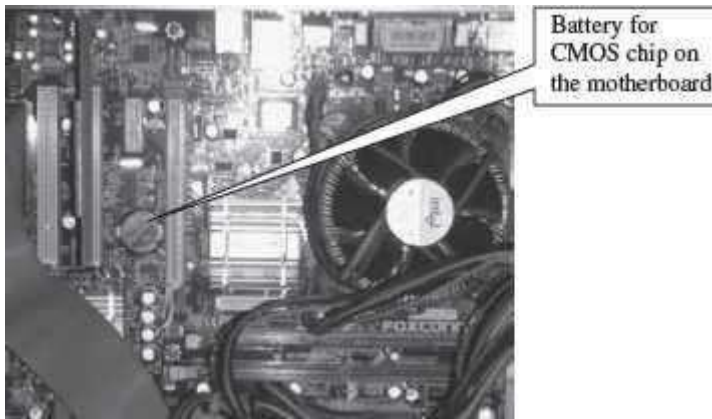


Figure 2.15 Battery for CMOS chip

Ports and Interfaces

Motherboard has a certain number of I/O sockets that are connected to the ports and interfaces found on the rear side of a computer ([Figure 2.16](#)). You can connect external devices to the ports and interfaces, which get connected to the computer's motherboard.

- Serial Port— to connect old peripherals.
- Parallel Port— to connect old printers.



Figure 2.16 Ports on the rear side of a PC

- USB Ports—to connect newer peripherals like cameras, scanners and printers to the computer. It uses a thin wire to connect to the devices, and many devices can share that wire simultaneously.
- Firewire is another bus, used today mostly for video cameras and external hard drives.
- RJ45 connector (called LAN or Ethernet port) is used to connect the computer to a network. It corresponds to a network card integrated into the motherboard.
- VGA connector for connecting a monitor. This connector interfaces with the built-in graphics card.
- Audio plugs (line-in, line-out and microphone), for connecting sound speakers and the microphone. This connector interfaces with the built-in sound card.

- PS/2 port to connect mouse and keyboard into PC.
- SCSI port for connecting the hard disk drives and network connectors.

Expansion Slots

The expansion slots ([Figure 2.17](#)) are located on the motherboard. The expansion cards are inserted in the expansion slots. These cards give the computer new features or increased performance. There are several types of slots:

- ISA (Industry Standard Architecture) slot—To connect modem and input devices.
- PCI (Peripheral Component InterConnect) slot—To connect audio, video and graphics. They are much faster than ISA cards.
- AGP (Accelerated Graphic Port) slot—A fast port for a graphics card.
- PCI (Peripheral Component InterConnect) Express slot—Faster bus architecture than AGP and PCI buses.
- PC Card—It is used in laptop computers. It includes Wi-Fi card, network card and external modem.

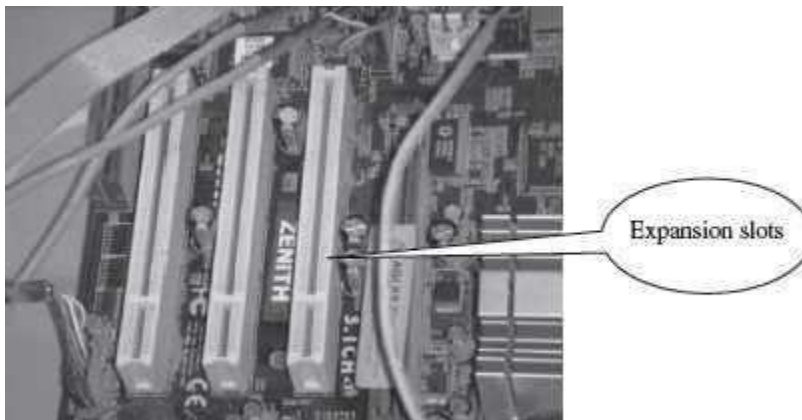


Figure 2.17 Expansion slots

Ribbon Cables

Ribbon cables ([Figure 2.18](#)) are flat, insulated and consist of several tiny wires moulded together that carry data to different components on the motherboard. There is a wire for each bit of the word or byte and additional wires to coordinate the activity of moving information. They also connect the floppy drives, disk drives and CD-ROM drives to the connectors in the motherboard. Nowadays, Serial Advanced Technology Attachment (SATA) cables have replaced the ribbon cables to connect the drives to the motherboard.

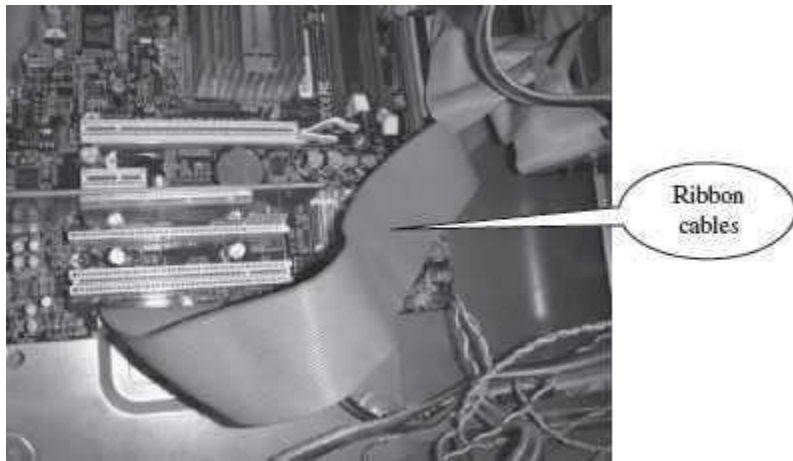


Figure 2.18 Ribbon cables inside a PC

Memory Chips

The RAM consists of chips on a small circuit board ([Figure 2.19](#)). Two types of memory chips—Single In-line Memory Module (SIMM) and Dual In-line Memory Module (DIMM) are used in desktop computers. The CPU can retrieve information from DIMM chip at 64 bits compared to 32 bits or 16 bits transfer with SIMM chips. DIMM chips are used in Pentium 4 onwards to increase the access speed.

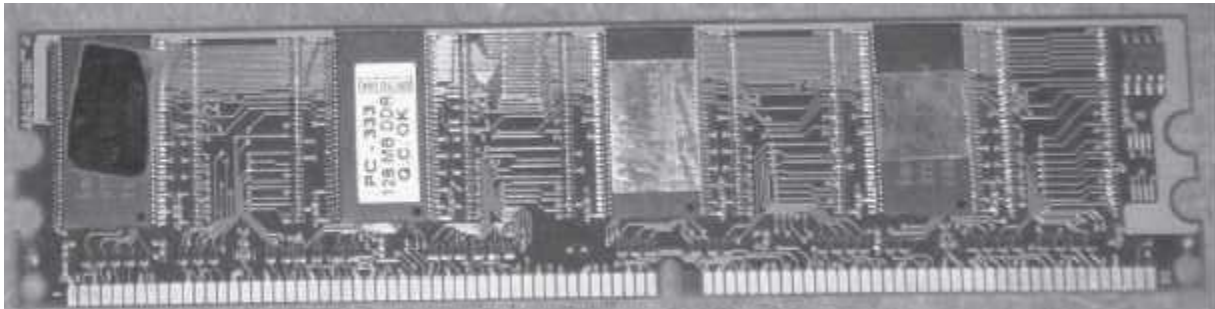


Figure 2.19 RAM memory chip

Storage Devices

The disk drives are present inside the machine. The common disk drives in a machine are hard disk drive, floppy drive ([Figure 2.20 \(i & ii\)](#)) and CD drive or DVD drive. High-storage devices like hard disk, floppy disk and CDs ([Figure 2.20 \(iii\) & \(iv\)](#)) are inserted into the hard disk drive, floppy drive and CD drive, respectively. These storage devices can store large amounts of data, permanently.

Processor

The processor or the CPU is the main component of the computer. Select a processor based on factors like its speed, performance, reliability and motherboard support. Pentium Pro, Pentium 2 and Pentium 4 are some of the processors.



Figure 2.20 Storage devices (i) Hard disk drive, (ii) DVD drive, (iii) Floppy disk, (iv) CD

port, USB port, Firewire, RJ45 connector, VGA connector, Audio plugs, PS/2 port, and SCSI port.

CENTRAL PROCESSING UNIT

Central Processing Unit (CPU) or the processor is also often called the *brain of computer*. CPU (Figure 2.1) consists of Arithmetic Logic Unit (ALU) and Control Unit (CU). In addition, CPU also has a set of registers which are temporary storage areas for holding data, and instructions. *ALU* performs the arithmetic and logic operations on the data that is made available to it. *CU* is responsible for organizing the processing of data and instructions. *CU* controls and coordinates the activity of the other units of computer. CPU uses the registers to store the data, instructions during processing.

CPU executes *the stored program instructions*, i.e. instructions and data are stored in memory before execution. For processing, CPU gets data and instructions from the memory. It interprets the program instructions and performs the arithmetic and logic operations required for the processing of data. Then, it sends the processed data or result to the memory. CPU also acts as an administrator and is responsible for supervising operations of other parts of the computer.

The CPU is fabricated as a single Integrated Circuit (IC) chip, and is also known as the *microprocessor*. The microprocessor is plugged into the motherboard of the computer (*Motherboard* is a circuit board that has electronic circuit etched on it and connects the microprocessor with the other hardware components).

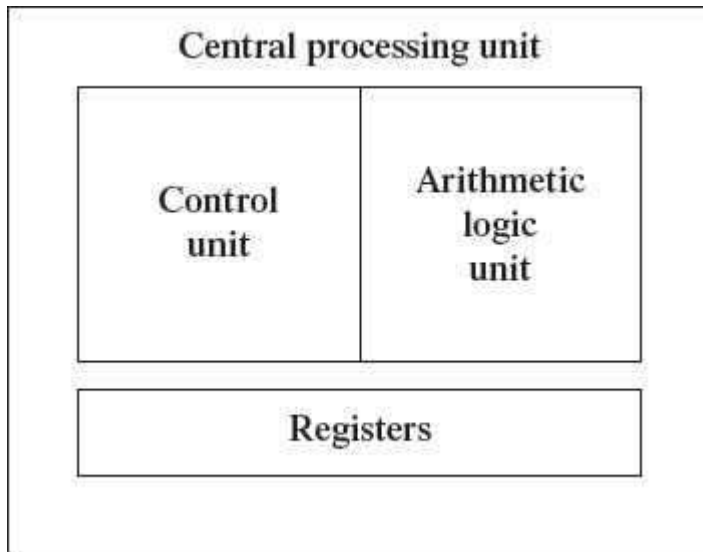


Figure 2.1 CPU

Arithmetic Logic Unit

- ALU consists of two units—arithmetic unit and logic unit.
- The arithmetic unit performs arithmetic operations on the data that is made available to it. Some of the arithmetic operations supported by the arithmetic unit are—addition, subtraction, multiplication and division.
- The logic unit of ALU is responsible for performing logic operations. Logic unit performs comparisons of numbers, letters and special characters. Logic operations include testing for greater than, less than or equal to condition.
- ALU performs arithmetic and logic operations, and uses *registers* to hold the data that is being processed.

Registers

- Registers are high-speed storage areas within the CPU, but have the least storage capacity. Registers are not referenced by their address, but are directly accessed and manipulated by the CPU during instruction execution.
- Registers store data, instructions, addresses and intermediate results of processing. Registers are often referred to as the CPU's *working memory*.
- The data and instructions that require processing must be brought in the registers of CPU before they can be processed. For example, if two numbers are to be added, both numbers are brought in the registers, added and the result is also placed in a register.
- Registers are used for different purposes, with each register serving a specific purpose. Some of the important registers in CPU ([Figure 2.2](#)) are as follows—
 - Accumulator (ACC) stores the result of arithmetic and logic operations.
 - Instruction Register (IR) contains the current instruction most recently fetched.
 - Program Counter (PC) contains the address of next instruction to be processed.
 - Memory Address Register (MAR) contains the address of next

- location in the memory to be accessed.
- Memory Buffer Register (MBR) temporarily stores data from memory or the data to be sent to memory.
- Data Register (DR) stores the operands and any other data.



Figure 2.2 CPU registers

- The number of registers and the size of each (number of bits) register in a CPU helps to determine the power and the speed of a CPU.
- The overall number of registers can vary from about ten to many hundreds, depending on the type and complexity of the processor.
- The size of register, also called *word size*, indicates the amount of data with which the computer can work at any given time. The bigger the size, the more quickly it can process data. The size of a register may be 8, 16, 32 or 64 bits. For example, a 32-bit CPU is one in which each register is 32 bits wide and its CPU can manipulate 32 bits of data at a time. Nowadays, PCs have 32-bit or 64-bit registers.
- 32-bit processor and 64-bit processor are the terms used to refer to the size of the registers. Other factors remaining the same, a 64-bit processor can process the data twice as fast as one with 32-bit processor.

Control Unit

- The control unit of a computer does not do any actual processing of data. It organizes the processing of data and instructions. It acts as a supervisor and, controls and coordinates the activity of the other units of computer.
- CU coordinates the input and output devices of a computer. It directs the computer to carry out stored program instructions by communicating with the ALU and the registers. CU uses the instructions in the Instruction Register (IR) to decide which circuit needs to be activated. It also instructs the ALU to perform the arithmetic or logic operations. When a program is run, the Program Counter (PC) register keeps track of the program instruction to be executed next.
- CU tells when to fetch the data and instructions, what to do, where to store the results, the sequencing of events during processing etc.
- CU also holds the CPU's Instruction Set, which is a list of all operations that the

CPU can perform.

The function of a (CU) can be considered synonymous with that of a conductor of an orchestra. The conductor in an orchestra does not perform any work by itself but manages the orchestra and ensures that the members of orchestra work in proper coordination.

MEMORY UNIT

The memory unit consists of cache memory and primary memory. *Primary memory or main memory* of the computer is used to store the data and instructions during execution of the instructions. Random Access Memory (RAM) and Read Only Memory (ROM) are the primary memory. In addition to the main memory, there is another kind of storage device known as the secondary memory. Secondary memory is non-volatile and is used for permanent storage of data and programs. A program or data that has to be executed is brought into the RAM from the secondary memory.

Cache Memory

- The data and instructions that are required during the processing of data are brought from the secondary storage devices and stored in the RAM. For processing, it is required that the data and instructions are accessed from the RAM and stored in the registers. The time taken to move the data between RAM and CPU registers is large. This affects the speed of processing of computer, and results in decreasing the performance of CPU.
- Cache memory is a very high speed memory placed in between RAM and CPU. Cache memory increases the speed of processing.
- Cache memory is a storage buffer that stores the data that is used more often, temporarily, and makes them available to CPU at a fast rate. During processing, CPU

first checks cache for the required data. If data is not found in cache, then it looks in the RAM for data.

- To access the cache memory, CPU does not have to use the motherboard's system bus for data transfer. (The data transfer speed slows to the motherboard's capability, when data is passed through system bus. CPU can process data at a much faster rate by avoiding the system bus.)

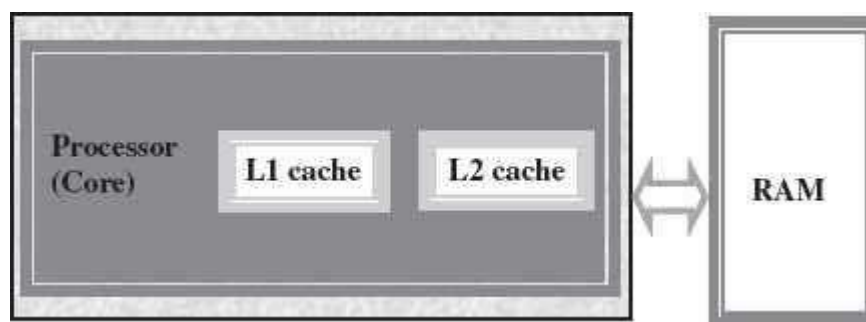


Figure 2.3 Illustration of cache memory

- Cache memory is built into the processor, and may also be located next to it on a

separate chip between the CPU and RAM. Cache built into the CPU is faster than separate cache, running at the speed of the microprocessor itself. However, separate cache is roughly twice as fast as RAM.

- The CPU has a built-in *Level 1 (L1)* cache and *Level 2 (L2)* cache, as shown in [Figure 2.3](#). In addition to the built-in L1 and L2 cache, some CPUs have a separate cache chip on the motherboard. This cache on the motherboard is called *Level 3 (L3)* cache. Nowadays, high-end processor comes with built-in L3 cache, like in Intel core i7. The L1, L2 and L3 cache store the most recently run instructions, the next ones and the possible ones, respectively. Typically, CPUs have cache size varying from 256KB (L1), 6 MB (L2), to 12MB (L3) cache.
- Cache memory is very expensive, so it is smaller in size. Generally, computers have cache memory of sizes 256 KB to 2 MB.

Primary Memory

- Primary memory is the main memory of computer. It is used to store data and instructions during the processing of data. Primary memory is semiconductor memory.
- Primary memory is of two kinds—Random Access Memory (RAM) and Read Only Memory (ROM).
- RAM is volatile. It stores data when the computer is on. The information stored in RAM gets erased when the computer is turned off. RAM provides *temporary storage* for data and instructions.
- ROM is non-volatile memory, but is a read only memory. The storage in ROM is permanent in nature, and is used for storing standard processing programs that permanently reside in the computer. ROM comes programmed by the manufacturer.
- RAM *stores data and instructions during the execution* of instructions. The data and instructions that require processing are brought into the RAM from the storage devices like hard disk. CPU accesses the data and the instructions from RAM, as it can access it at a *fast* speed than the storage devices connected to the input and output unit ([Figure 2.4](#)).
- The input data that is entered using the input unit is stored in RAM, to be made available during the processing of data. Similarly, the output data generated after processing is stored in RAM before being sent to the output device. Any intermediate results generated during the processing of program are stored in RAM.
- RAM provides a *limited storage capacity*, due to its *high cost*.

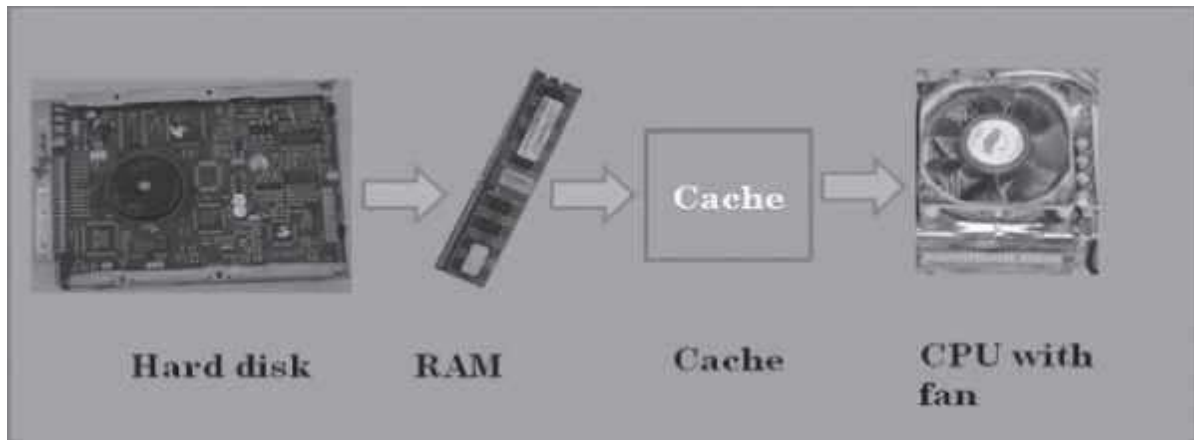


Figure 2.4 Interaction of CPU with memory

Secondary Memory

- The secondary memory stores data and instructions *permanently*. The information can be stored in secondary memory for a long time (years), and is generally permanent in nature unless erased by the user. It is a non-volatile memory.
- It provides *back-up storage* for data and instructions. Hard disk drive, floppy drive and optical disk drives are some examples of storage devices.
- The data and instructions that are currently not being used by CPU, but may be required later for processing, are stored in secondary memory.
- Secondary memory has a *high storage capacity* than the primary memory.
- Secondary memory is also *cheaper* than the primary memory.
- It takes *longer time to access* the data and instructions stored in secondary memory than in primary memory.

