



# Fundamental Theories of Computer Science

**SANJEEV KUMAR**

ASSISTANT PROFESSOR

RAM CHAMELI CHADHA VISHVAS GIRLS COLLEGE , GHAZIABAD



## COMPUTER SCIENCE: GENERAL INTRODUCTION

### Introduction

The study of Computers and computing, including their theoretical and algorithmic foundations, hardware and software, and applications for processing information, is known as Computer science. The study of algorithms and data structures, Computer and network architecture, modelling data and information processes, and artificial intelligence are all part of Computer science. Although Computer science depends on mathematics and engineering for some of its principles, it combines ideas from queueing theory, probability and statistics, and electrical circuit design. During the conceptualization, creation, measurement, and development of novel algorithms, information structures, and Computer architectures, Computer science makes extensive use of hypothesis testing and experimentation.

Computer science is one of five distinct but related fields that includes Computer engineering, Computer science, information systems, information technology, and software engineering. The Computer discipline is the name given to this group of disciplines. These five disciplines are similar in that they all study Computers, but they are distinct in that each has its own research viewpoint and curricular concentration. (The Association for Computing Machinery [ACM], the IEEE Computer Society [IEEE-CS], and the Association for Information Systems [AIS] have worked together since 1991 to develop and update the taxonomy of these five interrelated

disciplines, as well as the guidelines that educational institutions around the world use in their undergraduate, graduate, and research programmes.)

The traditional study of Computer architecture, programming languages, and software development are all key subfields of Computer science. Computational science (the application of algorithmic tools for modelling scientific data), graphics and visualisation, human-Computer interaction, databases and information systems, networks, and the social and professional challenges peculiar to the practise of Computer science are also included. As may be seen, several of these subfields' activities intersect with those of other current sciences like bioinformatics and computational chemistry. These overlaps are the result of Computerscientists' proclivity for recognising and acting on their field's many multidisciplinary linkages.

### **Development of Computer science**

Computer science originated as a separate subject in the early 1960s, despite the fact that the electronic digital Computer that it studies was invented two decades prior. The roots of Computer science maybe found in mathematics, electrical engineering, physics, and management information systems, among other subjects.

Two important concepts in the creation of the Computer are derived from mathematics: the idea that all information may be represented as a series of zeros and ones, and the abstract concept of a "stored programme." Numbers in the binary number system are represented by a series of binary digits 0 and 1, similar to how numbers in the decimal system are represented by the digits 0 through 9. The binary digit, or bit, became the fundamental unit of data storage and transmission in a Computer system due to the relative simplicity with which two states (e.g., high and low voltage) can be produced in electrical and electronic equipment.

Electrical engineering teaches the fundamentals of circuit design, such as how to connect electrical impulses into a circuit using Boolean algebra to generate arbitrary outputs. (In the 19th century, Boolean algebra provided a framework for building a circuit with binary input values of zeros and ones [false or true, respectively, in logic] to generate any desired combination of zeros and ones as output.) Advances in electrical engineering and physics led to the discovery of the transistor and the shrinking of circuits, as well as the invention of electronic, magnetic, and optical media for data storage and transmission.

Various Computer science concepts like as sorting, searching, databases, information retrieval, and graphical user interfaces emerged from management information systems, which were initially named data processing systems. Payroll, accounting, inventory management, production control, shipping, and receiving were all vital to the tasks of operating a firm,

and large businesses housed Computers that kept this information.

The 1936 specification of the Turing machine (a theoretical computational model that carries out instructions represented as a series of zeros and ones) by British mathematician Alan Turing and his proof of the model's computational power provided the needed extension of these advances to the design of whole machines; a milestone was the 1936 specification of the Turing machine (a theoretical computational model that carries out instructions represented as a series of zeros and ones) by the British mathematician Alan Turing and his proof of the model. The notion of the stored-program Computer, ascribed to Hungarian-American mathematician John von Neumann, was another milestone. These are the roots of the branch of Computer science known as architecture and organisation.

Most Computer users in the 1950s worked in either scientific research facilities or huge enterprises. Computers were utilised by the first group to assist them in doing difficult mathematical calculations (e.g., missile trajectories), whereas the second group used Computers to handle massive quantities of business data (e.g., payrolls and inventories). Both parties immediately realised that developing programmes in the zero-and-one machine language was neither feasible nor trustworthy. In the early 1950s, this finding led to the creation of assembly language, which allowed programmers to utilise symbols for instructions (for example, ADD for addition) and variables (for example, X). Another software, called an assembler, converted these symbolic codes into binary programmes that the Computer could "execute," or carry out.

Linking loaders, another type of system software, were created to join portions of compiled code and load them into the Computer's memory, where they could be run. The idea of connecting independent bits of code was crucial because it allowed "libraries" of programmes to be reused for performing common tasks. This was the initial step in the creation of software engineering, a branch of Computer science.

Assembly language was proven to be so inefficient later in the 1950s that high-level languages (closer to natural languages) were developed to facilitate easier, quicker programming. COBOL became the primary high-level language for commercial programming, whereas FORTRAN became the primary high-level language for scientific programming. These languages necessitated the use of special software known as compilers, which convert high-level language programmes into machine code. Building compilers that produce high-quality machine code while being efficient in terms of execution speed and storage usage became a difficult Computer science challenge as programming languages got more sophisticated and complex. The branch of Computer science known as programming languages is centred on the design and implementation of high-level languages.

The growing popularity of Computers in the early 1960s prompted the creation of the first operating systems, which comprised of system-resident software that handled input and output as well as the execution of programmes known as "jobs." The quest for improved computing procedures sparked a renewed interest in numerical methods and their analysis, which grew to the point that it was dubbed "computational science."