Magnetic tape drives, disk drives and optical disk drives are the different types of storage devices.

Computer memory

The computer's memory stores data, instructions required during the processing of data, and output results. Storage may be required for a limited period of time, instantly, or, for an extended period of time. Different types of memories, each having its own unique features, are available for use in a computer. The cache memory, registers, and RAM are fast memories and store the data and instructions temporarily during the processing of data and instructions. The secondary memory like magnetic disks and optical disks have large storage capacities and store the data and instructions permanently, but are slow memory devices. The memories are organized in the computer in a manner to achieve high levels of performance at the minimum cost.

In this chapter, we discuss different types of memories, their characteristics and their use in the computer.

MEMORY REPRESENTATION

The computer memory stores different kinds of data like input data, output data, intermediate results, etc., and the instructions. **Binary digit** or **bit** is the basic unit of memory. A **bit** is a single

binary digit, i.e., 0 or 1. A bit is the smallest unit of representation of data in a computer. However, the data is handled by the computer as a combination of bits. A group of 8 bits form a **byte**. One byte is the smallest unit of data that is handled by the computer. One byte can store 2^8 , i.e., 256 different combinations of bits, and thus can be used to represent 256 different symbols. In a byte, the different combinations of bits fall in the range 00000000 to 11111111. A group of bytes can be further combined to form a **word**. A word can be a group of 2, 4 or 8 bytes.

1 bit = 0 or 1

1 Byte (B) = 8 bits

1 Kilobyte (KB) = 2^{10} =

1024 bytes 1 Megabyte

(MB) = 2^{20} = 1024KB

1 Gigabyte (GB) = 2^{30} = 1024 MB = 1024 * 1024 KB

1 Terabyte (TB) = 2^{40} = 1024 GB = 1024 * 1024 * 1024 KB

Memory is logically organized as a linear array of locations. For a processor, the range of the memory addresses is 0 to the maximum size of memory. [Figure 3.1](#) shows the organization of a 16 MB block of memory for a processor with a 32-bit word length.

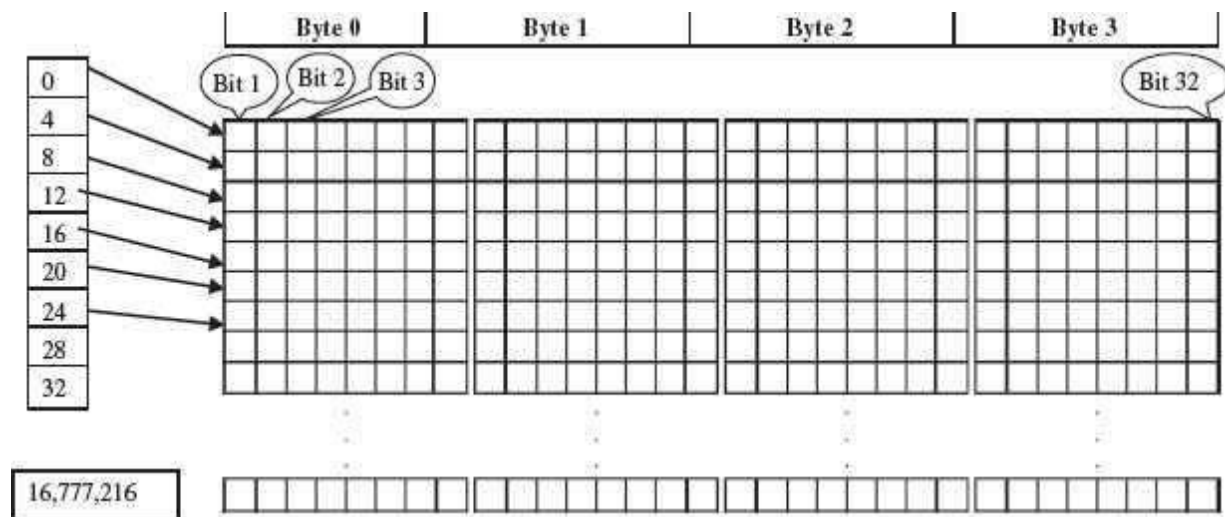


Figure 3.1 Organization of memory

MEMORY HIERARCHY

The memory is characterized on the basis of two key factors—capacity and access time. *Capacity* is the amount of information (in bits) that a memory can store. *Access time* is

the time interval between the read/ write request and the availability of data. The lesser the access time, the faster is the *speed of memory*. Ideally, we want the memory with *fastest speed and largest capacity*. However, the cost of fast memory is very high. The computer uses a hierarchy of

memory that is organized in a manner to enable the fastest speed and largest capacity of memory. The hierarchy of the different memory types is shown in [Figure 3.2](#).

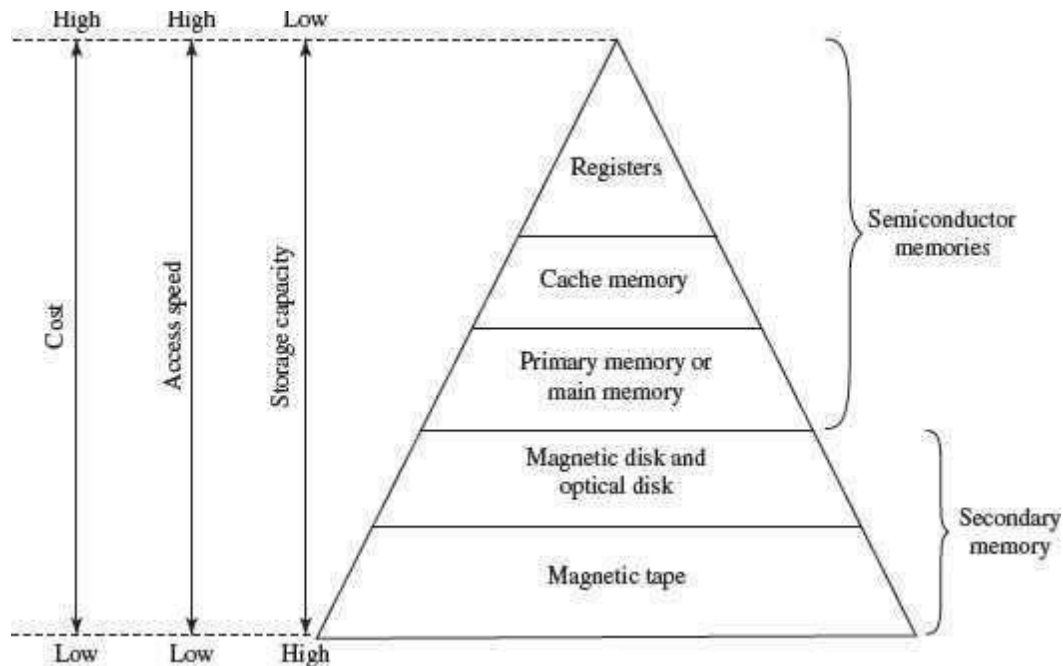


Figure 3.2 Memory hierarchy

The internal memory and external memory are the two broad categories of memory used in the computer. The internal memory consists of the CPU registers, cache memory and primary memory. The internal memory is used by the CPU to perform the computing tasks. The external memory is also called the secondary memory. The secondary memory is used to store the large amount of data and the software .

In general, referring to the computer memory usually means the internal memory.

- Internal Memory**—The key features of internal memory are—(1) limited storage capacity, (2) temporary storage, (3) fast access, and (4) high cost. Registers, cache memory, and primary memory constitute the internal memory. The primary memory is further of two kinds—RAM and ROM. Registers are the fastest and the most expensive among all the memory types. The registers are located inside the CPU, and are directly accessible by the CPU. The speed of registers is between 1—2 ns (nanosecond). The sum of the size of registers is about 200B. Cache memory is next in the hierarchy and is placed between the CPU and the main memory. The speed of cache is between 2—10 ns. The cache size varies between 32 KB to 4MB. Any program or data that has to be executed must be brought into RAM from the secondary memory. Primary memory is relatively slower than the cache memory. The speed of RAM is around 60ns.

The RAM size varies from 512KB to 3GB.

- **Secondary Memory**—The key features of secondary memory storage devices are—(1) very high storage capacity, (2) permanent storage (non-volatile), unless erased by user, (3) relatively slower access, (4) stores data and instructions that are not currently being used by CPU but may be required later for processing, and (5) cheapest among all memory. The storage devices consist of two parts—drive and device. For example, magnetic tape drive and magnetic tape, magnetic disk drive and disk, and, optical disk drive and disk. The speed of magnetic disk is around 60ms. The capacity of a hard disk ranges from 160 GB to 1,600 GB (1.6 Tera Bytes). [Figure 3.3](#) shows the interaction between CPU and memory.

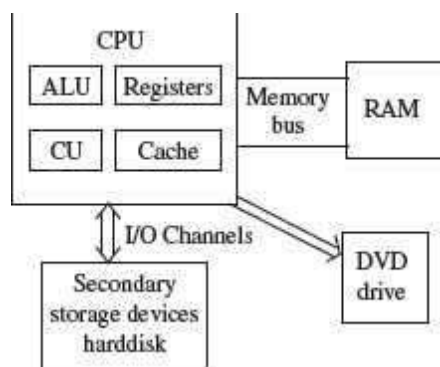


Figure 3.3 CPU and the memory

To get the fastest speed of memory with largest capacity and least cost, the fast memory is located close to the processor. The secondary memory, which is not as fast, is used to store information permanently, and is placed farthest from the processor. With respect to CPU, the memory is organized as follows—

- Registers are placed inside the CPU (small capacity, high cost, very high speed)
- Cache memory is placed next in the hierarchy (inside and outside the CPU)
- Primary memory is placed next in the hierarchy
- Secondary memory is the farthest from CPU (large capacity, low cost, low speed)

The speed of memories is dependent on the kind of technology used for the memory. The registers, cache memory and primary memory are semiconductor memories. They do not have any moving parts and are fast memories. The secondary memory is magnetic or optical memory, has moving parts and has slow speed.

CPU REGISTERS

- Registers are very high-speed storage areas located inside the CPU. After CPU gets the data and instructions from the cache or RAM, the data and instructions are moved to the registers for processing. Registers are manipulated directly by the control unit of CPU during instruction execution. That is why registers are often referred to as the CPU's *working memory*. Since CPU uses registers for the processing of data, the number of registers in a CPU and the size of each register affect the power and speed of a CPU. The

more the number of registers (ten to hundreds) and bigger the size of each register (8 bits to 64 bits), the better it is.

CACHE MEMORY

- Cache memory is placed in between the CPU and the RAM. Cache memory is a fast memory, faster than the RAM. When the CPU needs an instruction or data during processing, it first looks in the cache. If the information is present in the cache, it is called a *cache hit*, and the data or instruction is retrieved from the cache. If the information is not present in cache, then it is called a *cache miss* and the information is then retrieved from RAM. The content of cache is decided by the cache controller (a circuit on the motherboard). The most recently accessed information or instructions help the controller to guess the RAM locations that may be accessed next. To get good system performance, the number of hits must far outnumber the misses. The two main factors that affect the performance of cache are its size and level (L1, L2 and L3).

The CPU registers and the cache memory have been discussed in detail in the previous chapter.

PRIMARY MEMORY

Primary memory is the main memory of computer. It is a chip mounted on the motherboard of computer. Primary memory is categorized into two main types-

- Random Access Memory (RAM), and
- Read Only Memory (ROM)

RAM is used for the temporary storage of input data, output data and intermediate results. The input data entered into the computer using the input device, is stored in RAM for processing. After processing, the output data is stored in RAM before being sent to the output device. Any intermediate results generated during the processing of program are also stored in RAM. Unlike RAM, the data once stored in ROM either cannot be changed or can only be changed using some special operations. Therefore, ROM is used to store the data that does not require a change.

Flash memory is another form of rewritable read-only memory that is compact, portable, and requires little energy.

Random Access Memory

- RAM is used to *store data and instructions during the operation of computer*.
 - The data and instructions that need to be operated upon by CPU are first brought to RAM from the secondary storage devices like the hard disk.
 - CPU interacts with RAM to get the data and instructions for processing.
- RAM loses information when the computer is powered off. It is a *volatile memory*. When the power is turned on, again, all files that are required by the CPU are loaded from the hard disk to RAM. Since RAM is a volatile memory, any information that needs to be saved for a longer duration of time must not be stored in RAM.
- RAM provides *random access* to the stored bytes, words, or larger data units. This means that it requires same amount of time to access information from

- RAM, irrespective of where it is located in it.
- RAM can be *read from and written to* with the same speed.
 - The *size of RAM is limited due to its high cost*. The size of RAM is measured in MB or GB.
 - The performance of RAM is affected by—
 - Access speed (how *quickly* information can be retrieved). The speed of RAM is expressed in nanoseconds.
 - Data transfer unit size (how *much* information can be retrieved in one request).
 - RAM affects the speed and power of a computer. More the RAM, the better it is. Nowadays, computers generally have 512 MB to 4 GB of RAM.
 - RAM is a microchip implemented using semiconductors.
 - There are two categories of RAM, depending on the technology used to construct a RAM— (1) Dynamic RAM (DRAM), and (2) Static RAM (SRAM).
 - **DRAM** is the most common type of memory chip. DRAM is mostly used as main memory since it is small and cheap.
 - It uses transistors and capacitors. The transistors are arranged in a matrix of rows and columns. The capacitor holds the bit of information 0 and 1. The transistor and capacitor are paired to make a *memory cell*. The transistor acts as a switch that lets the control circuitry on the memory chip read the capacitor or change its state.
 - DRAM must be refreshed continually to store information. For this, a memory controller is used. The memory controller recharges all the capacitors holding a 1 before they discharge. To do this, the memory controller reads the memory and then writes it right back.
 - DRAM gets its name from the refresh operation that it requires to store the information; otherwise it will lose what it is holding. The refresh operation occurs automatically thousands of times per second. DRAM is slow because the refreshing takes time.
 - Access speed of DRAM ranges from 50 to 150 ns.
 - **SRAM** chip is usually used in *cache memory* due to its high speed.
 - SRAM uses multiple transistors (four to six), for each memory cell. It does not have a capacitor in each cell.
 - A SRAM memory cell has more parts so it takes more space on a chip than DRAM cell.
 - It does not need constant refreshing and therefore is faster than DRAM.
 - SRAM is more expensive than DRAM, and it takes up more space.
 - It stores information as long as it is supplied with power.
 - SRAM are easier to use and very fast. The access speed of SRAM ranges from 2–10 nanosecond.
 - The memory chips ([Figure 3.4](#)) are available on a separate Printed Circuit Board (PCB) that is plugged into a special connector on the motherboard. Memory chips are generally available as part of a card called a *memory module*. There are generally two types of RAM modules—Single Inline Memory Module (SIMM) and Dual Inline Memory Module (DIMM).



Figure 3.4 PCB containing RAM chip of 1 GB

- SIMM modules have memory chip on one side of the PCB. SIMM modules can store 8 bits to 32 bits of data simultaneously.
- DIMM modules have memory chips on both sides of the PCB. DIMM format are 64-bit memories. Smaller modules known as Small Outline DIMM (SO DIMM) are designed for portable computers. SO DIMM modules have 32-bit memory.

Read Only Memory

ROM is a *non-volatile* primary memory. It does not lose its content when the power is switched off. The features of ROM are described as follows—

- ROM, as the name implies, has only read capability and no write capability. After the information is stored in ROM, it is permanent and cannot be corrected.
- ROM comes programmed by the manufacturer. It stores standard processing programs that permanently reside in the computer. ROM stores the data needed for the start up of the computer. The instructions that are required for initializing the devices attached to a computer are stored in ROM.
- The ROM memory chip ([Figure 3.5](#)) stores the *Basic Input Output System (BIOS)*. BIOS provides the processor with the information required to boot the system. It provides the system with the settings and resources that are available on the system. BIOS is a permanent part of the computer. It does not load from disk but instead is stored in a ROM memory chip. The program code in the BIOS differs from ordinary software since it acts as an integral part of the computer. When the computer is turned on, the BIOS does the following things—



Figure 3.5 ROM BIOS and CMOS battery on a motherboard

- *Power On Self Test (POST)* is a program that runs automatically when the system is booted. BIOS performs the power-on self-test. It checks that the major hardware components are working properly.
 - BIOS setup program, which is a built-in utility in BIOS, lets the user set the many functions that control how the computer works. BIOS displays the system settings and finds the bootable devices. It loads the interrupt handlers and device drivers. It also initializes the registers.
 - *Bootstrap Loader* is a program whose purpose is to start the computer software for operation when the power is turned on. It loads the operating system into RAM and launches it. It generally seeks the operating system on the hard disk. The bootstrap loader resides in the ROM. The BIOS initiates the bootstrap sequence.
- ROMs are of different kinds. They have evolved from the fixed read only memory to the ones that can be programmed and re-programmed. They vary in the number of re-writes and the method used for the re-writing. Programmable ROM (PROM), Erasable Programmable ROM (EPROM) and Electrically Erasable Programmable ROM (EEPROM) are some of the ROMs. All the different kinds of ROM retain their content when the power is turned off.
 - **PROM** can be programmed with a special tool, but after it has been programmed the contents cannot be changed. PROM memories have thousands of fuses (or diodes). High voltage (12 V) is applied to the fuses to be burnt. The burnt fuses correspond to 0 and the others to 1.
 - **EPROM** can be programmed in a similar way as PROM, but it can be erased by exposing it to ultra violet light and re-programmed. EPROM chips have to be removed from the computer for re-writing.
 - **EEPROM** memories can be erased by electric charge and re-programmed. EEPROM chips do not have to be removed from the computer for re-writing.
- **Flash Memory** is a kind of semiconductor-based non-volatile, rewritable computer memory that can be electrically erased and reprogrammed ([Figure 3.6](#)). It is a specific type of EEPROM.

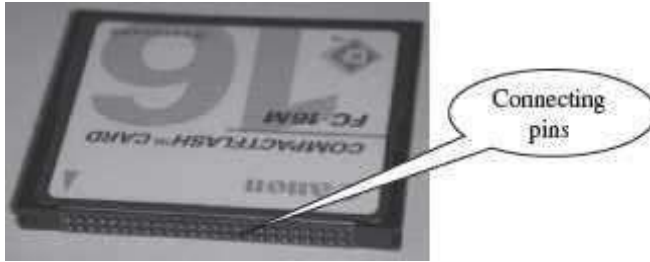


Figure 3.6 Flash memory

- It combines the features of RAM and ROM. It is a random access memory and its content can be stored in it at any time. However, like ROM, the data is not lost when the machine is turned off or the electric power is cut. Flash memory stores bits of data in memory cells.
- Flash memories are high-speed memories, durable, and have low-energy consumption. Since flash memory has no moving part, it is very shock-resistant. Due to these features, flash memory is used in devices such as digital camera, mobile phone, printer, laptop computer, and record and play back sound devices, such as MP3 players.

SECONDARY MEMORY

In the previous section, we saw that RAM is expensive and has a limited storage capacity. Since it is a volatile memory, it cannot retain information after the computer is powered off. Thus, in addition to primary memory, an auxiliary or secondary memory is required by a computer. The secondary memory is also called the storage device of computer. *In this chapter, the terms secondary memory and storage device are used interchangeably.* In comparison to the primary memory, the secondary memory stores much larger amounts of data and information (for example, an entire software program) for extended periods of time. The data and instructions stored in secondary memory must be fetched into RAM before processing is done by CPU.

Magnetic tape drives, magnetic disk drives, optical disk drives and magneto-optical disk drives are the different types of storage devices.

ACCESS TYPES OF STORAGE DEVICES

The information stored in storage devices can be accessed in two ways—

1. Sequential access
2. Direct access

Sequential Access Devices

Sequential access means that computer must run through the data in sequence, starting from the beginning, in order to locate a particular piece of data. Magnetic tape is an example of sequential access device. Let us suppose that magnetic tape consists of 80 records. To access the 25th

record, the computer starts from first record, then reaches second, third etc. until it reaches the 25th record. Sequential access devices are generally slow devices.

Direct Access Devices

Direct access devices are the ones in which any piece of data can be retrieved in a non-sequential manner by locating it using the data's address. It accesses the data directly, from a desired location. Magnetic disks and optical disks are examples of direct access devices. There is no predefined order in which one can read and write data from a direct access device. In a magnetic disk consisting of 80 records, to access the 25th record, the computer can directly access the 25th record, without going past the first 24 records. Based on access, magnetic tapes are sequential access devices, and, magnetic disks, optical disk and magneto-optical disks are direct access devices.

MAGNETIC TAPE

Magnetic tape is a plastic tape with magnetic coating ([Figure 3.7](#)). It is a storage medium on a large open reel or in a smaller cartridge or cassette (like a music cassette). Magnetic tapes are cheaper storage media. They are durable, can be written, erased, and re-written. Magnetic tapes are sequential access devices, which mean that the tape needs to rewind or move forward to the location where the requested data is positioned in the magnetic tape. Due to their sequential nature, magnetic tapes are not suitable for data files that need to be revised or updated often. They are generally used to store back-up data that is not frequently used or to transfer data from one system to other.



Figure 3.7 A 10.5-inch reel of 9-track tape

The **working of magnetic tape** is explained as follows—

- Magnetic tape is divided horizontally into tracks (7 or 9) and vertically into frames ([Figure 3.8](#)). A frame stores one byte of data, and a track in a frame stores one bit. Data is stored in successive frames as a string with one data (byte) per frame.

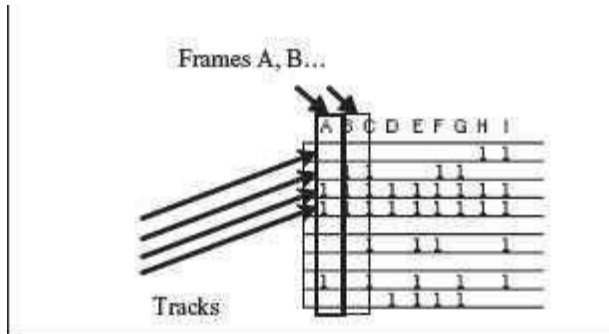


Figure 3.8 A portion of magnetic tape

- Data is recorded on tape in the form of blocks, where a block consists of a group of data also called as records. Each block is read continually. There is an *Inter-Record Gap (IRG)* between two blocks that provides time for the tape to be stopped and started between records ([Figure 3.9](#)).

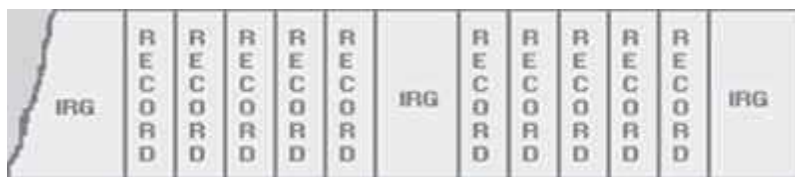


Figure 3.9 Blocking of data in a magnetic tape

- Magnetic tape is mounted on a magnetic tape drive for access. The basic *magnetic tape drive* mechanism consists of the supply reel, take-up reel, and the read/write head assembly. The magnetic tape moves on tape drive from the supply reel to take-up reel, with its magnetic coated side passing over the read/write head.
- Tapes are categorized based on their width - ¼ inch, ½ inch, etc.
- The storage capacity of the tape varies greatly. A 10-inch diameter reel of tape which is 2400 feet long can store up to 180 million characters.

The features of magnetic tape are—

- Inexpensive storage device
- Can store a large amount of data
- Easy to carry or transport
- Not suitable for random access data
- Slow access device
- Needs dust prevention, as dust can harm the tape
- Suitable for back-up storage or archiving

MAGNETIC DISK

Magnetic disk is a direct access secondary storage device. It is a thin plastic or metallic circular plate coated with magnetic oxide and encased in a protective cover. Data is stored on magnetic

disks as magnetized spots. The presence of a magnetic spot represents the bit 1 and its absence represents the bit 0.

The working of magnetic disk is explained as follows—

- The surface of disk is divided into concentric circles known as **tracks**. The outermost track is numbered 0 and the innermost track is the last track. Tracks are further divided into **sectors**. A sector is a pie slice that cuts across all tracks. The data on disk is stored in sector. Sector is the smallest unit that can be read or written on a disk. A disk has eight or more sectors per track ([Figure 3.10](#)).

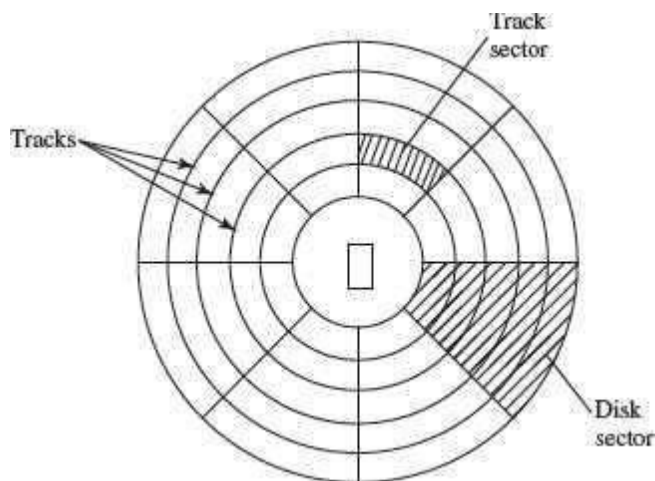


Figure 3.10 Tracks and sectors of a disk

- Magnetic disk is inserted into a magnetic disk drive for access. The drive consists of a read/write head that is attached to a disk arm, which moves the head. The disk arm can move inward and outward on the disk.
- During reading or writing to disk, the motor of disk drive moves the disk at high speed (60–150 times/sec.)
- Accessing data on the disk requires the following—
 - The read/write head is positioned to the desired track where the data is to be read from or written to. The time taken to move the read/write head to the desired track is called the **seek time**.
 - Once the read/write head is at the right track, then the head waits for right sector to come under it (disk is moving at high speed). The time taken for desired sector of the track to come under read/write head is called the **latency time**.
 - Once the read/write head is positioned at the right track and sector, the data has to be written to disk or read from disk. The rate at which data is written to disk or read from disk is called **data transfer rate**.
 - The sum of seek time, latency time and time for data transfer is the **access time** of the disk.
- The storage capacity of disk drive is measured in gigabytes (GB).

- Large disk storage is created by stacking together multiple disks. A set of same tracks on all disks forms a *cylinder*. Each disk has its own read/write head which work in coordination.
- A disk can also have tracks and sectors on both sides. Such a disk is called *double-sided disk*.

The features of magnetic disk are—

- Cheap storage device
- Can store a large amount of data
- Easy to carry or transport
- Suitable for frequently read/write data
- Fast access device
- More reliable storage device
- To be prevented from dust, as the read/write head flies over the disk. Any dust particle in between can corrupt the disk.

Finding data on a magnetic disk is as follows—

- In order to use a disk, it has to be formatted. Formatting includes assigning addresses to various locations on disk, assigning location of root directory and checking for defects on the surface of disk.
- During formatting, the tracks and sectors of a disk are labeled, which provides an address to each location of the disk.
- There are different methods to format a disk. File Allocation Table (FAT) is the commonly used logical format for disk formatting performed by Windows.
- Four areas are created when a disk is formatted using FAT—
 - **Boot Sector** It contains the program that runs when the computer is started. The program checks if the disk has files required to run the operating system. It then transfers control to an operating system program which continues the startup process. Boot sector also contains information about the disk, like number of bytes per sector and number of sectors per track. This information is required by the operating system to access the data on the disk.
 - **File Allocation Table** It records the location of each file and status of each sector. While reading or writing to disk, operating system checks the FAT to find free area or locate where data is stored on disk, respectively.
 - **Root Directory** This is the main folder of disk. It contains other folders in it, creating a hierarchical system of folders. The root directory contains information about all folders on the disk.
 - **Data Area** The remaining area of the disk (after boot sector, FAT, root directory) is the data area. It stores the program files and data files that are stored on the disk.
- The Windows XP and the Windows 2000 operating system use the New Technology File System (NTFS) file system. The NTFS file system offers better security and increased performance. It allows using of filenames that are more than eight characters long.

- Floppy disk, hard disk and zip disk are the different types of magnetic disks.

Floppy Disk

- Floppy disk (FD) is a flat, round, single disk made of Mylar plastic and enclosed in square plastic jacket ([Figure 3.11](#)).
- Floppy Disk Drive (FDD) is the disk drive for floppy disk.
- The floppy disk is inserted into the floppy disk drive to read or write data to it.
- Floppy disk has a write-protect slide tab that prevents a user from writing to it.
- A floppy disk may be single-sided or double-sided disk, i.e., data can be read and written on one and both sides of floppy disk, respectively.



Figure 3.11 Floppy disk

- They are portable. They can be removed from the disk drive, carried or stored separately.
- They are small and inexpensive.
- Floppy disks are slower to access than hard disk. They have less storage capacity and are less expensive than hard disk.
- They come in two basic sizes—5-¼ inch and 3-½ inch.
- The 5-¼ inch disk came around 1987. It can store 360 KB to 1.2 MB of data.
- The 3-½ inch disk has capacity of 400 KB to 1.44 MB. It usually contains 40 tracks and 18 sectors per track and can store 512 bytes per sector.

Hard Disk

- A hard disk (HD) consists of one or more platters divided into concentric tracks and sectors. It is mounted on a central spindle, like a stack. It can be read by a read/write head that pivots across the rotating disks. The data is stored on the platters covered with magnetic coating ([Figure 3.12](#)).

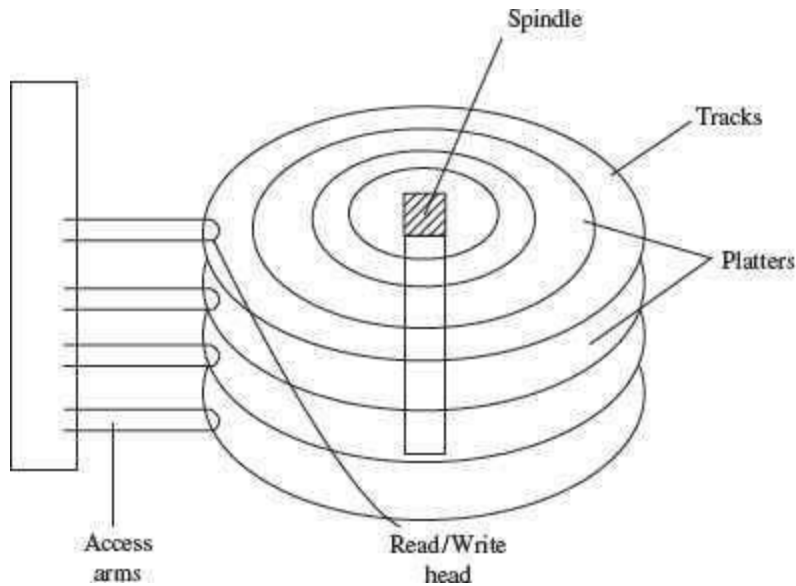


Figure 3.12 Parts of hard disk

- Hard disk is a fixed disk. The disk is not removable from the drive, unlike floppy disk.
- The hard disk and Hard Disk Drive (HDD) is a single unit.
- Hard disk can store much more data than floppy disk. The data in hard disk are packed more closely (because fast spinning uses smaller magnetic charges) and they have multiple platters, with data being stored on both sides of each platter. Large capacity hard disks may have 12 or more platters.
- Unlike floppy disk, the read/write head of hard disk does not touch the disk during accessing.
- Hard disk can spin at the speed of up to 10,000 revolutions per minute and have an access time of 9—14 ms. It stores 512 bytes per sector but the number of sectors are more per track (54 or more) than floppy disk.
- Nowadays, hard disks are available that can store up to 500 GB of data. Generally, PCs come with 160 GB hard disk.
- Hard disk is the key secondary storage device of computer. The operating system is stored on the hard disk. The performance of computer like speed of computer boot up, loading of programs to primary memory, loading of large files like images, video, audio etc., is also dependent on the hard disk.
- Nowadays, *portable external hard disk drive* is available which can be attached to the USB drive of the computer. They come in the storage capacities of 80 GB to 500 GB.

Zip Disk

- They are high-capacity removable disk and drive.
- They have the speed and capacity of hard disk and portability of floppy disk.
- Zip disk are of the same size as floppy disk, i.e., 3½ inch but have a much higher capacity than the floppy disk ([Figure 3.13](#)).

- Zip disk and drive were made by Iomega Corp. It comes as a complete unit—disk, drive, connection cable, power cord and operating system. It can be connected to the computer system externally using a parallel chord or SCSI cable.
- Their capacity ranges from 100 MB to 750 MB. They can be used to store large files, audio and video data.



Figure 3.13 Zip disk

OPTICAL DISK

Optical disk ([Figure 3.14](#)) is a flat and circular disk which is coated with reflective plastic material that can be altered by laser light. Optical disk does not use magnetism. The bits 1 and 0 are stored as spots that are relatively bright and light, respectively.

- An optical disk consists of a single spiral track that starts from the edge to the centre of disk. Due to its spiral shape, it can access large amount of data sequentially, for example music and video. The random access on optical disk is slower than that of magnetic disk, due to its spiral shape.
- The tracks on optical disk are further divided into sectors which are of same length. Thus, the sectors near the centre of disk wrap around the disk longer than the sectors on the edges of disk. Reading the disk thus requires spinning the disk faster when reading near the centre and slower when reading near the edge of disk. Optical disks are generally slower than hard disks. [Figure 3.15](#) shows the tracks and sectors in a magnetic disk and optical disk.



Figure 3.14 Optical disk

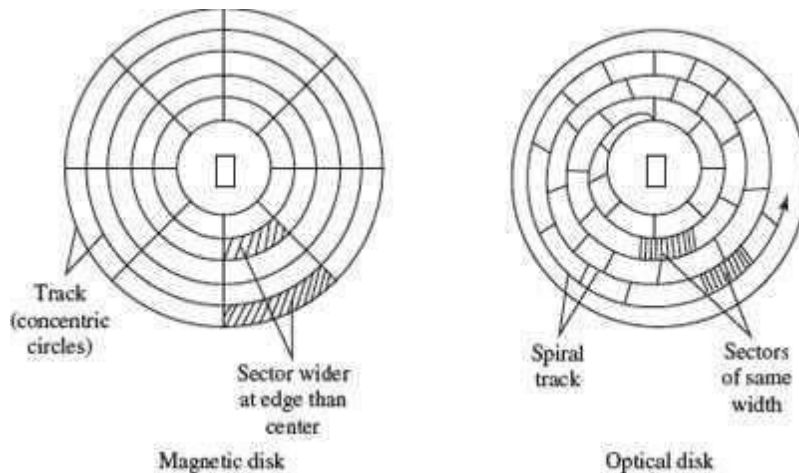


Figure 3.15 Sectors and track in magnetic disk and optical disk

- Optical disks can store large amount of data, up to 6 GB, in a small space. Commonly used optical disks store 600–700 MB of data.
- The access time for an optical disk ranges from 100 to 200 ms.
- There are two most common categories of optical disks—read-only optical disks and recordable optical disks.

CD-ROM

- Originally, Compact Disk (CD) was a popular medium for storing music. Now, it is used in computers to store data and is called Compact Disk-Read Only Memory (CD-ROM).
- As the name suggests, CD-ROM ([Figure 3.16](#)) is an optical disk that can only be read and not written on. CD-ROM is written on by the manufacturer of the CD-ROM using the laser light.
- A CD-ROM drive reads data from the compact disk. Data is stored as pits (depressions) and lands (flat area) on CD-ROM disk. When the laser light is focused on the disk, the pits scatter the light (interpreted as 0) and the lands reflect the light to a sensor (interpreted as 1).
- As CD-ROM is read only, no changes can be made into the data contained in it.
- Since there is no head touching the disk, but a laser light, CD-ROM does not get worn out easily.
- The storage density of CD-ROM is very high and cost is low as compared to floppydisk and hard disk.
- Access time of CD-ROM is less. CD-ROM drives can read data at 150Kbps. They come in multiples of this speed like—2x, 4x, 52x, 75x, etc.
- It is a commonly used medium for distributing software and large data.

DVD-ROM

- Digital Video Disk-Read Only Memory (DVD-ROM) is an optical storage device used to store digital video or computer data ([Figure 3.17](#)).
- DVDs look like CDs, in shape and physical size.



Figure 3.16 CD-ROM



Figure 3.17 DVDs

- It improves on CD technology.
- It is a high-density medium with increased track and bit density.
- DVD-ROM uses both sides of the disk and special data compression technologies. The tracks for storing data are extremely small.
- A full-length movie can be stored on a single disk.
- Each side of DVD-ROM can store 4.7 GB of data, so a single DVD can store 9.4 GB of data.
- New DVD-ROMs use layers of data track, to double its capacity. Such dual layer disks can store 17 GB of data.

Recordable Optical Disk

In addition to the read only CDs and DVDs, recordable optical disks ([Figure 3.18](#)) are also available. Users can record music, video, audio and data on it. The recordable optical disks are—

- **Compact Disk-Recordable (CD-R)** is a Write Once-Read Many (WORM) disk. A CD-R disk allows the user to write data permanently on to the disk. Once the data is written, it cannot be erased. CD-R disk uses a laser that burns pits into the disk surface. It looks like a CD disk externally. To write to a CD-R disk, a device named CD-Writer or CD-burner is required. A CD-R disk can store 700 MB of data that can run for 80 minutes. CD-R is used to create music CDs in home computers, back up data from other storage devices, archives of large data, etc.
- **Compact Disk-ReWritable (CD-RW)** allows data to be written, erased and re-written on. The capacity of CD-RW is same as a CD. They generally do not play on all CD-ROM drives.
- **Digital Video Disk-Recordable (DVD-R)** allows recording of data on a DVD. A DVD writer device is required to write the data to DVD. The data once written on a DVD cannot be erased or changed.