In the 1970s and 1980s, sophisticated Computer graphics equipment were available for scientific modelling and other visual tasks. (The presentation of primitive graphics on paper plots and cathode-ray tube [CRT] displays was the first Computerised graphical device in the early 1950s.) Until the early 1980s, when the Computer memory necessary for bitmap graphics (in which an image is made up of tiny rectangular pixels) became more accessible, the field was held back by expensive hardware and restricted software availability. The tremendous expansion of the area has been fueled by bitmap technology, high-resolution display displays, and the creation of graphics standards that make software less machine-dependent. Graphics and visual computing is a branch of Computer science that provides support for all of these tasks.

The design and study of systems that interact directly with people performing various computing activities is closely connected to this topic. When line-edited interactions with users were supplanted with graphical user interfaces in the 1980s and 1990s, these systems became popular (GUIs). The importance of GUI design, which was pioneered by Xerox and then adopted by Apple (Macintosh) and then Microsoft (Windows), is that it determines what users see and do when they interact with a computing device. Human-Computer interaction (HCI) is a branch of Computer science that focuses on designing acceptable user interfaces for a variety of users (HCI).

Since the first stored-program Computers were built in the 1950s, the area of Computer architecture and organisation has also changed tremendously. In the 1960s, time-sharing systems were developed to allow several users to run programmes at the same time from various hard-wired terminals connected to the Computer. The first wide-area Computer networks (WANs) and protocols for delivering information at fast rates between Computers separated by huge distances were developed in the 1970s. As time went on, these activities converged into the subject of Computer science known as networking and communications. The creation of the Internet was a great achievement in this discipline.

The concept that instructions might be stored in a Computer's memory alongside data was crucial to basic findings concerning algorithm theoretical behaviour. To put it another way, problems like "What can/cannot be computed?" have been officially answered utilising these abstract concepts.



Algorithms and complexity, a branch of Computer science, arose from these discoveries. The study and implementation of data structures that are suited for various purposes is an important component of this area. Because data structures are so widely used in Computer software, including compilers, operating systems, file systems, and search engines, data structures, as well as the development of optimal algorithms for inserting, deleting, and locating data in such structures, are a major concern for Computer scientists.

The introduction of magnetic disc storage in the 1960s allowed for quick access to data stored in any location on the disc. This discovery led to the creation of database and information retrieval systems, which were eventually necessary for storing, retrieving, and transferring enormous volumes of data via the Internet. Information management is the name given to this branch of Computer science.

Another long-term objective of Computer science research is the development of computing machines and robotic devices capable of doing activities that would normally need human intellect. Moving, seeing, hearing, speaking, interpreting natural language, thinking, and even expressing human emotions are examples of such activities. Although the phrase artificial intelligence was not developed until 1956, the Computer science discipline of intelligent systems, initially known as artificial intelligence (AI), predates the first electronic Computers in the 1940s.

Platform-based development, parallel and distributed computing, and security and information assurance emerged as a result of three advancements in computing in the early twenty-first century: mobile computing, client-server computing, and Computer hacking. The study of the unique requirements of mobile devices, operating systems, and apps is referred to as platform-based development. The development of architectures and programming languages that support the development of algorithms whose components can run concurrently and asynchronously (rather than sequentially) to make better use of time and space is referred to as parallel and distributed computing. The design of computing systems and software that protects the integrity and security of data, as well as the privacy of persons who are identified by that data, falls under the category of security and information assurance.

Finally, throughout its history, Computer science has been concerned about the unique societal effect that comes with Computer science research and technical developments. When the Internet first came online in the 1980s, for example, software engineers had to deal with serious challenges including data security, personal privacy, and system stability. Furthermore, the question of whether Computer software is intellectual property, as well as the associated question of "Who owns it?" gave rise to a whole new legal

area of software licencing and licencing standards. These and other challenges are at the heart of Computer science's social and professional issues, and they can be found in practically all of the other areas mentioned above.

To conclude, Computer science has developed into the 15 areas listed below:

- Algorithms and complexity
- Architecture and organization
- Computational science
- Graphics and visual computing
- Human-Computer interaction
- Information management
- Intelligent systems
- Networking and communication
- Operating systems
- Parallel and distributed computing
- Platform-based development
- Programming languages Security and information assurance
- Software engineering Social and professional issues

The roots of Computer science may still be found in mathematics and engineering. Postsecondary academic institutions often provide Computer science bachelor's, master's, and doctorate degree programmes, and these programmes need students to finish suitable mathematics and engineering courses, depending on their area of emphasis. For example, discrete mathematics (logic, combinatorics, and elementary graph theory) is required of all undergraduate Computer science majors. Many schools also require students to finish early in their studies courses in calculus, statistics, numerical analysis, physics, and engineering concepts.

### **Computer Science Principles**

Computer Science Principles (CSP) is a new Advanced Placement course that teaches students core Computer abilities, as well as a grasp of how computing applications affect real-world situations and programming literacy. It is a non-majors course designed to encourage students who may not otherwise consider studying computing and Computer science to do so. The creation of CSP is being led by a group of Computer science educators formed by the College Board and the National Science Foundation, and it provides a curricular foundation around which instructors can design their own unique course. CSP will be available as an AP subject in the fall of 2016, with the first AP tests scheduled for May of 2017.

Each of the following descriptions corresponds to one of the curriculum's seven essential Big Ideas. You may learn more about the curriculum by looking through the groups that are working with it, or by joining the CSP

Open Community, which is a new group for all CSP instructors (regardless of project or geographic area) to get together and speak about all things CSP!