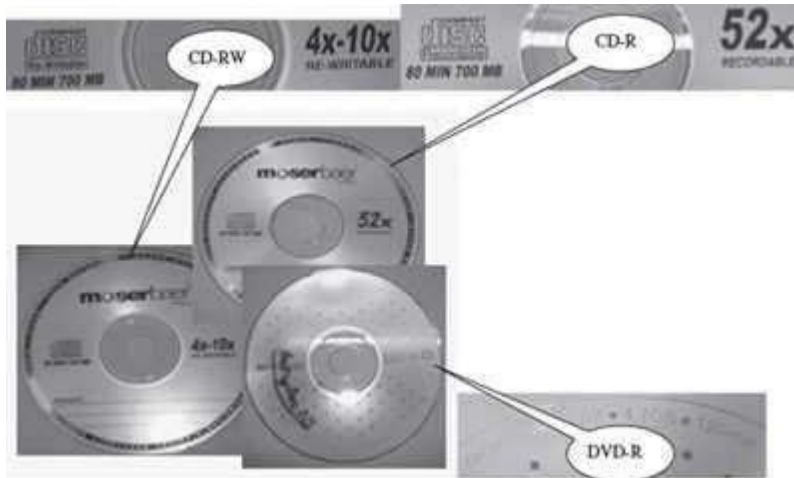


Figure 3.18 CD-R, CD-RW and DVD-R

MAGNETO-OPTICAL DISK

- Magneto-optical disks use laser beam to read data and magnetic field to write data to disk. • These are optical disks where data can be written, erased and re-written.
- They are expensive and outdated. They were used during the mid 1990s. They have now been replaced by CD-RW and DVD-R.

Input Devices

Devices used to provide data and instructions to the computer are called

Input devices. Some important input devices are

Key board, Mouse, Scanner, MICR, Web camera, Microphone etc.

1. **Keyboard**: The Key board is used for typing text into the computer. It is also known as standard Input device. A computer keyboard is similar to that of a type writer with additional keys. The most commonly available computer keyboard has 104 keys.

There are different types of keys on the keyboard. The keys are categorized as :

- Alphanumeric keys , including letters & numbers.
- Punctuation keys, such as colon (:), semicolon (;) Question mark (?),
Single & doublequotes (_ , |)
- Special keys such as arrow keys, control keys, function keys (F1 to F12), HOME, END etc.



2.. **Mouse:** It is a device that controls the movement of the cursor on a monitor. A mouse will have 2 buttons on its top. The left button is the most frequently used button. There will be a wheel between the left and right buttons. This wheel enables us to smoothly scroll through screens of information. As we move the mouse, the pointer on the monitor moves in the same direction. Optical mouse is another advanced pointing device that uses a light emitting component instead of the mouse ball. Mouse cannot be used for entering the data. It is only useful to select the options on the screen.



3. **Scanner:** : It is an input device that can read text or illustrations printed on paper and translate into digital form. The main advantage of these scanners is that the data need not be entered separately resulting in saving lot of time.



Scanners are of two types: i) optical scanners ii) MICR

i) Optical scanners:

a. Optical character Recognition(OCR): In this, characters are read with the help of a light. This is used in office automation, documentation in library etc.

b. Optical mark recognition(OMR): It is a technology where an OMR device senses the presence or absence of a mark such as a pencil mark. OMR is used in tests such as aptitude tests.

c. Optical barcode recognition(OBCR): Barcode readers are photoelectric scanners that read the bar codes or vertical zebra striped marks printed on product containers. This is

used in super markets, bookshops etc.

ii. MICR: This is widely used in banks to process the cheques. This allows the computer to recognize characters printed using magnetic ink.

4. **Magnetic Ink Character Recognition(MICR)** : It is a character recognition technology used primarily by the banking industry to facilitate the processing of the cheques. MICR characters (cheque No., Acc.No.etc) are printed in special ink usually containing iron oxide. When a document that contains the ink needs to be read, it passes through a machine which magnetizes the ink and there will be a reader sorter unit which translates the magnetic information into characters. MICR provides a secure, high speed of scanning and processing information. It scans about 2600 cheques/min.

Output devices

Any device that is capable of representing information on a computer is called an Output device. Output devices receive information from the CPU and present it to the user in the desired form.

Some important Output devices are : Monitor, Printer

1. **Terminal/Monitor**: It is similar to TV screen- either a monochrome (black & white) or colour – and it displays the output. It is also referred as Visual Display Unit(VDU). Several types of monitors are in use. Some of them are Colour Graphic Adapter(CGA), Enhanced Graphics Adaptor(EGA) , Video Graphics Adapter (VGA) and Super Video Graphics Adapter (SVGA).

The screen sizes differ from system to system. The standard size is 24 lines by 80 characters. Most systems have provision for scrolling which helps in moving the text vertically or horizontally on the screen.



2 . **Printer**: A printer is used to transfer data from a computer onto paper. The paper copy

obtained from a printer is often referred as —printoutll. The different printers and their speeds are as follows:

S. No.	Type	Mode of Printing	Speed
1	Dot – Matrix printer	Prints the character in dotted pattern through printer ribbon using either 24 pin or 9 pin	200/300 to 700 CPS
2	Ink Jet printer	Work by spraying ionized ink	Slow, 90 CPS
3	Laser printer	Also called page printer. Uses laser beam to produce an image.	6 to 12 PPM
4	Line printer	Prints lines at a time instead of single characters.	300 to 600 LPM
5	Plotter	Produces drawings or graphs through pens which are filled with different colours.	

(CPS: Characters Per Second; PPM: Pages Per Minutes; LPM : Lines Per Minute)



Laser printer

UNIT-III

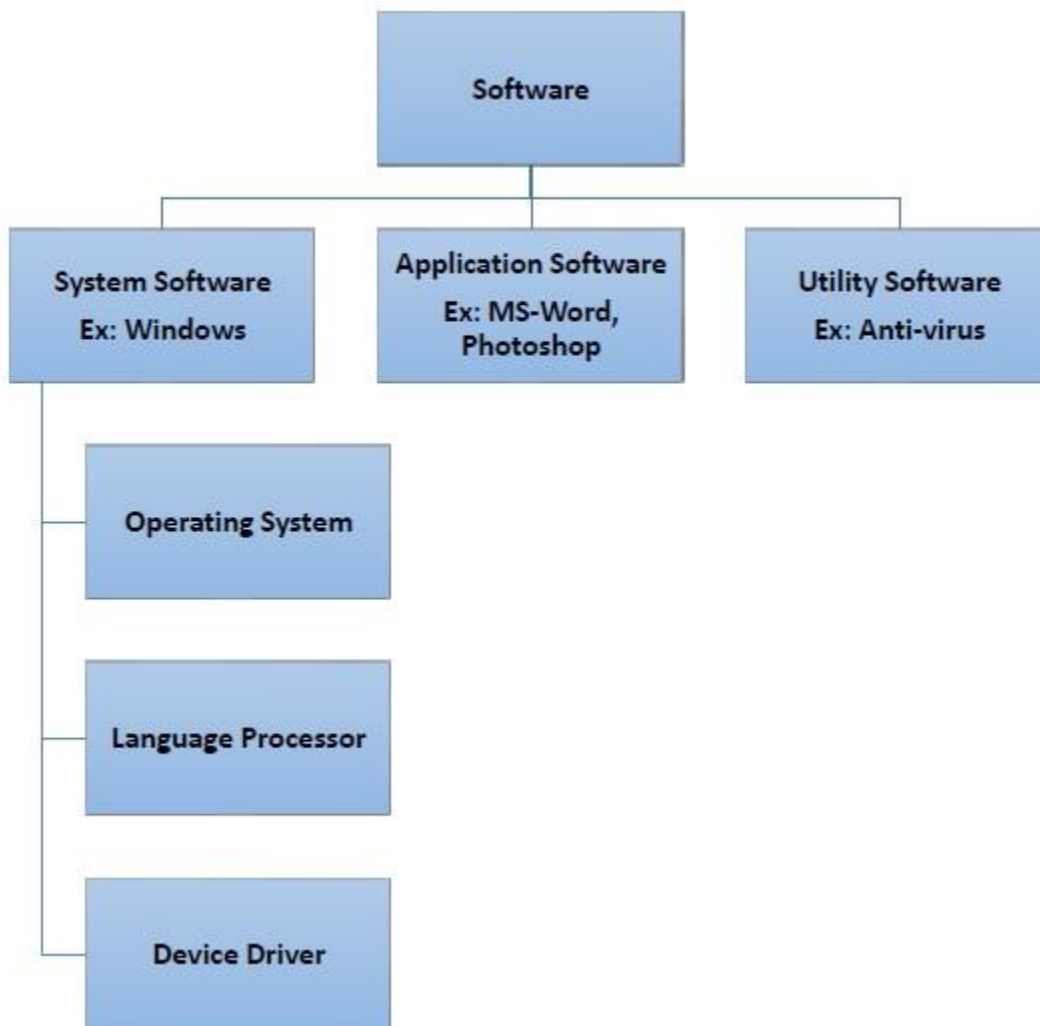
Basics of Computers - Software Concepts

As you know, the hardware devices need user instructions to function. A set of instructions that achieve a single outcome are called program or procedure. Many programs functioning together to do a task make a **software**.

For example, a word-processing software enables the user to create, edit and save documents. A web browser enables the user to view and share web pages and multimedia files. There are two categories of software –

- System Software
- Application Software
- Utility Software

Let us discuss them in detail.



System Software

Software required to run the hardware parts of the computer and other application software are called **system software**. System software acts as **interface** between hardware and user applications. An interface is needed because hardware devices or machines and humans speak in different languages.

Machines understand only binary language i.e. 0 (absence of electric signal) and 1 (presence of electric signal) while humans speak in English, French, German, Tamil, Hindi and many other languages. English is the pre-dominant language of interacting with computers. Software is required to convert all human instructions into machine understandable instructions. And this is exactly what system software does.

Based on its function, system software is of four types –

- Operating System
- Language Processor
- Device Drivers

Operating System

System software that is responsible for functioning of all hardware parts and their interoperability to carry out tasks successfully is called **operating system (OS)**. OS is the first software to be loaded into computer memory when the computer is switched on and this is called **booting**. OS manages a computer's basic functions like storing data in memory, retrieving files from storage devices, scheduling tasks based on priority, etc.

Language Processor

As discussed earlier, an important function of system software is to convert all user instructions into machine understandable language. When we talk of human machine interactions, languages are of three types –

- **Machine-level language** – This language is nothing but a string of 0s and 1s that the machines can understand. It is completely machine dependent.
- **Assembly-level language** – This language introduces a layer of abstraction by defining **mnemonics**. **Mnemonics** are English like words or symbols used to denote a long string of 0s and 1s. For example, the word “READ” can be defined to mean that computer has to retrieve data from the memory. The complete **instruction** will also tell the memory address. Assembly level language is **machine dependent**.
- **High level language** – This language uses English like statements and is completely independent of machines. Programs written using high level languages are easy to create, read and understand.

Program written in high level programming languages like Java, C++, etc. is called **source code**. Set of instructions in machine readable form is called **object code** or **machine code**. **System software** that converts source code to object code is called **language processor**. There are three types of language interpreters–

- **Assembler** – Converts assembly level program into machine level program.
- **Interpreter** – Converts high level programs into machine level program line by line.
- **Compiler** – Converts high level programs into machine level programs at one go rather than line by line.

Device Drivers

System software that controls and monitors functioning of a specific device on computer is called **device driver**. Each device like printer, scanner, microphone, speaker, etc. that needs to be attached externally to the system has a specific driver associated with it. When you attach a new device, you need to install its driver so that the OS knows how it needs to be managed.

Application Software

A software that performs a single task and nothing else is called **application software**. Application software are very specialized in their function and approach to solving a problem. So a spreadsheet software can only do operations with numbers and nothing else. A hospital management software will manage hospital activities and nothing else. Here are some commonly used application software –

- Word processing
- Spreadsheet
- Presentation
- Database management
- Multimedia tools

Utility Software

Application software that assist system software in doing their work is called **utility software**. Thus utility software is actually a cross between system software and application software. Examples of utility software include –

- Antivirus software
- Disk management tools
- File management tools
- Compression tools
- Backup tools

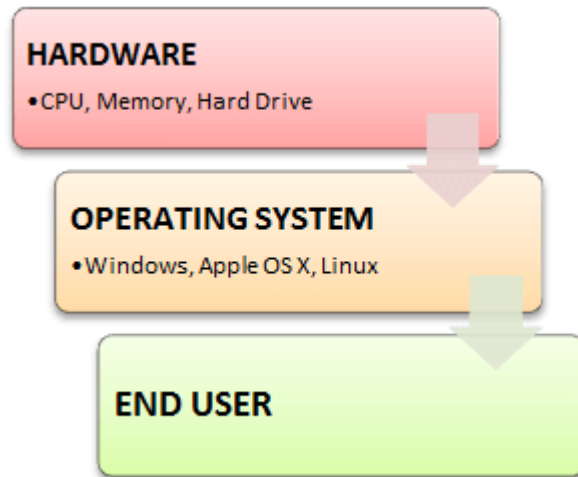
What is Operating System? Types of OS, Features and Examples

What is an Operating System?

An **Operating System (OS)** is a software that acts as an interface between computer hardware components and the user. Every computer system must have at least one operating system to run

other programs. Applications like Browsers, MS Office, Notepad Games, etc., need some environment to run and perform its tasks.

The OS helps you to communicate with the computer without knowing how to speak the computer's language. It is not possible for the user to use any computer or mobile device without having an operating system.

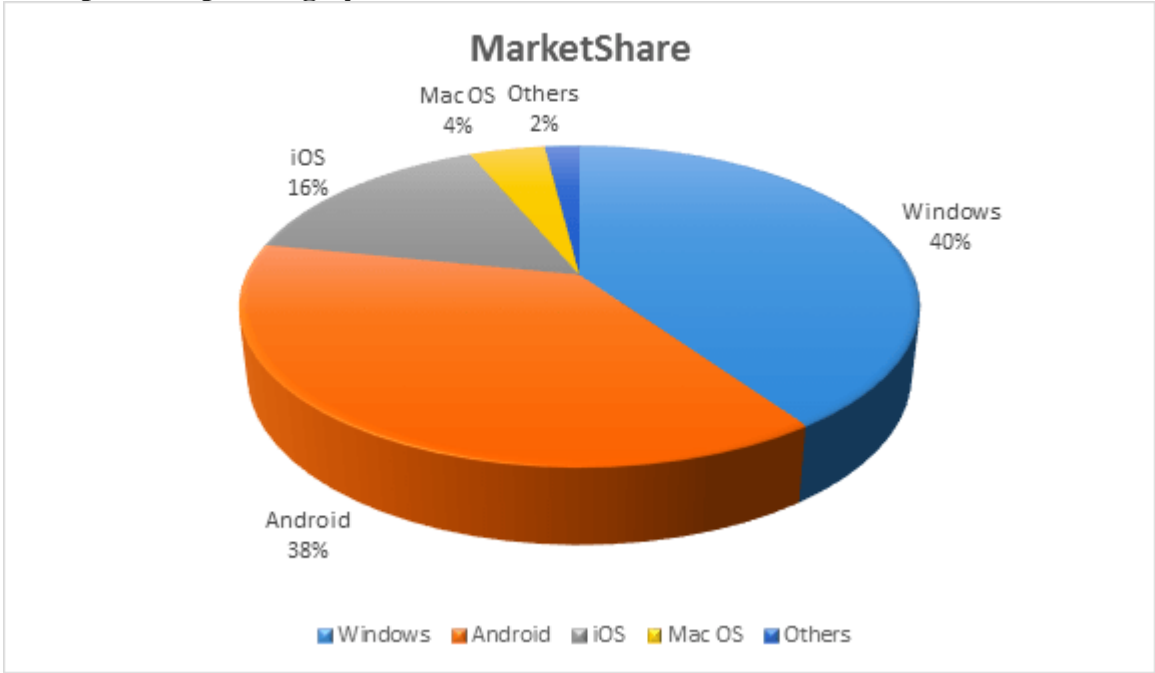


Introduction to Operating System

History Of OS

- Operating systems were first developed in the late 1950s to manage tape storage
- The General Motors Research Lab implemented the first OS in the early 1950s for their IBM 701
- In the mid-1960s, operating systems started to use disks
- In the late 1960s, the first version of the Unix OS was developed
- The first OS built by Microsoft was DOS. It was built in 1981 by purchasing the 86-DOS software from a Seattle company
- The present-day popular OS Windows first came to existence in 1985 when a GUI was created and paired with MS-DOS.

Examples of Operating System with Market Share



Share of Operating Systems

Market

Following are the examples of Operating System with the latest Market Share

OS Name	Share
Windows	40.34
Android	37.95
iOS	15.44
Mac OS	4.34
Linux	0.95

Chrome OS	0.14
Windows Phone OS	0.06

Types of Operating System (OS)

Following are the popular types of Operating System:

- Batch Operating System
- Multitasking/Time Sharing OS
- Multiprocessing OS
- Real Time OS
- Distributed OS
- Network OS
- Mobile OS

Batch Operating System

Some computer processes are very lengthy and time-consuming. To speed the same process, a job with a similar type of needs are batched together and run as a group.

The user of a batch operating system never directly interacts with the computer. In this type of OS, every user prepares his or her job on an offline device like a punch card and submit it to the computer operator.

Multi-Tasking/Time-sharing Operating systems

Time-sharing operating system enables people located at a different terminal(shell) to use a single computer system at the same time. The processor time (CPU) which is shared among multiple users is termed as time sharing.

Real time OS

A real time operating system time interval to process and respond to inputs is very small. Examples: Military Software Systems, Space Software Systems are the Real time OS example.

Distributed Operating System

Distributed systems use many processors located in different machines to provide very fast computation to its users.

Network Operating System

Network Operating System runs on a server. It provides the capability to serve to manage data, user, groups, security, application, and other networking functions.

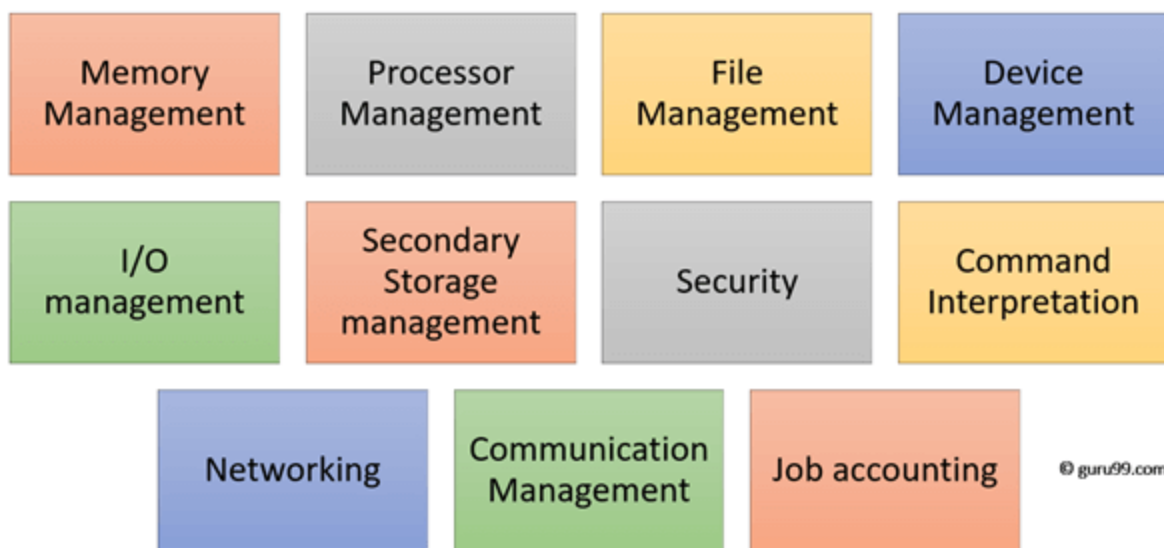
Mobile OS

Mobile operating systems are those OS which is especially that are designed to power smartphones, tablets, and wearables devices.

Some most famous mobile operating systems are Android and iOS, but others include BlackBerry, Web, and watchOS.

Functions of Operating System

Below are the main functions of Operating System:



Functions of Operating System

In an operating system software performs each of the function:

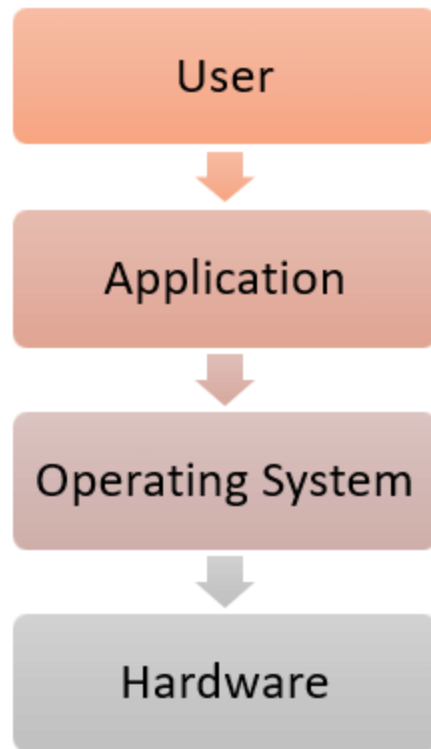
1. **Process management:**- Process management helps OS to create and delete processes. It also provides mechanisms for synchronization and communication among processes.
2. **Memory management:-** Memory management module performs the task of allocation and de-allocation of memory space to programs in need of this resources.
3. **File management:-** It manages all the file-related activities such as organization storage, retrieval, naming, sharing, and protection of files.

4. **Device Management:** Device management keeps tracks of all devices. This module also responsible for this task is known as the I/O controller. It also performs the task of allocation and de-allocation of the devices.
5. **I/O System Management:** One of the main objects of any OS is to hide the peculiarities of that hardware devices from the user.
6. **Secondary-Storage Management:** Systems have several levels of storage which includes primary storage, secondary storage, and cache storage. Instructions and data must be stored in primary storage or cache so that a running program can reference it.
7. **Security:-** Security module protects the data and information of a computer system against malware threat and authorized access.
8. **Command interpretation:** This module is interpreting commands given by the and acting system resources to process that commands.
9. **Networking:** A distributed system is a group of processors which do not share memory, hardware devices, or a clock. The processors communicate with one another through the network.
10. **Job accounting:** Keeping track of time & resource used by various job and users.
11. **Communication management:** Coordination and assignment of compilers, interpreters, and another software resource of the various users of the computer systems.

Features of Operating System (OS)

Here is a list important features of OS:

- Protected and supervisor mode
- Allows disk access and file systems Device drivers Networking Security
- Program Execution
- Memory management Virtual Memory Multitasking
- Handling I/O operations
- Manipulation of the file system
- Error Detection and handling
- Resource allocation
- Information and Resource Protection



Advantage of using Operating System

- Allows you to hide details of hardware by creating an abstraction
- Easy to use with a GUI
- Offers an environment in which a user may execute programs/applications
- The operating system must make sure that the computer system convenient to use
- Operating System acts as an intermediary among applications and the hardware components
- It provides the computer system resources with easy to use format
- Acts as an intermediary between all hardware's and software's of the system

Disadvantages of using Operating System

- If any issue occurs in OS, you may lose all the contents which have been stored in your system
- Operating system's software is quite expensive for small size organization which adds burden on them. Example Windows
- It is never entirely secure as a threat can occur at any time

What is a Kernel?

The kernel is the central component of a computer operating systems. The only job performed by the kernel is to manage the communication between the software and the hardware. A Kernel

is at the nucleus of a computer. It makes the communication between the hardware and software possible. While the Kernel is the innermost part of an operating system, a shell is the outermost one.

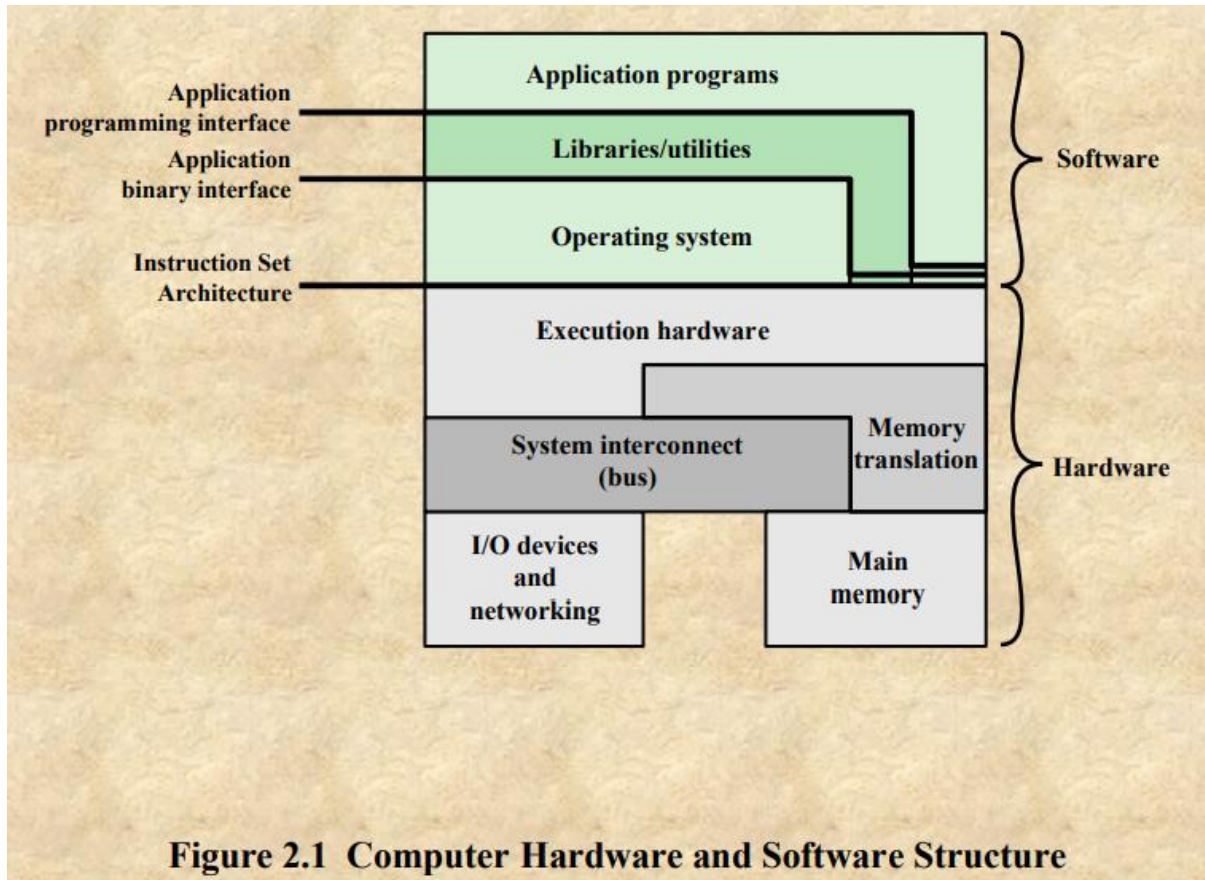


Figure 2.1 Computer Hardware and Software Structure

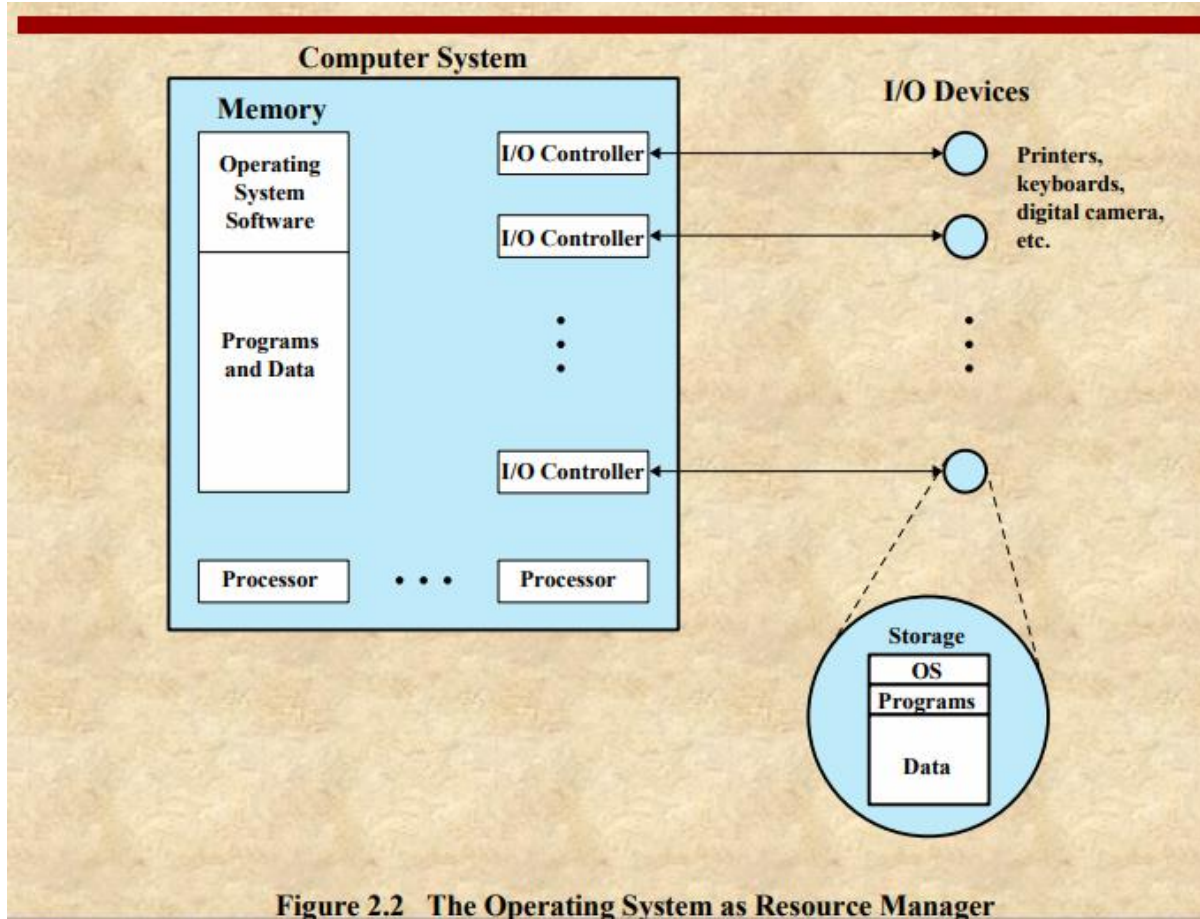


Figure 2.2 The Operating System as Resource Manager

WHAT IS A PROGRAMMING LANGUAGE?

A programming language consists of a vocabulary containing a set of grammatical rules intended to convey instructions to a computer or computing device to perform specific tasks.

Each programming language has a unique set of keywords along with a special syntax to organize the software's instructions.

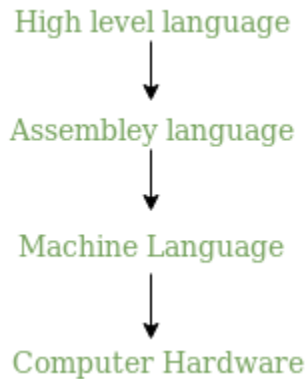
There are low-level and high-level programming languages which, although simple compared to human languages, are more complex than machine languages.

Low-level languages include assembly and machine languages. An assembly language contains a list of basic instructions and is much harder to read than a high-level language.

High-level languages, on the other hand, are designed to be easy to read and understand, allowing programmers to write source codes naturally, using logical words and symbols.

Between high-level language and machine language there are assembly language also called symbolic machine code. Assembly language are particularly computer architecture specific. Utility program (**Assembler**) is used to convert assembly code into executable machine code. High Level Programming Language are portable but require Interpretation or compiling to convert it into a machine language which is computer understood.

Hierarchy of Computer language –



There have been many programming language some of them are listed below:

C	Python	C++
C#	R	Ruby
COBOL	ADA	Java

INTRODUCTION TO DATABASE MANAGEMENT SYSTEM

A database management system (DBMS) refers to the technology for creating and managing databases. DBMS is a software tool to organize (create, retrieve, update, and manage) data in a database.

The main aim of a DBMS is to supply a way to store up and retrieve database information that is both convenient and efficient.

Usually, people use software such as DBASE IV or V, Microsoft ACCESS, or EXCEL to store data in the form of a database

. A datum is a unit of data. Meaningful data combined to form information. Hence, information is interpreted data - data provided with semantics.

MS. ACCESS is one of the most common examples of database management software.

Why Use DBMS?

- To develop software applications In less time.
- Data independence and efficient use of data.
- For uniform data administration.
- For data integrity and security.
- For concurrent access to data, and data recovery from crashes.
- To use user-friendly declarative query language.

Where is a Database Management System (DBMS) being Used?

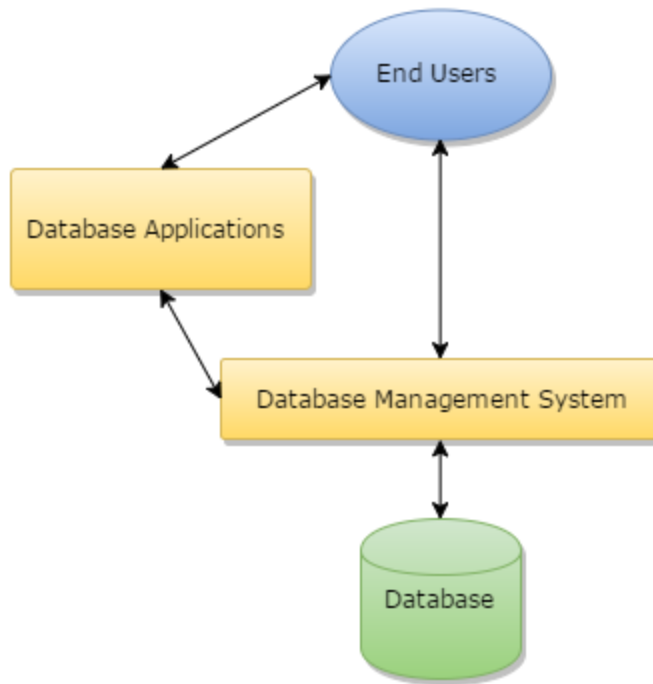
- **Airlines:** reservations, schedules, etc
- **Telecom:** calls made, customer details, network usage, etc
- **Universities:** registration, results, grades, etc
- **Sales:** products, purchases, customers, etc
- **Banking:** all transactions etc

Advantages of DBMS

A DBMS manages data and has many benefits. These are:

- **Data independence:** Application programs should be as free or independent as possible from details of data representation and storage. DBMS can supply an abstract view of the data for insulating application code from such facts.
- **Efficient data access:** DBMS utilizes a mixture of sophisticated concepts and techniques for storing and retrieving data competently. This feature becomes important in cases where the data is stored on external storage devices.
- **Data integrity and security:** If data is accessed through the DBMS, the DBMS can enforce integrity constraints on the data.
- **Data administration:** When several users share the data, integrating the administration of data can offer significant improvements. Experienced professionals understand the nature of the data being managed and can be responsible for organizing the data representation to reduce redundancy and make the data to retrieve efficiently.

Components of DBMS



Components of a Database Management System

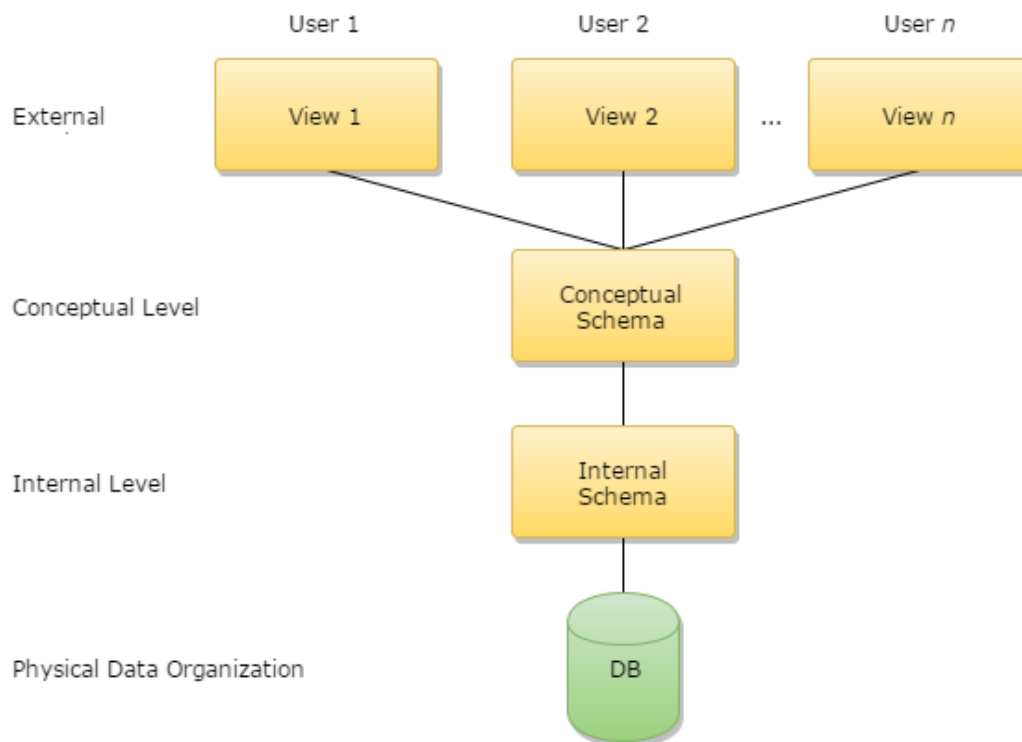
- **Users:** Users may be of any kind such as DB administrator, System developer, or database users.
- **Database application:** Database application may be Departmental, Personal, organization's and / or Internal.
- **DBMS:** Software that allows users to create and manipulate database access,
- **Database:** Collection of logical data as a single unit.