- **Abstraction** : In computing, many degrees of abstraction are utilised. Abstraction is used in models and simulations to ask and answer questions.
- **Algorithms** : An algorithm is a detailed set of instructions for a Computer to follow in order to complete a task. Languages are used to convey them, and they can solve many, but not all, difficulties.
- **Creativity** : Computing encourages the development of objects and the expression of creativity. Programming is an artistic endeavour.
- **Data** : The generation of knowledge is aided by data and information. Computer programmes are used to process data in order to obtain insight and knowledge. Computing makes it easier to explore and identify relationships in data. Information representation, storage, security, and transmission must all be considered while manipulating data computationally.
- **Impact** : Communication, interaction, and cognition are all influenced by computing. It promotes innovation in practically every industry and has both positive and negative consequences.

Computing takes place in a variety of economic, social, and cultural settings.

- **Internet** : The internet has become an integral part of modern computing. It's a collection of self-contained systems. The Internet and the systems built on it have characteristics that impact how they are used. For the Internet and those systems, cybersecurity is a major worry.
- **Programming** : Programming is a creative process that allows people to solve problems, express themselves, and create knowledge. It makes use of mathematical and logical principles, as well as suitable abstractions. People create and utilise programmes, which are written to carry out algorithms.

## **Basic concept of Computer**

A Computer is an electronic device used to manipulate data or information. It can store, retrieve, and process information. You may already be aware that a Computer may be used to compose papers, send email, play games, and browse the Web. It also allows you to edit and create spreadsheets, presentations, and movies. Computer is the device that processes, stores, and displays data.

The term "Computer" used to refer to a human who performed calculations, but it now nearly exclusively refers to automated electronic technology. The first section of this article delves into the design, components, and applications of contemporary digital electronic Computers. The history of Computers is covered in the second part. See Computer science for further information on Computer architecture, software, and theory. It operates under the control of a set of instructions that is stored in its memory unit. A Computer accepts data from an input device and processes it into useful

information which it displays on its output device.

Actually , a Computer is a collection of hardware and software components that helps us to accomplish many different tasks. Hardware consists of the Computer itself and includes a CPU,a monitor ,a keyboard ,a mouse and any equipment connected to it. Software is the set if instructions that the Computer follow inperforming a task.

### Hardware vs. software

Let's speak about two elements that all Computers have in common:hardware and software, before we go into different sorts of Computers.

**Hardware :** Any portion of your Computer with a physical structure, such as the keyboard or mouse, is referred to as hardware.It also contains all of the Computer's internal components, as seen in the figure below.



**Software** is any **set of instructions** that tells the hardware **what to do** and **how to do it**. Examples of software include web browsers, games, and word processors.

Hardware and software will play a role in everything you do on your Computer. For example, you may be watching this course on a web browser (software) and clicking from page to page using your mouse (hardware). As you learn more about different types of Computers, consider the hardware differences.

### Comparison between Human Beings and Computers

Human Being	Computers
Human beings are slow in doing calculation.	Computers can do complex calculations in seconds.
Human beings cannot remember lots of things atone time.	Computers can store and remember a large amount of information at one time.
Human beings can make mistake.	Computers do not make mistakes.
Human beings have feelings.	Computers do not have feelings.
Human beings can think.	Computers cannot think.



**Human beings get tired if they work for long hours.**

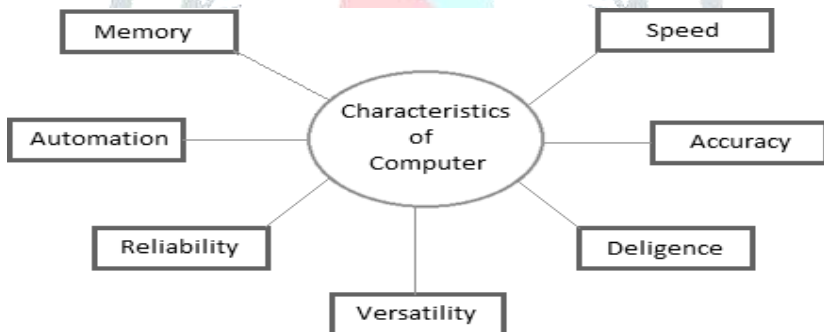
**Computers never get tired.**

## Characteristics of a Computer

**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. Computer can perform data processing jobs very fast, usually measured in **microseconds** ( $10^{-6}$ ), **nanoseconds** ( $10^{-9}$ ), and **picoseconds** ( $10^{-12}$ ).

**Accuracy :** Computers perform calculations with 100% accuracy. Errors may occur due to data inconsistency or inaccuracy. Accuracy of a Computer is consistently high and the degree of its accuracy depends upon its design. Computer errors caused due to incorrect input data or unreliable programs are often referred to as *Garbage- In- Garbage-Out* (GIGO).

**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. Computer is capable of performing almost any task, if the task can be reduced to a finite series of logical steps.

**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.

### **Basic application/uses of a 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 in homes for a variety of functions, including online bill payment, watching movies or shows at home, home tutoring, access to social media, playing games, and access to the internet. They use e-mail as a means of communication. They assist corporate employees in obtaining work-from-home opportunities. Computers enable students to access online instructional resources.

**Medical Field :** In hospitals, Computers are used to keep track of patients' medical histories, diagnoses, X-rays, and live patient monitoring, among other things. Robotic surgical instruments are currently used by surgeons to undertake delicate procedures and to conduct surgeries remotely. Virtual reality technology may also be utilised for training. It also assists in the monitoring of the foetus within the mother's womb.

**Entertainment :** Computers allow you to view movies online, play games online, and function as a virtual entertainment while you play games, listen to music, and so on. People in the entertainment sector can use MIDI devices to record music using artificial instruments. Full-screen televisions may be fed videos from PCs. There are a variety of photo editors accessible, each with its own set of functions.