DATABASE ARCHITECTURE

An early proposal for a standard terminology and general architecture for database systems was produced in 1971 by the DBTG (Data Base Task Group) appointed by the Conference on Data Systems and Languages (CODASYL, 1971).

The DBTG recognized the need for a two-level approach with a system view called the schema and user views called sub-schemas.

Here is the figure showing the ANSI_SPARC Architecture of the database system:



ANSI_SPARC Architecture of the database system

The levels form a three-level architecture that includes an external, a conceptual, and an internal level.

The way users recognize the data is called the external level.

The way the DBMS and the operating system distinguish the data is the internal level, where the data is stored using the data structures and file.

The conceptual level offers both the mapping and the desired independence between the external and internal levels.

What is Database Architecture?

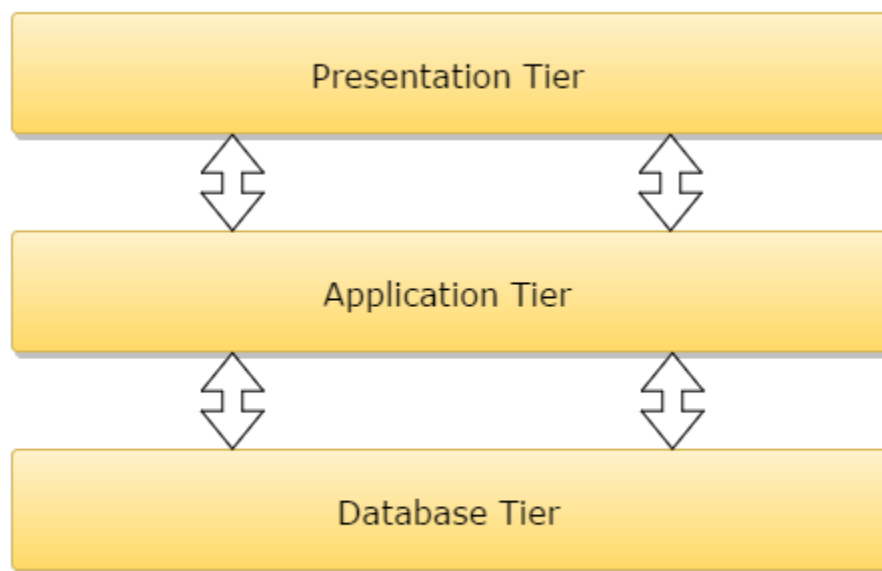
A DBMS architecture is depending on its design and can be of the following types:

- Centralized
- Decentralized
- Hierarchical

DBMS architecture can be seen as either a single-tier or multi-tier. An architecture having n-tier splits the entire system into related but independent n modules that can be independently customized, changed, altered, or replaced.

The architecture of a database system is very much influenced by the primary computer system on which the database system runs. Database systems can be centralized, or client-server, where one server machine executes work on behalf of multiple client machines. Database systems can also be designed to exploit parallel computer architectures. Distributed databases span multiple geographically separated machines.

The Three-Tier Architecture



The Three Tier Architecture

A 3-tier application is an application program that is structured into three major parts; each of them is distributed to a different place or places in a network. These three divisions are as follows:

- The workstation or presentation layer
- The business or application logic layer
- The database and programming related to managing layer

Data Independence

An important objective of the three-tier architecture is to provide data independence, which means that the upper levels are unaffected by changes in the lower levels.

There are two kinds of data independence: logical and physical.

Logical Data Independence

Logical data independence can be defined as the immunity of the external schemas to changes in the conceptual schema.

Physical data independence

Physical data independence can be defined as the immunity of the conceptual schema to changes in the internal schema.

DBMS languages

Database languages are used to read, update and store data in a database. There are several such languages that can be used for this purpose; one of them is SQL (Structured Query Language).

Different types of Database Users

Database users are categorized based up on their interaction with the data base.

These are seven types of data base users in DBMS.

1. Database Administrator (DBA) :

Database Administrator (DBA) is a person/team who defines the schema and also controls the 3 levels of database.

The DBA will then create a new account id and password for the user if he/she need to access the data base.

DBA is also responsible for providing security to the data base and he allows only the authorized users to access/modify the data base.

- DBA also monitors the recovery and back up and provide technical support.
- The DBA has a DBA account in the DBMS which called a system or superuser account.
- DBA repairs damage caused due to hardware and/or software failures.

2. **Naive / Parametric End Users :**

Parametric End Users are the unsophisticated who don't have any DBMS knowledge but they frequently use the data base applications in their daily life to get the desired results.

For examples, Railway's ticket booking users are naive users. Clerks in any bank is a naive user because they don't have any DBMS knowledge but they still use the database and perform their given task.

3. **System Analyst :**

System Analyst is a user who analyzes the requirements of parametric end users. They check whether all the requirements of end users are satisfied.

4. **Sophisticated Users :**

Sophisticated users can be engineers, scientists, business analyst, who are familiar with the database. They can develop their own data base applications according to their requirement. They don't write the program code but they interact the data base by writing SQL queries directly through the query processor.

5. **Data Base Designers :**

Data Base Designers are the users who design the structure of data base which includes tables, indexes, views, constraints, triggers, stored procedures. He/she controls what data must be stored and how the data items to be related.

6. **Application Program :**

Application Program are the back end programmers who writes the code for the application programs. They are the computer professionals. These programs could be written in Programming languages such as Visual Basic, Developer, C, FORTRAN, COBOL etc.

7. **Casual Users / Temporary Users :**

Casual Users are the users who occasionally use/access the data base but each time when they access the data base they require the new information, for example, Middle or higher level manager.

Mapping constraints in DBMS

Mapping constraints can be explained in terms of [mapping cardinality](#):

Mapping Cardinality:

One to One: An entity of entity-set A can be associated with at most one entity of entity-set B and an entity in entity-set B can be associated with at most one entity of entity-set A.

One to Many: An entity of entity-set A can be associated with any number of entities of entity-set B and an entity in entity-set B can be associated with at most one entity of entity-set A.

Many to One: An entity of entity-set A can be associated with at most one entity of entity-set B and an entity in entity-set B can be associated with any number of entities of entity-set A.

Many to Many: An entity of entity-set A can be associated with any number of entities of entity-set B and an entity in entity-set B can be associated with any number of entities of entity-set A.

What is a Data Mining?

Data mining is the process of uncovering patterns and finding anomalies and relationships in large datasets that can be used to make predictions about future trends. The main purpose of data mining is extracting valuable information from available data.

Data mining is considered an interdisciplinary field that joins the techniques of computer science and **statistics**. Note that the term “data mining” is a misnomer. It is primarily concerned with discovering patterns and anomalies within datasets, but it is not related to the extraction of the data itself.

Data Mining Applications

Applications	Usage
Communications	Data mining techniques are used in communication sector to predict customer behavior to offer highly targeted and relevant campaigns.
Education	Data mining benefits educators to access student data, predict achievement levels and find students or groups of students which need extra attention. For example, students who are weak in maths subject.
Banking	Data mining helps finance sector to get a view of market risks and manage regulatory compliance. It helps banks to identify probable defaulters to decide whether to issue credit cards, loans, etc.

Super Markets Data Mining allows supermarket's develop rules to predict if their shoppers were likely to be expecting. By evaluating their buying pattern, they could find woman customers who are most likely pregnant. They can start targeting products like baby powder, baby shop, diapers and so on.

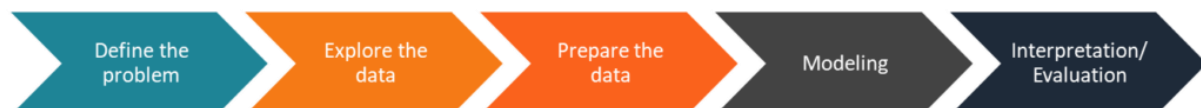
Crime Investigation Data Mining helps crime investigation agencies to deploy police workforce (where is a crime most likely to happen and when?), who to search at a border crossing etc.

Bioinformatics Data Mining helps to mine biological data from massive datasets gathered in biology and medicine.

Data Mining Process

Generally, the process can be divided into the following steps:

1. **Define the problem:** Determine the scope of the business problem and objectives of the data exploration project.
2. **Explore the data:** This step includes the exploration and collection of data that will help solve the stated business problem.
3. **Prepare the data:** Clean and organize collected data to prepare it for further **modeling** procedures.
4. **Modeling:** Create a model using data mining techniques that will help solve the stated problem.
5. **Interpretation and evaluation of results:** Draw conclusions from the data model and assess its validity. Translate the results into a business decision.



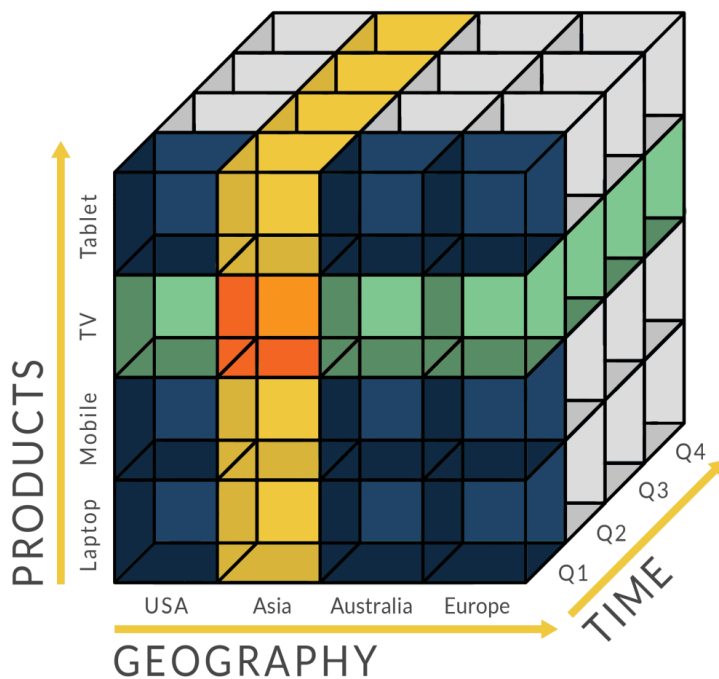
Data Mining Techniques

The most commonly used techniques in the field include:

1. **Detection of anomalies:** Identifying unusual values in a dataset.
2. **Dependency modeling:** Discovering existing relationships within a dataset. This frequently involves regression analysis.
3. **Clustering:** Identifying structures (clusters) in unstructured data.
4. **Classification:** Generalizing the known structure and applying it to the data.

OLAP (online analytical processing)

OLAP (Online Analytical Processing) is the technology behind many [Business Intelligence \(BI\)](#) applications. OLAP is a powerful technology for data discovery, including capabilities for limitless report viewing, complex analytical calculations, and predictive “what if” scenario (budget, forecast) planning.



How is OLAP Technology Used?

OLAP is an acronym for **Online Analytical Processing**. OLAP performs multidimensional analysis of business data and provides the capability for complex calculations, trend analysis, and sophisticated data modeling.

It is the foundation for many kinds of business applications for Business Performance Management, Planning, Budgeting, Forecasting, Financial Reporting, Analysis, Simulation Models, Knowledge Discovery, and Data Warehouse Reporting. OLAP enables end-users to

perform ad hoc analysis of data in multiple dimensions, thereby providing the insight and understanding they need for better decision making.

Difference between Data Mining and OLAP

1. Data Mining :

Data mining is defined as a process used to extract usable data from larger set of any raw data.

Some key features of data mining are –

- Automatic Pattern Prediction based on trend and behavior analysis.
- Predictions based on likely outcomes.
- creation of decision Oriented Information.
- Focus on large data and databases for analysis.
- Clustering based on group of facts not previously known.

2. Online analytical Processing (OLAP) :

OLAP is a computer processing that enables a user to easily and selectively extract and view data from different points of view. It allows user to analyze database information from multiple database systems at one time. OLAP data is stored in multidimensional databases.

Some key features of OLAP are –

- Multidimensional views of data.
- Support for complex calculations.
- Time intelligence.

Some applications of OLAP are –

- OLE DB for OLAP
- Database marketing
- Marketing and sales analysis.

Difference between Data Mining and OLAP :

S.No.	Data Mining	OLAP
1.	Multidimensional Analysis.	Online analytical processing.
2.	It has large number of dimensions.	It has limited number of dimensions.
3.	Deals with the summary of data.	Deals with the detailed Transaction level data.
4.	Insight and Prediction.	Analysis.

- | | | |
|----|-----------------------------------|---------------------------------|
| 5. | It is used to predict the future. | It is used to analyze the past. |
| 6. | Bottom-up approach. | Top-down approach. |
| 7. | Discovery driven. | Query driven. |
| 8. | It is a emerging technique. | Widely Used. |

UNIT-IV

What is a Computer Network?

Definition – A group of computers which are connected to each other and follow similar usage protocols for the purpose of sharing information and having communications provided by the networking nodes is called a Computer Network.

A network may be small where it may include just one system or maybe as large as what one may want. The nodes may further be classified into various types. These include:

- Personal Computers
- Servers
- Networking Hardware
- General Hosts

Types of Computer Networks

There are five main types of Computer Networks:

1. **LAN (Local Area Network)** –
 - Systems connected in a small network like in a building or a small office
 - It is inexpensive
 - It uses Ethernet or Token-ring technology

- Two or more personal computers can be connected through wires or cables acting as nodes
- Transfer of data is fast and is highly score

PAN (Personal Area Network) –

- The smallest computer network
- Devices may be connected through Bluetooth or other infra-red enables devices
- It has a connectivity range of upto 10 metres
- It covers an area of upto 30 feet
- Personal devices belonging to a single person can be connected to each other using PAN

MAN (Metropolitan Area Network) –

- A network that can be connected within a city, for example, cable TV Connection
- It can be in the form of Ethernet, ATM, Token-ring and FDDI
- It has a higher range
- This type of network can be used to connect citizens with the various Organisations

WAN (Wide Area Network) –

- A network which covers over a country or a larger range of people
- Telephonic lines are also connected through WAN
- Internet is the biggest WAN in the world
- Mostly used by Government Organisations to manage data and information

VPN (Virtual Private Network): –

- A network which is constructed by using public wires to connect to a private network
- There are a number of systems which enable you to create networks using the Internet as a medium for transporting data
- These systems use encryptions and other security mechanisms to ensure only authorised users can access

Network Topologies

Given below are the eight types of Network Topologies:

1. **Point to Point Topology** – Point to Point topology is the simplest topology that connects two nodes directly together with a common link.
2. **Bus Topology** – A bus topology is such that there is a single line to which all nodes are connected and the nodes connect only to the bus
3. **Mesh Topology** – This type of topology contains at least two nodes with two or more paths between them
4. **Ring Topology** – In this topology every node has exactly two branches connected to it. The ring is broken and cannot work if one of the nodes on the ring fails

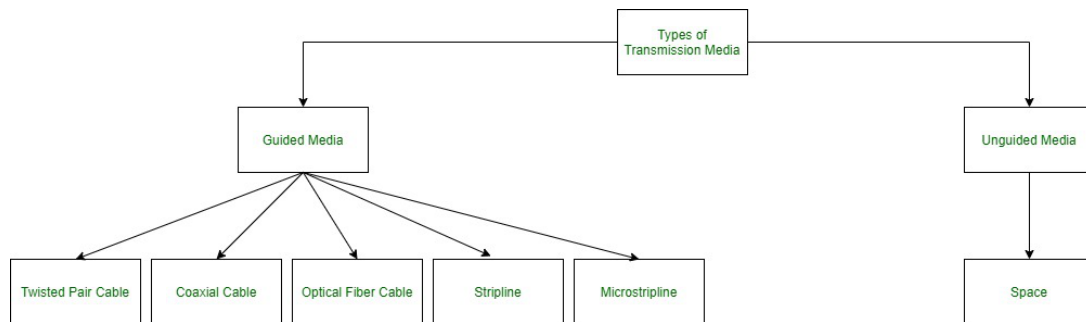
5. **Star Topology** – In this network topology, the peripheral nodes are connected to a central node, which rebroadcasts all the transmissions received from any peripheral node to all peripheral nodes on the network, including the originating node
6. **Tree Topology** – In this type of topology nodes are connected in the form of a tree. The function of the central node in this topology may be distributed
7. **Line Topology** – in this topology all the nodes are connected in a straight line
8. **Hybrid Topology** – When two more types of topologies combine together, they form a Hybrid topology

Network Devices

- **Network Repeater** – Used to generate incoming electrical, wireless or optical signals
- **Network Hub** – It is a small network device. It joins multiple computers together to form a single network segment. On this segment, all computers can interact with each other
- **Network Switch** – It is a small hardware device which joins multiple computers together with a single LAN
- **Network Router** – This device interfaces in multiple networks whose task is to copy packages from one network to another. It provides connectivity inside enterprises, between Enterprises and the Internet and within an ISP
- **Network Bridge** – It reads the outermost section of the data packet to tell where the message is going. It reduces the traffic on other network segments.
- **Modem** – This device converts digital signals into analog signals. It is always placed between a telephone and a computer system

Types of Transmission Media

In data communication terminology, a transmission medium is a physical path between the transmitter and the receiver i.e. it is the channel through which data is sent from one place to another. Transmission Media is broadly classified into the following types:



1. Guided Media:

It is also referred to as Wired or Bounded transmission media. Signals being transmitted are directed and confined in a narrow pathway by using physical links.

Features:

- High Speed
- Secure

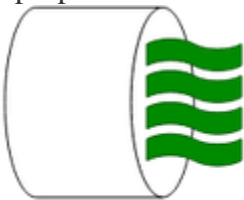
- Used for comparatively shorter distances
- There are 3 major types of Guided Media:

(i) Twisted Pair Cable –

It consists of 2 separately insulated conductor wires wound about each other. Generally, several such pairs are bundled together in a protective sheath. They are the most widely used Transmission Media. Twisted Pair is of two types:

- **Unshielded Twisted Pair (UTP):**

UTP consists of two insulated copper wires twisted around one another. This type of cable has the ability to block interference and does not depend on a physical shield for this purpose. It is used for telephonic applications.



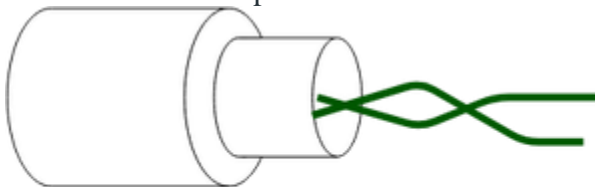
Unshielded Twisted Pair

Advantages:

- Least expensive
- Easy to install
- High-speed capacity
- Susceptible to external interference
- Lower capacity and performance in comparison to STP
- Short distance transmission due to attenuation

- **Shielded Twisted Pair (STP):**

This type of cable consists of a special jacket (a copper braid covering or a foil shield) to block external interference. It is used in fast-data-rate Ethernet and in voice and data channels of telephone lines.



Shielded Twisted Pair

Advantages:

- Better performance at a higher data rate in comparison to UTP
- Eliminates crosstalk
- Comparatively faster
- Comparatively difficult to install and manufacture
- More expensive
- Bulky

(ii) Coaxial Cable –

It has an outer plastic covering containing an insulation layer made of PVC or Teflon and 2 parallel conductors each having a separate insulated protection cover. The coaxial cable transmits information in two modes: Baseband mode(dedicated cable bandwidth) and Broadband mode(cable bandwidth is split into separate ranges). Cable TVs and analog television networks widely use Coaxial cables.

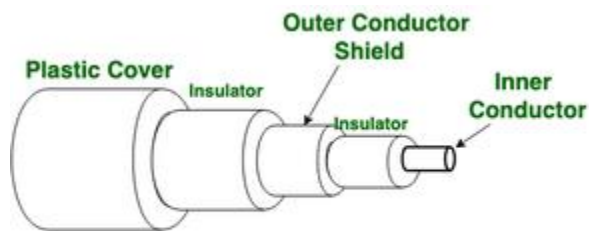


Figure of Coaxial Cable

Advantages:

- High Bandwidth
- Better noise Immunity
- Easy to install and expand
- Inexpensive

Disadvantages:

- Single cable failure can disrupt the entire network

(iii) Optical Fiber Cable –

It uses the concept of reflection of light through a core made up of glass or plastic. The core is surrounded by a less dense glass or plastic covering called the cladding. It is used for the transmission of large volumes of data.

The cable can be unidirectional or bidirectional. The WDM (Wavelength Division Multiplexer) supports two modes, namely unidirectional and bidirectional mode.

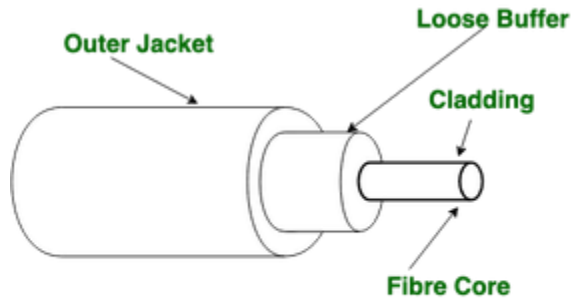


Figure of Optical Fibre Cable

Advantages:

- Increased capacity and bandwidth
- Lightweight
- Less signal attenuation
- Immunity to electromagnetic interference
- Resistance to corrosive materials

Disadvantages:

- Difficult to install and maintain
- High cost
- Fragile

(iv) Stripline

Stripline is a transverse electromagnetic (TEM) transmission line medium invented by Robert M. Barrett of the Air Force Cambridge Research Centre in the 1950s. Stripline is the earliest form of the planar transmission line. It uses a conducting material to transmit high-frequency waves it is also called a waveguide. This conducting material is sandwiched between two layers of the ground plane which are usually shorted to provide EMI immunity.

(v) Microstripline

In this, the conducting material is separated from the ground plane by a layer of dielectric.

2. Unguided Media:

It is also referred to as Wireless or Unbounded transmission media. No physical medium is required for the transmission of electromagnetic signals.

Features:

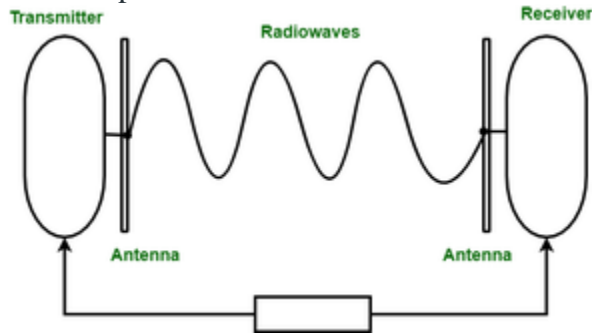
- The signal is broadcasted through air
- Less Secure
- Used for larger distances

There are 3 types of Signals transmitted through unguided media:

(i) Radio waves –

These are easy to generate and can penetrate through buildings. The sending and receiving

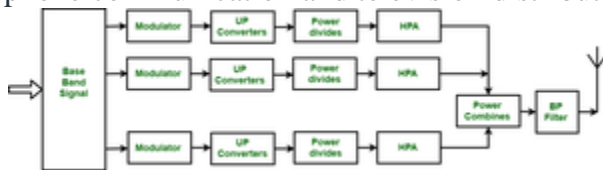
antennas need not be aligned. Frequency Range:3KHz – 1GHz. AM and FM radios and cordless phones use Radio waves for transmission.



Further Categorized as (i) Terrestrial and (ii) Satellite.

(ii) Microwaves –

It is a line of sight transmission i.e. the sending and receiving antennas need to be properly aligned with each other. The distance covered by the signal is directly proportional to the height of the antenna. Frequency Range:1GHz – 300GHz. These are majorly used for mobile phone communication and television distribution.



(iii) Infrared –

Infrared waves are used for very short distance communication. They cannot penetrate through obstacles. This prevents interference between systems. Frequency Range:300GHz – 400THz. It is used in TV remotes, wireless mouse, keyboard, printer, etc.



Television



Infrared Radiations



Remote

The Internet and the Web

1. The Internet:

In simplest terms, the Internet is a global network comprised of smaller networks that are interconnected using **standardized** communication protocols. The Internet standards describe a framework known as the Internet protocol suite. This model divides methods into a *layered system of protocols*.

These layers are as follows:

1. **Application layer (highest)** – concerned with the data(URL, type, etc.). This is where HTTP, HTTPS, etc., comes in.
2. **Transport layer** – responsible for end-to-end communication over a network.
3. **Network layer** – provides data route.

The Internet provides a variety of information and communication facilities; contains forums, databases, email, hypertext, etc. It consists of private, public, academic, business, and government networks of local to global scope, linked by a broad array of electronic, wireless, and optical networking technologies.

2. The World Wide Web:

The Web is the only way to access information through the Internet. It's a system of Internet servers that support specially formatted documents. The documents are formatted in a markup language called **HTML**, or "HyperText Markup Language", which supports a number of features including links and multimedia. These documents are interlinked using hypertext links and are accessible via the Internet.

To link hypertext to the Internet, we need:

1. The markup language, i.e., HTML.
2. The transfer protocol, e.g., HTTP.
3. Uniform Resource Locator (URL), the address of the resource.

We access the Web using **Web browsers**.

Difference between Web and Internet:

Internet

The Internet is the network of networks and the network allows to exchange of the data between two or more

Web

The Web is a way to access information through the Internet.

Internet

Web

computers.

The Web is a model for sharing information using the Internet.

It is also known as the Network of Networks.

The Internet is a way of transporting information between devices.

The protocol used by the web is http.

The Web is accessed by the Web Browser.

URI:

URI stands for ‘**Uniform Resource Identifier**’. A URI can be a name, locator, or both for an online resource whereas a URL is just the locator. URLs are a subset of URIs. A URL is a human-readable text that was designed to replace the numbers (IP addresses) that computers use to communicate with servers.

A URL consists of a protocol, domain name, and path (which includes the specific subfolder structure where a page is located) like-

protocol://WebSiteName.topLevelDomain/path

1. Protocol – HTTP or HTTPS.
2. WebSiteName – geeksforgeeks, google etc.
3. topLevelDomain- .com, .edu, .in etc.
4. path- specific folders and/or subfolders that are on a given website.

Who governs the Internet?

The Internet is not governed and has no single authority figure. The ultimate authority for where the Internet is going rests with **the Internet Society**, or ISOC.

ISOC is a voluntary membership organization whose purpose is to promote global information exchange through Internet technology.

- ISOC appoints the **IAB- Internet Architecture Board**. They meet regularly to review standards and allocate resources, like addresses.

- **IETF- Internet Engineering Task Force.** Another volunteer organization that meets regularly to discuss operational and technical problems.

Internet Access Techniques

Internet can be accessed using following methods –

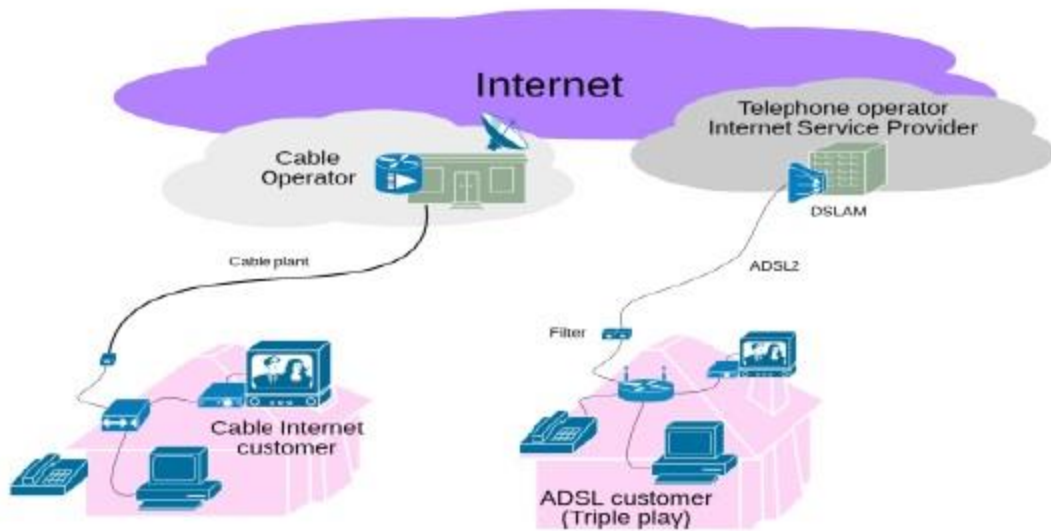
Dial-up Connections

In dial-up connection, computer uses its modem to dial a telephone number given to the user by an Internet Service Provider. This launches a connection between personal computer and ISP server. The process begins when the ISP server answers, and ceases when your computer or the server "hangs up". This is similar to a traditional telephone call. Most ISP servers disconnect automatically after a certain period of inactivity. Once a connection is configured on the user's computer, he/she can use the connection. It is secure and de-allocates unused memory automatically.



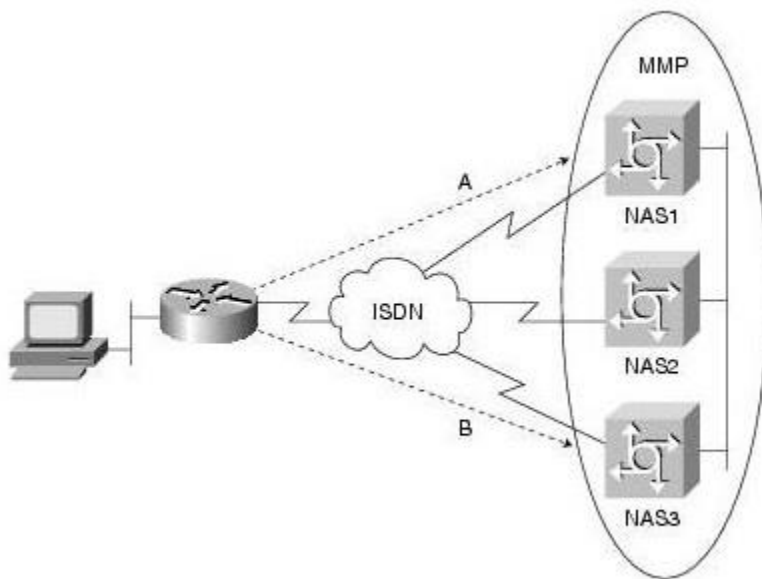
Broadband Connection

Broadband connections are considered as high speed connections, as they use modes that can handle several signals at once, such as fiber optics, twisted pair cables, coaxial cable and other technologies. Even with hundreds of users on the network, these connections allow large files and complex web pages to download quickly. To be considered as a broadband, the connection must be able to transmit data at a rate faster than is possible with the fastest dial-up connection. Downloading and uploading content will be fast.



Integrated Services Digital Network (ISDN) Service

Integrated Services Digital Network (ISDN) is a digital service that simultaneously transmits voice & data, and controls signals over a single telephone line. ISDN service operates on a standard telephone line, but requires a special modem and phone service, which adds to the cost. An ISDN data connection can transfer data up to 128,000 bits per second (128 Kbps). It helps to connect a PC, telephone and fax to a single ISDN line and use them simultaneously.



Digital Subscriber Line (DSL)

Digital Subscriber Line is similar to that of ISDN in using telephone network, but it uses more advanced digital signal processing and algorithms to squeeze maximum number of signals

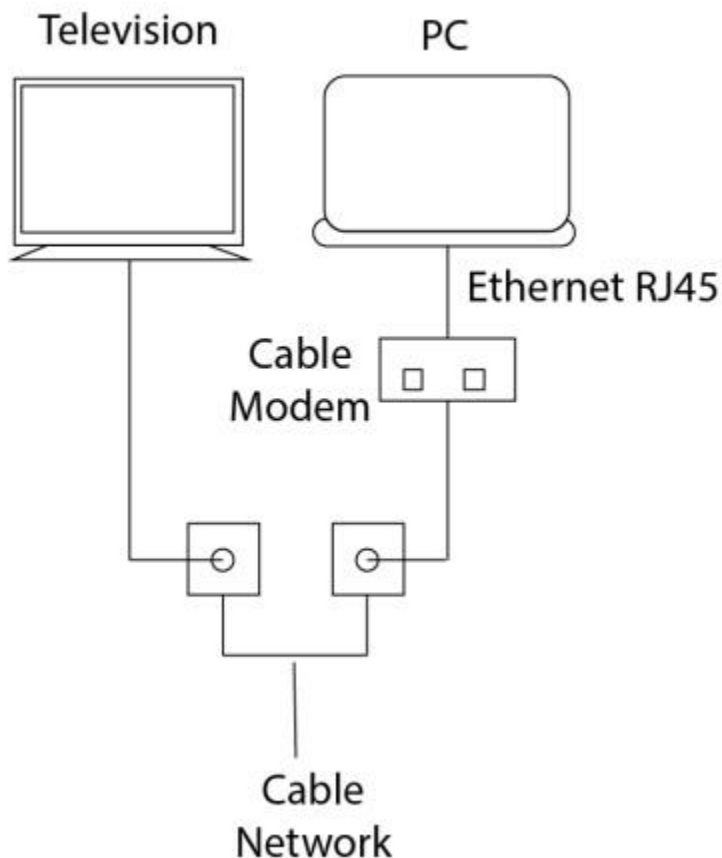
through telephone lines. DSL also requires changes in components of telephone network before it can be offered in any area. Like ISDN, DSL provides simultaneous data, voice and fax transmission on the same line. Several versions of DSL services are available for home and business use; each version provides 24/7 full-time connection at different levels of service, speed, bandwidth and distance.



DSL Type	Maximum Sending speed	Maximum Receiving speed	Maximum Distance	Lines Required	Phone Support
ADSL	800 Kbps	8 Mbps	5,500 m	1	Yes
HDSL	1.54 Kbps	1.54 Mbps	3,650 m	2	No
IDSL	144 Kbps	144 Mbps	10,700 m	1	No
MSDSL	2 Mbps	2 Mbps	8,800 m	1	No
RADSL	1 Mbps	7 Mbps	5,500 m	1	Yes
SDSL	2.3 Mbps	2.3 Mbps	6,700 m	1	No
VDSL	16 Mbps	52 Mbps	1,200 m	1	Yes

Cable Modem Service

Now-a-days many cable television companies use some percentage of their network's bandwidth to provide internet access through prevailing cable television connections. Since this connection uses a special cable modem, it is called "Cable Modem Service". Cable television systems transmit data via coaxial cable, which can transmit data as much as 100 times faster than common telephone lines. Coaxial cable allows transmission via several channels simultaneously, i.e., the internet data can be transmitted on one channel, while audio, video and control signals are transmitted separately. The user can access internet and watch television concurrently, with two non-interfering data streams.



Wireless LAN (WLAN) Connections

Wireless LAN connections are very common these days, which are based on the technology that is often cited as Wi-Fi (Wireless Fidelity). The distance covered by WLAN is usually measured in meters rather than miles. Therefore, this is not a technology that connects directly to an ISP but can be used to connect to another LAN or device through which internet access is achieved.



Process

- To connect to internet, the wireless access point is connected to a wired LAN like any other devices, and then computers with wireless NICs can access the wired LAN.
- "Wireless access point" is a device that acts as a hub or switch.
- "NIC" refers to a Network Interface Card which helps to identify a computer on a network.

Wireless WAN (WWAN) Connections

A WWAN is a digital network that spans over a large geographical area. A WWAN accepts and transmits data using radio signals via cellular sites and satellites. At the switching center, the WWAN divides off into segments and then connects to either isolated or public network through telephone or other high speed communication links. The data is then linked to an organization's existing LAN/WAN infrastructure. The coverage area for WWAN is normally measured in miles (kilometers) with a data transmission rate of 100 Mbps.



Satellite Services

Satellite services provide a mutual (two-way) communication between user and the internet. This provides a full-time connection which is used in armed forces, business, etc. It includes two parts –

Transceiver – A satellite dish that is placed outdoors in direct line of sight to one of the several satellites in geostationary orbit.

Modem-like device – It is connected to a dish, placed indoors and connected to a LAN or computer.

Types of Internet Protocols

There's more to the Internet than the World Wide Web

When we think of the Internet we often think only of the World Wide Web. The Web is one of several ways to retrieve information from the Internet. These different types of Internet connections are known as protocols. You could use separate software applications to access the Internet with each of these protocols, though you probably wouldn't need to. Many Internet Web browsers allow users to access files using most of the protocols. Following are three categories of Internet services and examples of types of services in each category.

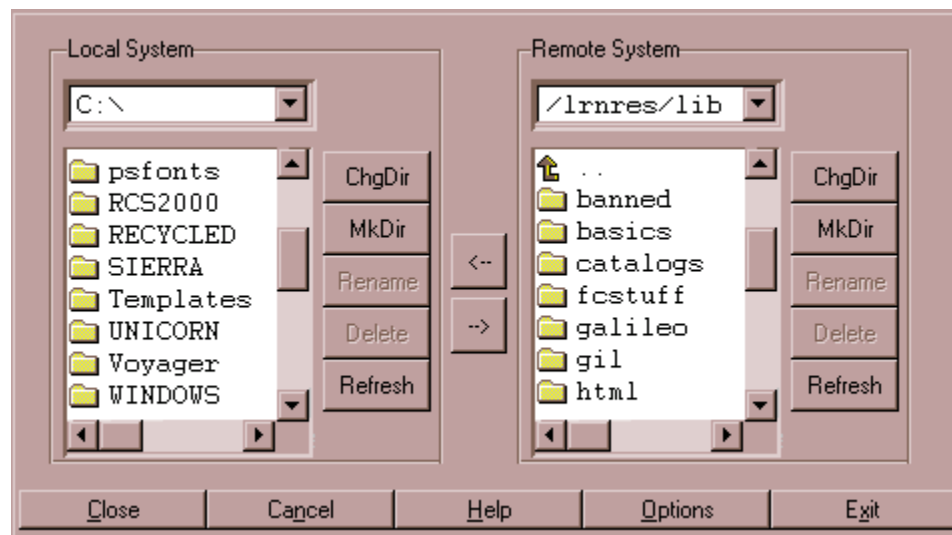
File retrieval protocols

This type of service was one of the earliest ways of retrieving information from computers connected to the Internet. You could view the names of the files stored on the serving computer, but you didn't have any type of graphics and sometimes no description of a file's content. You would need to have advanced knowledge of which files contained the information you sought.

FTP (File Transfer Protocol)

This was one of the first Internet services developed and it allows users to move files from one computer to another. Using the FTP program, a user can logon to a remote computer, browse through its files, and either download or upload files (if the remote computer allows). These can be any type of file, but the user is only allowed to see the file name; no description of the file content is included. You might encounter the FTP protocol if you try to download any software applications from the World Wide Web. Many sites that offer downloadable applications use the FTP protocol.