**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 utilised in the education industry for online classrooms, online assessments, e-book referencing, and online tutoring, among other things. They contribute to the rising usage of audio-visual aids in education.

**Government :** Computers are used in government sectors to process data, maintain a citizen database, and enable a paperless environment. Computers have substantially aided the country's defence institutions in the creation of missiles, satellites, and rocket launches, among other things.

**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 :** Computers are now completely interwoven into business. Transaction processing, which includes dealings with suppliers, workers, and consumers, is the primary goal of business. These transactions may be made simple and accurate with the help of Computers. Computers may be used to examine investments, sales, costs, markets, and other areas of company.

**Training :** To reduce money and increase performance, many companies utilise Computer-based training to teach their personnel. By allowing individuals in different areas to interact via video conferencing using Computers, time and travel costs may be saved.

**Science and Engineering :** In Science and Engineering, high-performance Computers are used to excite dynamic processes. In the field of research and development, superComputers have a wide range of uses (R&D). Computers can be used to make topographic pictures. To gain a better knowledge of earthquakes, scientists utilise Computers to map and analyse data.

**Arts :** Dance, photography, the arts, and culture all use Computers significantly. Dance may be animated to depict its fluid movement in real time. Using Computers, photos may be digitised.

## Functions of a Computer

**1.Data Input :** Every Computer is built with data input as its primary function, which is achieved through input devices. Data is entered manually, automatically, or both ways. Add-on peripherals such as the keyboard, mouse, and stylus are used for manual input. Vocal dictation apps and body gesture peripherals like Kinect and biometric devices may also be used to provide input. Data is also input utilising supplementary storage media and networking connections in other places. What data is entered will also be dictated by the application software used for this purpose. Word processing software is used to enter basic alphanumeric data, and photo editing software is used to enter and change photographs. This data may be entered into a database, spreadsheet or other forms of a Computerized work area. Automated applications and robotics can also be used to intelligently feed data into the Computer on station or remotely. As an example, tallying of electoral process can be accomplished remotely and automatically.

**2.Data Processing :** Data processing is the core function of a Computer. Processing involves manipulation of raw data into before converting it into meaningful information. Usually, data is in raw form, and will thus undergo processing before dissemination for user consumption. The 'brain' of the

Computer where data is processed is referred to as the microprocessor. It is also commonly known as the central processing unit (CPU) or accelerated processing unit (APU). The processing chips in modern personal computing devices continue to evolve and outperform its predecessors. One particular evolution is the merger of microprocessor and graphics processing unit (GPU) into what is now known as accelerated processing unit. The merger allows for the integration of powerful graphics processing abilities inside the traditional arithmetic and logical computations of the processor. Besides the microprocessor, the dynamic random access memory (DRAM) and static random access memory (SRAM) are integral parts of data processing. Data entered via input devices is stored temporarily in DRAM, then transferred to SRAM from where the microprocessor manipulates it.

**3.Data output :** When raw data has been manipulated by the microprocessor, the outcome is meant to be disseminated for useful purposes. The output is thus referred to as information and is beneficial to the Computer user. Processed data or information can be,

- viewed as alphanumeric, images and video via a display hardware.
- listened to as audio files by use of a speaker
- printed as hard copy output onto paper
- printed as 3D models.

**4.Data and information storage :** The fourth and equally very important function of a Computer is data and information storage. After sleepless nights of video and animation creation and editing, the user wants to have the finished product stored for future dissemination and additional editing. A Computer can store information internally and externally. The hard disk drive (HDD) and/or solid-state disk drive (SSD) are internal storage devices and serve to protect and house all data and information on a Computer. In bigger systems, the RAID system is used. Multiple disk drives operate simultaneously to ensure data and information integrity. External storage is achieved through accessories that attach externally to the Computer. They include external drives and optical disks. Better still data and information can be stored online in cloud solutions for a fee or for a fee if large space is required. Storage integrity is a crucial phase that can actually determine the worth of a Computer system.

### **Instruction cycle**

The **instruction cycle** (also known as the **fetch–decode–execute cycle**, or simply the fetch-execute cycle) is the cycle that the central processing unit (CPU) follows from boot-up until the Computer has shut down in order to process instructions. The fetch stage, the decode stage, and the execute stage are the three primary phases.

The instruction cycle is conducted sequentially in simpler CPUs, with each instruction being processed before the next one begins. The instruction cycles are instead performed concurrently, and frequently in parallel, using an instruction pipeline in most contemporary CPUs: the next instruction begins processing before the preceding instruction has completed, which is feasible since the cycle is divided up into individual parts.



**1.Fetch the instruction :** The CPU fetches the instruction from main memory via the data bus , and it is then placed into the CIR( current instruction register). The Program Counter is instructed to contain the address of the need instruction.

**2.Decode the instruction :** The instruction decoder interprets instructions. If an instruction has an indirect address,the effective address is read from main memory, and any required data is fetched from main memory to be processed and then placed into data registers.

**3.Execute the instruction :** The CU passes the decoded information as a sequence of control signals to the relevant function units of the CPU to perform the actions required by the instruction, such as reading values from registers, passing them to the ALU to perform mathematical or logic functions on them,and writing the result back into a register. If the ALU is involved, it sends a condition signal back to the CU.