An example of a FTP Protocol Window:

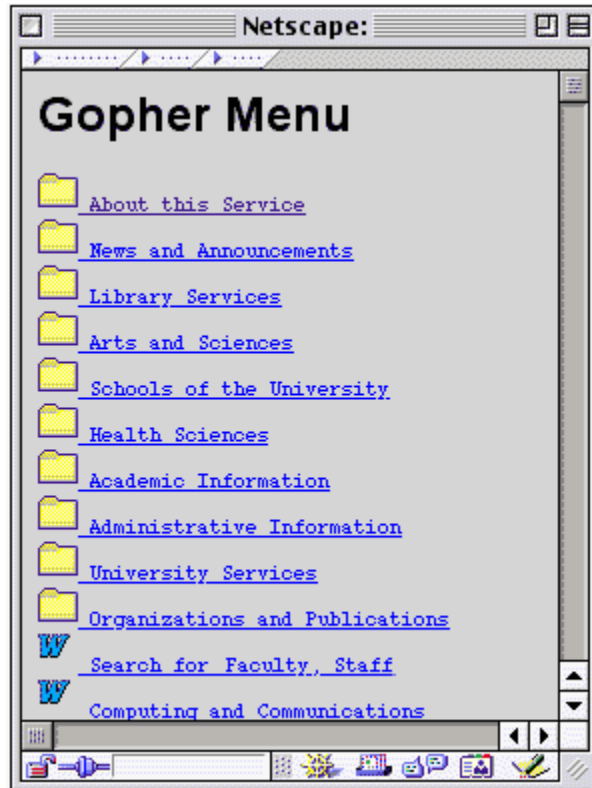


Gopher

Gopher offers downloadable files with some content description to make it easier to find the file

you need. The files are arranged on the remote computer in a hierarchical manner, much like the files on your computer's hard drive are arranged. This protocol isn't widely used anymore, but you can still find some operational gopher sites.

An example of a Gopher Window:



Telnet

You can connect to and use a remote computer program by using the telnet protocol. Generally you would telnet into a specific application housed on a serving computer that would allow you to use that application as if it were on your own computer. Again, using this protocol requires special software.

UNIT V

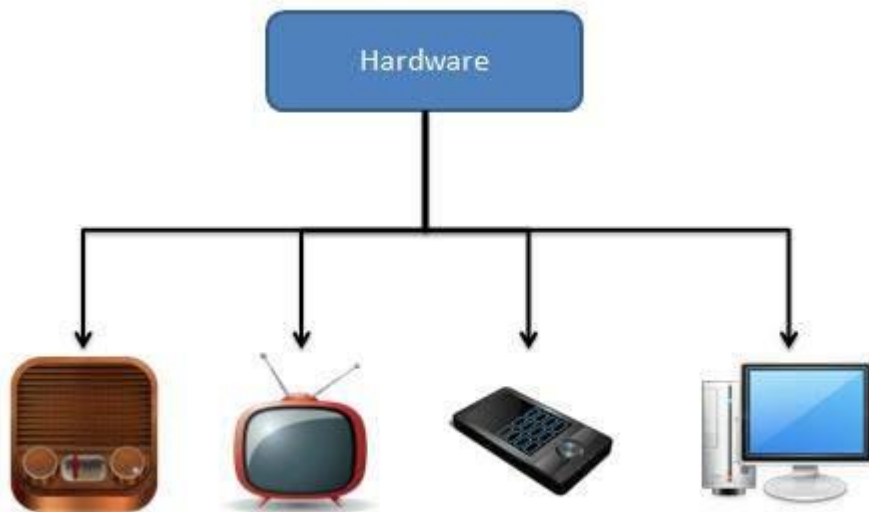
Multimedia Introduction

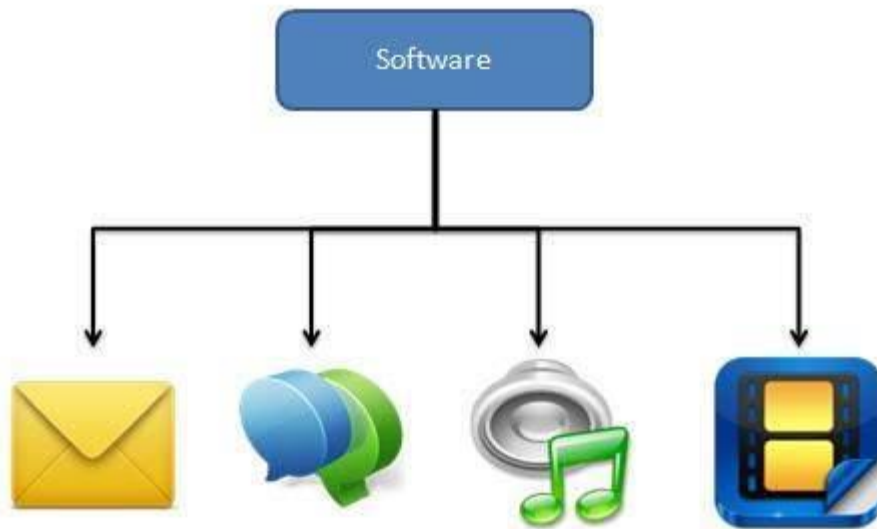
Multimedia is an interactive media and provides multiple ways to represent information to the user in a powerful manner. It provides an interaction between users and digital information. It is a medium of communication. Some of the sectors where multimedia is used extensively are education, training, reference material, business presentations, advertising and documentaries.

Definition of Multimedia

By definition Multimedia is a representation of information in an attractive and interactive manner with the use of a combination of text, audio, video, graphics and animation. In other words we can say that Multimedia is a computerized method of presenting information combining textual data, audio, visuals (video), graphics and animations. For examples: E-Mail, Yahoo Messenger, Video Conferencing, and Multimedia Message Service (MMS).

Multimedia as name suggests is the combination of Multi and Media that is many types of media (hardware/software) used for communication of information.





Components of Multimedia

Following are the common components of multimedia:

- **Text-** All multimedia productions contain some amount of text. The text can have various types of fonts and sizes to suit the professional presentation of the multimedia software.
- **Graphics-** Graphics make the multimedia application attractive. In many cases people do not like reading large amount of textual matter on the screen. Therefore, graphics are used more often than text to explain a concept, present background information etc. There are two types of Graphics:
 - **Bitmap images-** Bitmap images are real images that can be captured from devices such as digital cameras or scanners. Generally bitmap images are not editable. Bitmap images require a large amount of memory.
 - **Vector Graphics-** Vector graphics are drawn on the computer and only require a small amount of memory. These graphics are editable.
- **Audio-** A multimedia application may require the use of speech, music and sound effects. These are called audio or sound element of multimedia. Speech is also a perfect way for teaching. Audio are of analog and digital types. Analog audio or sound refers to the original sound signal. Computer stores the sound in digital form. Therefore, the sound used in multimedia application is digital audio.
- **Video-** The term video refers to the moving picture, accompanied by sound such as a picture in television. Video element of multimedia application gives a lot of information in small duration of time. Digital video is useful in multimedia application for showing real life objects. Video have highest performance demand on the computer memory and on the bandwidth if placed on the internet. Digital video files can be stored like any other files in the computer and the quality of the video can still be maintained. The

digital video files can be transferred within a computer network. The digital video clips can be edited easily.

- **Animation-** Animation is a process of making a static image look like it is moving. An animation is just a continuous series of still images that are displayed in a sequence. The animation can be used effectively for attracting attention. Animation also makes a presentation light and attractive. Animation is very popular in multimedia application

Applications of Multimedia

Following are the common areas of applications of multimedia.

- **Multimedia in Business-** Multimedia can be used in many applications in a business. The multimedia technology along with communication technology has opened the door for information of global work groups. Today the team members may be working anywhere and can work for various companies. Thus the work place will become global. The multimedia network should support the following facilities:
 - Voice Mail
 - Electronic Mail
 - Multimedia based FAX
 - Office Needs
 - Employee Training
 - Sales and Other types of Group Presentation
 - Records Management
- **Multimedia in Marketing and Advertising-** By using multimedia marketing of new products can be greatly enhanced. Multimedia boost communication on an affordable cost opened the way for the marketing and advertising personnel. Presentation that have flying banners, video transitions, animations, and sound effects are some of the elements used in composing a multimedia based advertisement to appeal to the consumer in a way never used before and promote the sale of the products.
- **Multimedia in Entertainment-** By using multimedia marketing of new products can be greatly enhanced. Multimedia boost communication on an affordable cost opened the way for the marketing and advertising personnel. Presentation that have flying banners, video transitions, animations, and sound effects are some of the elements used in composing a multimedia based advertisement to appeal to the consumer in a way never used before and promote the sale of the products.
- **Multimedia in Education-** Many computer games with focus on education are now available. Consider an example of an educational game which plays various rhymes for kids. The child can paint the pictures, increase reduce size of various objects etc apart from just playing the rhymes. Several other multimedia packages are available in the market which provide a lot of detailed information and playing capabilities to kids.

- **Multimedia in Bank-** Bank is another public place where multimedia is finding more and more application in recent times. People go to bank to open saving/current accounts, deposit funds, withdraw money, know various financial schemes of the bank, obtain loans etc. Every bank has a lot of information which it wants to impart to its customers. For this purpose, it can use multimedia in many ways. Bank also displays information about its various schemes on a PC monitor placed in the rest area for customers. Today on-line and internet banking have become very popular. These use multimedia extensively. Multimedia is thus helping banks give service to their customers and also in educating them about banks attractive finance schemes.
- **Multimedia in Hospital-** Multimedia best use in hospitals is for real time monitoring of conditions of patients in critical illness or accident. The conditions are displayed continuously on a computer screen and can alert the doctor/nurse on duty if any changes are observed on the screen. Multimedia makes it possible to consult a surgeon or an expert who can watch an ongoing surgery line on his PC monitor and give online advice at any crucial juncture.

In hospitals multimedia can also be used to diagnose an illness with CD-ROMs/ Cassettes/ DVDs full of multimedia based information about various diseases and their treatment. Some hospitals extensively use multimedia presentations in training their junior staff of doctors and nurses. Multimedia displays are now extensively used during critical surgeries.

- **Multimedia Pedagogues-** Pedagogues are useful teaching aids only if they stimulate and motivate the students. The audio-visual support to a pedagogue can actually help in doing so. A multimedia tutor can provide multiple numbers of challenges to the student to stimulate his interest in a topic. The instruction provided by pedagogue have moved beyond providing only button level control to intelligent simulations, dynamic creation of links, composition and collaboration and system testing of the user interactions.
- **Communication Technology and Multimedia Services-** The advancement of high computing abilities, communication ways and relevant standards has started the beginning of an era where you will be provided with multimedia facilities at home. These services may include:
 - Basic Television Services
 - Interactive entertainment
 - Digital Audio
 - Video on demand
 - Home shopping
 - Financial Transactions
 - Interactive multiplayer or single player games
 - Digital multimedia libraries
 - E-Newspapers, e-magazines

PAINT AND DRAW APPLICATIONS

1. Bitmaps

2. Vector Graphics

A bitmap (also called "raster") graphic is created from rows of different colored pixels that together form an image. In their simplest form, bitmaps have only two colors, with each pixel being either black or white. With increasing complexity, an image can include more colors; photograph-quality images may have millions. Examples of bitmap graphic formats include GIF, JPEG, PNG, TIFF, XBM, BMP, and PCX as well as bitmap (i.e., screen) fonts. The image displayed on a computer monitor is also a bitmap, as are the outputs of printers, scanners, and similar devices. They are created using paint programs like Adobe Photoshop.

Vector (also known as "object-oriented") graphics are constructed using mathematical formulas describing shapes, colors, and placement. Rather than a grid of pixels, a vector graphic consists of shapes, curves, lines, and text which together make a picture. While a bitmap image contains information about the color of each pixel, a vector graphic contains instructions about where to place each of the components. It is even possible to embed a bitmap graphic within a vector graphic, which is how vector-bitmap hybrid graphics work. It is not possible, however, to embed vector information within a bitmap. Examples of vector graphic formats are PICT, EPS, and WMF as well as PostScript and TrueType fonts. These are created with GIS and CAD applications as well as drawing programs like FreeHand.

GRAPHIC EFFECTS AND TECHNIQUES

3D Graphics Programs

Animation

Shading

Anti-Aliasing

Morphing

Sound And Music

Digital Sound Data

MIDI

3D Sound

Video

MULTIMEDIA AUTHORIZING TOOLS

Multimedia authoring tools give an integrated environment for joining together the different elements of a multimedia production. It gives the framework for organizing and editing the components of a multimedia project. It enables the developer to create interactive presentation by combining text, audio, video, graphics and animation.

Basic Applications of Computer

Computers play a role in every field of life. They are used in homes, business, educational institutions, research organizations, medical field, government offices, entertainment, etc.

Home

Computers are used at homes for several purposes like online bill payment, watching movies or shows at home, home tutoring, social media access, playing games, internet access, etc. They provide communication through electronic mail. They help to avail work from home facility for corporate employees. Computers help the student community to avail online educational support.

Medical Field

Computers are used in hospitals to maintain a database of patients' history, diagnosis, X-rays, live monitoring of patients, etc. Surgeons nowadays use robotic surgical devices to perform delicate operations, and conduct surgeries remotely. Virtual reality technologies are also used for training purposes. It also helps to monitor the fetus inside the mother's womb.

Entertainment

Computers help to watch movies online, play games online; act as a virtual entertainer in playing games, listening to music, etc. MIDI instruments greatly help people in the entertainment industry in recording music with artificial instruments. Videos can be fed from computers to full screen televisions. Photo editors are available with fabulous features.

Industry

Computers are used to perform several tasks in industries like managing inventory, designing purpose, creating virtual sample products, interior designing, video conferencing, etc. Online marketing has seen a great revolution in its ability to sell various products to inaccessible corners like interior or rural areas. Stock markets have seen phenomenal participation from different levels of people through the use of computers.

Education

Computers are used in education sector through online classes, online examinations, referring e-books, online tutoring, etc. They help in increased use of audio-visual aids in the education field.

Government

In government sectors, computers are used in data processing, maintaining a database of citizens and supporting a paperless environment. The country's defense organizations have greatly benefitted from computers in their use for missile development, satellites, rocket launches, etc.

Banking

In the banking sector, computers are used to store details of customers and conduct transactions, such as withdrawal and deposit of money through ATMs. Banks have reduced manual errors and expenses to a great extent through extensive use of computers.

Business

Nowadays, computers are totally integrated into business. The main objective of business is transaction processing, which involves transactions with suppliers, employees or customers. Computers can make these transactions easy and accurate. People can analyze investments, sales, expenses, markets and other aspects of business using computers.

Training

Many organizations use computer-based training to train their employees, to save money and improve performance. Video conferencing through computers allows saving of time and travelling costs by being able to connect people in various locations.

Arts

Computers are extensively used in dance, photography, arts and culture. The fluid movement of dance can be shown live via animation. Photos can be digitized using computers.

Science and Engineering

Computers with high performance are used to stimulate dynamic process in Science and Engineering. Supercomputers have numerous applications in area of Research and Development (R&D). Topographic images can be created through computers. Scientists use computers to plot and analyze data to have a better understanding of earthquakes.

What is computer security?

Computer security basically is the protection of computer systems and information from harm, theft, and unauthorized use. It is the process of preventing and detecting unauthorized use of your computer system.

There are various types of computer security which is widely used to protect the valuable information of an organization.

What is Computer Security and its types?

One way to ascertain the similarities and differences among Computer Security is by asking what is being secured. For example,

- *Information security* is securing information from unauthorized access, modification & deletion
- *Application Security* is securing an application by building security features to prevent from Cyber Threats such as SQL injection, DoS attacks, data breaches and etc.
- *Computer Security* means securing a standalone machine by keeping it updated and patched
- *Network Security* is by securing both the software and hardware technologies
- *Cybersecurity* is defined as protecting computer systems, which communicate over the computer networks

Computer security threats

[Computer security threats](#) are possible dangers that can possibly hamper the normal functioning of your computer. In the present age, [cyber threats](#) are constantly increasing as the world is going digital. The most harmful types of computer security are:

Viruses



A computer virus is a malicious program which is loaded into the user's computer without user's knowledge. It replicates itself and infects the files and programs on the user's PC. The ultimate goal of a virus is to ensure that the victim's computer will never be able to operate properly or even at all.

Computer Worm



A computer worm is a software program that can copy itself from one computer to another, without human interaction. The potential risk here is that it will use up your computer hard disk space because a worm can replicate in great volume and with great speed.

Phishing



Disguising as a trustworthy person or business, phishers attempt to steal sensitive financial or personal information through fraudulent email or instant messages. Phishing is unfortunately very easy to execute. You are deluded into thinking it's the legitimate mail and you may enter your personal information.

Difference between Worms and Virus

1. Worms :

Worms are similar to a virus but it does not modify the program. It replicates itself more and more to cause slow down the computer system. Worms can be controlled by remote. The main objective of worms is to eat the system resources.

2. Virus :

A virus is a malicious executable code attached to another executable file that can be harmless or can modify or delete data. When the computer program runs attached with a virus it performs some action such as deleting a file from the computer system. Viruses can't be controlled by remote.

Difference between Worms and Virus :

S.No.WORMS

1. A Worm is a form of malware that replicates itself and can spread to different computers via Network.
2. The main objective of worms is to eat the system resources.
3. It doesn't need a host to replicate from one computer to another.
4. It is less harmful as compared.
5. Worms can be detected and removed by the Antivirus and firewall.
6. Worms can be controlled by remote.
7. Worms are executed via weaknesses in the system.
8. Internet worms, Instant messaging worms, Email worms, File sharing worms, Internet relay chat (IRC) worms are different types of worms.
9. Examples of worms include Morris worm, storm worm, etc.
10. It does not need human action to replicate.
11. that
11. Its spreading speed is faster.

VIRUS

- A Virus is a malicious executable code attached to another executable file which can be harmless or can modify or delete data.
- The main objective of viruses is to modify the information.
- It requires a host is needed for spreading. It is more harmful.
- Antivirus software is used for protection against viruses.
- Viruses can't be controlled by remote.
- Viruses are executed via executable files. Boot sector virus, Direct Action virus, Polymorphic virus, Macro virus, Overwrite virus, File Infector virus are different types of viruses
- Examples of viruses include Creeper, Blaster, Slammer, etc.
- It needs human action to replicate.
- Its spreading speed is slower as compared.

What is a logic bomb?

A logic bomb is a malicious piece of code that's secretly inserted into a computer network, operating system, or software application.

A logic bomb is a string of malicious [code](#) inserted intentionally into a program to harm a network when certain conditions are met. The term comes from the idea that the code "explodes" when triggered by a specific event, such as a certain date or time, the deletion of a particular record -- e.g., an employee -- from a system or the launch of the infected software [application](#).

How does a logic bomb work?

Either positive or negative conditions can trigger a logic bomb. A logic bomb coded with a positive condition goes off when that condition *is* met, while a bomb coded with a negative condition goes off when that condition *is not* met.

An example of a positive condition could be the opening of a particular file. An example of a negative condition is the code not being detected or deactivated before a certain date.

Whether the condition is positive or negative, as long as it's met, the logic bomb will go off and inflict damage unless a way is found to mitigate the condition or remove the code.