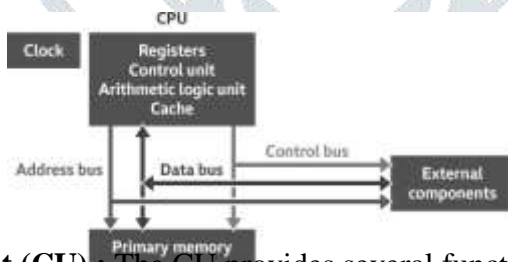
**4.Store results :** The result generated by the operation is stored in the main memory, or sent to an output device. Based on the condition of any feedback from the ALU, Program Counter maybe updated to a different address from which the next instructionwill be fetched . The cycle is then repeated.

### Components of a CPU

The central processing unit (CPU) consists of six main components:

- control unit (CU)
- arithmetic logic unit (ALU)
- registers
- cache
- buses
- clock

All components work together to allow processing and system control.



**Control Unit (CU) :** The CU provides several functions:

- it fetches, decodes and executes instructions
- it issues control signals that control hardware
- it moves data around the system

**Arithmetic Logic Unit (ALU) :** The ALU has two main functions:

- It performs arithmetic and logical operations (decisions). The ALU is where calculations are done and where decisions are made.
- It acts as a gateway between primary memory and secondary storage . Data transferred between them passes through the ALU.

The ALU performs calculations and makes logical decisions.

**Registers :** Registers are small amounts of high-speed memory contained within the CPU. They are used by the processor to store small amounts of data that are needed during processing, such as:

- the address of the next instruction to be executed
- the current instruction being decoded
- the results of calculations

Different processors have different numbers of registers for different purposes, but most have some, or all, of the following:

- program counter
- memory address register (MAR)
- memory data register (MDR)
- current instruction register (CIR)
- accumulator (ACC)

**Cache :** Cache is a small amount of high-speed random access memory (RAM) built directly within the processor. It is used to temporarily hold data and instructions that the processor is likely to reuse. This allows for faster processing as the processor does not have to wait for the data and instructions to be fetched from the RAM.

**Buses :** A bus is a high-speed internal connection. Buses are used to send control signals and data between the processor and other components.

Three types of bus are used:

- Address bus - carries memory addresses from the processor to other components such as primary memory and input/output devices.
- Data bus - carries the actual data between the processor and other components.
- Control bus - carries control signals from the processor to other components. The control bus also carries the clock's pulses.

**Clock :** The CPU contains a clock which is used to coordinate all of the Computer's components. The clock sends out a regular electrical pulse which synchronises (keeps in time) all the components.

The frequency of the pulses is known as the clock speed. Clock speed is measured in hertz. The higher the frequency, the more instructions can be performed in any given moment of time.

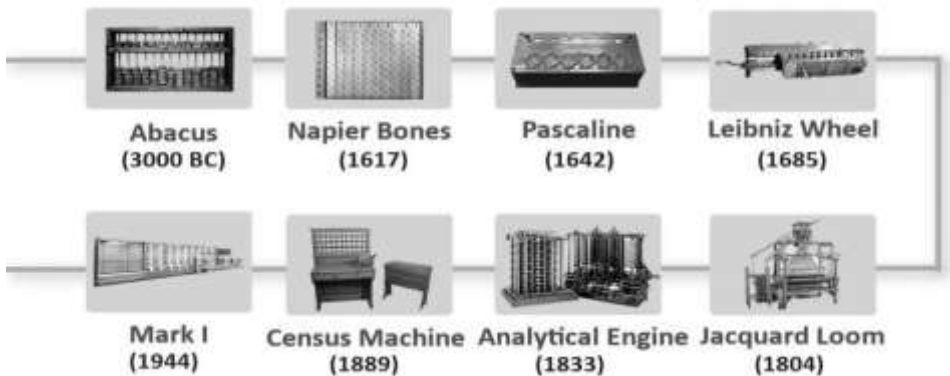
In the 1980s, processors commonly ran at a rate of between 3 megahertz (MHz) to 5 MHz, which is 3 million to 5 million pulses or cycles per second. Today, processors commonly run at a rate of 3 gigahertz (GHz) to 5 GHz, which is 3 billion to 5 billion pulses or cycles per second.

➤ **GIGO (Garbage in Garbage Out) :** It is a concept of Computer science that the quality of output is determined by quality of input, means wrong input will result in wrong output. It is related to accuracy of input and output.

# GENERATIONS OF COMPUTER

The Computers of today are vastly different in appearance and performance as compared to the Computers of earlier days. But where did this technology come from and Where is it heading? To fully understand the impact of Computers on today's world and the promises they hold for the future, it is important to understand the evolution of Computers.

## Evolution of Computers



**The First Generation:** The first generation Computers made use of:

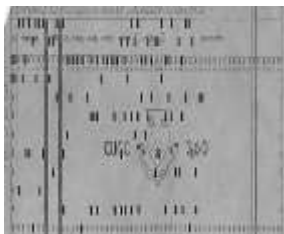
Vacuum tube technology, Punched cards for data input, Punched cards and paper tape for output, Machine Language for writing programs, Magnetic tapes and drums for external storage.

The Computers of the first generation were very bulky and emitted large amount of heat which required air conditioning. They were large in size and cumbersome to handle. They had to be manually assembled and had limited commercial use. The concept of operating systems was not known at that time. Each Computer had a different binary coded program called a machine language that told it how to operate.

**Punched cards**



**Paper tape**

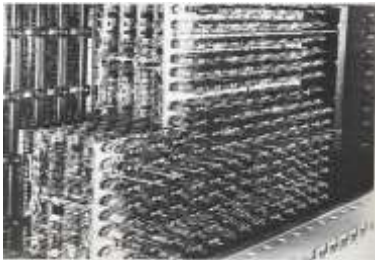


**Vacuum tube**



## The first Generation Computer technology

The Abacus, which emerged about 5000 years ago in Asia Minor and is still in use today, allows users to make computations using a system of sliding beads arranged on a rack. Early merchants used Abacus to keep trading transactions.



**Abacus**



**Pascaline**

### The first Generation Computers

Blaise Pascal, a French mathematician invented the first mechanical machine, a rectangular brass box, called Pascaline which could perform addition and subtraction on whole numbers. This was in the seventeenth century. Colmar, a Frenchman invented a machine that could perform the four basic arithmetic functions of addition, subtraction, multiplication and division. Colmar's mechanical calculator, "Arithmometer", presented a more practical approach to computing. With its enhanced versatility, the "Arithmometer" was widely used until the First World War, although later inventors refined Colmar's calculator, together with fellow inventors, Pascal and Leibniz, he helped define the age of mechanical computation.

Charles Babbage a British mathematician at Cambridge University invented the first analytical engine or difference engine. This machine could be programmed by instructions coded on punch cards and had mechanical memory to store the results. For his contributions in this field Charles Babbage is known as 'the father of modern digital Computer'.

Some of the early Computers included:

This was the first fully automatic calculating machine. It was designed by Howard Aiken of Harvard University in collaboration with IBM. This machine was an electronic relay Computer. Electromagnetic signals were used for the movement of mechanical parts. Mark I could perform the basic arithmetic and complex equations. Although this machine was extremely reliable, it was very slow (it took about 3-5 seconds per calculation) and was complex in design and large in size.

**Atanasoff-Berry Computer (ABC)** –This Computer developed by John Atanasoff and Clifford Berry was the world's first general purpose electronic



digital Computer. It made use of vacuum tubes for internal logic and capacitors for storage.

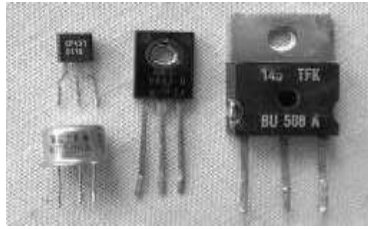
**ENIAC (Electronic Numeric Integrator and Calculator)** –The first all electronic Computer was produced by a partnership between the US Government and the University of Pennsylvania. It was built using 18,000 vacuum tubes, 70,000 resistors and 1,500 relays and consumed 160 kilowatts of electrical power. The ENIAC computed at speed about thousand times faster than Mark I. However, it could store and manipulate only a limited amount of data. Program modifications and detecting errors were also difficult.

**EDVAC** –In the mid 1940's Dr. John von Neumann designed the Electronic Discrete Variable Automatic Computer with a memory to store both program and data. This was the first machine which used the stored program concept. It had five distinct units - arithmetic, central control, memory, input and output. The key element was the central control. All the functions of the Computer were co-ordinate through this single source, the central control. The programming of the Computers was done in machine language.

**UNIVAC** - Remington Rand designed this Computer specifically for business data processing applications. The Universal Automatic Computer was the first general purpose commercially available Computer.

**The Second Generation:** In the second generation Computers: Vacuum tube technology was replaced by transistorized technology, Size of the Computers started reducing, Assembly language started being used in place of machine language, Concept of stored program emerged, High level languages were invented.

This was the generation of Transistorized Computers. Vacuum tubes were replaced by transistors. As a result, the size of the machines started shrinking. These Computers were smaller, faster, more reliable and more energy efficient. The first transistorized Computer was TX-0. The first large scale machines that took advantage of the transistor technology were the early superComputers, Stretch by IBM and LARC by Sperry Rand. These machines were mainly developed for atomic energy laboratories. Typical Computers of the second generation were the IBM 1400 and 7000 series, Honeywell 200 and General Electric.



## Transistors

IBM 1401 was universally accepted throughout the industry and most large businesses routinely processed financial information using second generation Computers. The machine language was replaced by assembly language. Thus the long and difficult binary code was replaced with abbreviated programming code which was relatively easy to understand.

The stored program concept and programming languages gave the Computers flexibility to finally be cost effective and productive for business use. The stored program concept implied that the instructions to run a Computer for a specific task were held inside the Computer's memory and could quickly be modified or replaced by a different set of instructions for a different function. High level languages like COBOL, FORTRAN and ALGOL were developed. Computers started finding vast and varied applications. The entire software industry began with the second generation Computers.

**The Third Generation:** The third generation Computers were characterized by:

- Use of Integrated circuits,
- Phenomenal increase in computation speed,
- Substantial reduction in size and power consumption of the machines,
- Use of magnetic tapes and drums for external storage,
- Design of Operating systems and new higher level languages,
- Commercial production of Computers.
- This generation was characterized by the invention of Integrated Circuits (ICs).
- The IC combined electronic components onto a small chip which was made from quartz..



i) Integrated Circuit



ii) Integrated Circuit

Later, even more components were fitted onto a single chip, called a semiconductor. This reduced the size even further. The weight and power consumption of Computers decreased and the speed increased tremendously. Heavy emphasis was given to the development of software. Operating systems were designed which allowed the machine to run many different programs at once. A central program monitored and co-ordinate the Computer s memory. Multiprogramming was made possible, whereby the machine could perform several jobs at the same time. Computers achieved speeds of executing millions of instructions per second. Commercial production became easier and cheaper. Higher level languages like Pascal and Report Program Generator (RPG) were introduced and applications oriented languages like FORTRAN, COBOL, and PL/1 were developed.

### The Fourth Generation:

- The general features of the fourth generation Computers were:
- Use of Very Large Scale Integration,
- Invention of microComputers,
- Introduction of Personal Computers,
- Networking,
- Fourth Generation Languages.



VLSI

The third generation Computers made use of 'Integrated Circuits that had 10-20 components on each chip, this was Small Scale Integration (SSI).The

Fourth Generation realized Large Scale Integration (LSI) which could fit hundreds of components on one chip and Very Large Scale integration (VLSI) which squeezed thousand of components on one chip. The Intel 4004 chip, located all the components of a Computer (central processing unit, memory, input and output controls) on a single chip and microComputers were introduced. Higher capacity storage media like magnetic disks were developed. Fourth generation languages emerged and applications software's started becoming popular.

Computer production became inexpensive and the era of Personal. Computers (PCs) commenced. In 1981, IBM introduced its personal Computer for use in office, home and schools. In direct competition, the Macintosh was introduced by Apple in 1984. Shared interactive systems and user friendly environments were the features of these Computers.

As the Computers started becoming more and more powerful, they could be linked together or networked to share not only data but also memory space and software. The networks could reach enormous proportions with local area networks. A global web of Computer circuitry, the Internet, links the Computers worldwide into a single network of information.

### **The Fifth Generation:**

Defining the fifth generation Computers is somewhat difficult because the field is still in its infancy. The Computers of tomorrow would be characterized by Artificial Intelligence (AI). An example of AI is Expert Systems. Computers could be developed which could think and reason in much the same way as humans. Computers would be able to accept spoken words as input (voice recognition).

Many advances in the science of Computer design and technology are coming together to enable the creation of fifth generation Computers. Two such advances are parallel processing where many CPUs work as one and advance in superconductor technology which allows the flow of electricity with little or no resistance, greatly improving the speed of information flow..



# CLASSIFICATION OF COMPUTERS

Computers are broadly classified into two categories depending upon the logic used in their design as:



**Analog Computers:** In analog Computers, data is recognized as a continuous measurement of a physical property like voltage, speed, pressure etc. Readings on a dial or graphs are obtained as the output, ex. Voltage, temperature; pressure can be measured in this way.

**Digital Computers:** These are high speed electronic devices. These devices are programmable. They process data by way of mathematical calculations, comparison, sorting etc. They accept input and produce output as discrete signals representing high (on) or low (off) voltage state of electricity. Numbers, alphabets, symbols are all represented as a series of 1s and 0s.

Digital Computers are further classified as General Purpose Digital Computers and Special Purpose Digital Computers. General Purpose Computers can be used for any applications like accounts, payroll, data processing etc. Special purpose Computers are used for a specific job like those used in automobiles, microwaves etc.

Another classification of digital Computers is done on the basis of their capacity to access memory and size like:

## Small Computers:

a) MicroComputers: MicroComputers are generally referred to as Personal Computers (PCs). They have Smallest memory and less power. They are widely used in day to day applications like office automation, and professional applications, ex. PC- AT, Pentium etc.

b) Note Book and Laptop Computers: These are portable in nature and are battery operated. Storage devices like CDs, floppies etc. and output devices like printers can be connected to these Computers. Notebook Computers are smaller in physical size than lap top Computers. However, both have powerful processors, support graphics, and can accept mouse driven input.



**Hybrid Computers:** Hybrid Computers are a combination of Analog and Digital Computers. They combine the speed of analog Computers and accuracy of digital Computers. They are mostly used in specialized applications where the input data is in an analog form i.e. measurement. This is converted into digital form for further processing. The Computers accept data from sensors and produce output using conventional input/output devices.

**Mini Computers:** Mini Computers are more powerful than the micro Computers. They have higher memory capacity and more storage capacity with higher speeds. These Computers are mainly used in process control systems. They are mainly used in applications like payrolls, financial accounting, Computer aided design etc. ex. VAX, PDP-11.

**Mainframe Computers:** Main frame Computers are very large

Computers which process data at very high speeds of the order of several million instructions per second. They can be linked into a network with smaller Computers, micro Computers and with each other. They are typically used in large organizations, government departments etc. ex. IBM4381, CDC.

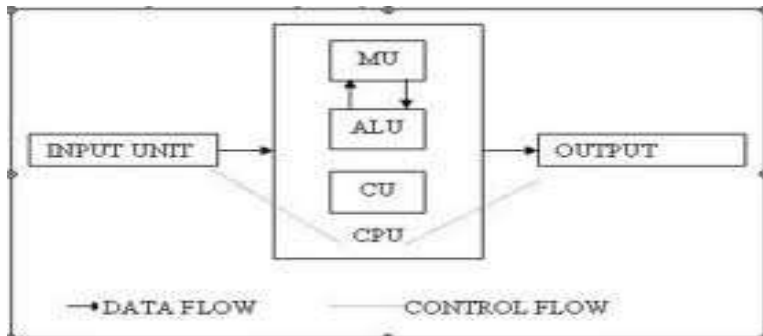
**Super Computers:** A super Computer is the fastest, most powerful and most expensive Computer which is used for complex tasks that require a lot of computational power. Super Computers have multiple processors which process multiple instructions at the same time. This is known as parallel processing. These Computers are widely used in very advanced applications like weather forecasting, processing geological data etc. ex. CRAY-2, NEC - 500, PARAM.

# COMPONENTS OF A COMPUTER SYSTEM

The basic parts of Computer system are: Input Unit

The Central Processing Unit

Output Unit



**The Input Unit:** Input devices are the devices which are used to feed programs and data to the Computer. The input system connects the external environment with the Computer system. The input devices are the means of communication between the user and the Computer system. Typical input devices include the keyboard, floppy disks, mouse, microphone, light pen, joy stick, magnetic tapes etc. The way in which the data is fed into the Computer through each of these devices is different. However, a Computer can accept data only in a specific form. Therefore these input devices transform the data fed to them, into a form which can be accepted by the Computer. These devices are a means of communication and interface station between the user and the Computer systems. Thus the functions of the input unit are :

accept information (data) and programs.

convert the data in a form which the Computer can accept. provide this converted data to the Computer for further processing.

**The Central Processing Unit:** This is the brain of any Computer system.

The central processing unit or CPU is made of three parts:

**a) Control Unit-** The Control Unit controls the operations of the entire Computer system. The control unit gets the instructions from the programs stored in primary storage unit interprets these instructions and subsequently directs the other units to execute the instructions. Thus it manages and coordinates the entire Computer system.

**b) ALU -**The Arithmetic Logic Unit (ALU) actually executes the instructions and performs all the calculations and decisions. The data is held

in the primary storage unit and transferred to the ALU whenever needed. Data can be moved from the primary storage to the arithmetic logic unit a number of times before the entire processing is complete. After the completion, the results are sent to the output storage section and the output devices.

**c) Storage Unit** - This is also called as Main Memory. Before the actual processing starts the data and the instructions fed to the Computer through the input units are stored in this primary storage unit. Similarly, the data which is to be output from the Computer system is also temporarily stored in the primary memory. It is also the area where intermediate results of calculations are stored. The main memory has the storage section that holds the Computer programs during execution.

**d) Thus the primary unit:**

Stores data and programs during actual processing, Stores temporary results of intermediate processing, Stores results of execution temporarily.

**e) Output Unit** - The output devices give the results of the process and computations to the outside world.

The output units accept the results produced by the Computer, convert them into a human readable form and supply them to the users. The more common output devices are printers, plotters, display screens, magnetic tape drives etc.

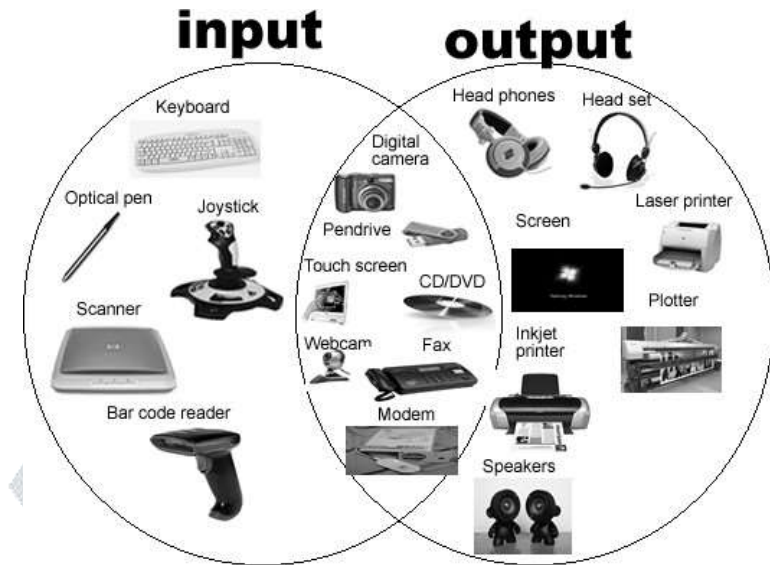
## INPUT DEVICES AND OUTPUT DEVICES

As seen earlier, Computer hardware is made up of the physical parts of the Computer system like the electronic ICs, magnetic storage media and the mechanical devices.

The devices which are a means of communication between the Computer and the outside world are called as **peripheral devices**.

Those peripheral devices which supply information i.e. data and programs from the outside world to the Computer are the **input devices**. Those peripheral devices which give information from the





Computer to the user or store them in secondary storage devices, like floppy disks or tapes for future use are called **output devices**.

The processors which are required to convert the input data into machine readable form and to convert the output generated by the Computer into human readable form are known as **input/output(I/O) interfaces**.

There are two concepts related to the way in which data is input to the Computer:

**On-line Data Input :** Here data is directly transferred to the Computer

**Off-line Data Input :** Here the data is not immediately transferred to the Computer.

## INPUT DEVICES

**The various types of input devices most commonly used are :**

**Punch Cards :** Data is recorded onto punch cards or punch tapes using standard codes, like the Hollerith code. The pattern of these holes is interpreted by a card reader device and converted into machine readable form. A punch card machine is used to transcribe the data onto the card. The major drawback of these cards is that they cannot be reused. Also the cards have to be handled and stored carefully. Even if a single card is misplaced or the arrangement of the cards gets disturbed it becomes very difficult to rearrange them and to detect their problem. Punched cards require large storage space since they cannot be folded.

**Keyboard :** The keyboard is one of the most commonly used input device. The Computer keyboard is similar to a typewriter keyboard. The keyboard has keys made up of letters, numbers, symbols and special function keys. A

display screen or monitor (Cathode Ray Tube) is used to display the data entered by the operator with the keyboard. This monitor can also display the results of processing as well as messages generated by the Computer. A special symbol, called a cursor, indicates the position on the screen. There are special keys on the keyboard which allow the cursor to move in up, down, left and right directions. Other special keys on the keyboard include keys like Tab, Del, Ctrl, Ins, PgUp, PgDn etc.

### **The keys on the keyboard include :**

**A-Z :** Used to enter alphabets

**0-9 :** Used to enter numbers

**Up, Down, Left, Right(Arrow Keys):** To Move the cursor in the specified direction

**F1-F12 :** Special Function Keys

**PgUp/PgDn :** To move cursor up or down by one page enter: To move cursor to a new line.

**Shift :** A Special key To Select the other option shown normal character on the same key Num Lock : Activates the keypad on the right side of the keyboard. In the normal mode this numeric pad works as per the function written below the number on the key



### **Advantages of the keyboard :**

It is very easy to use a keyboard It offers a number of facilities

Editing or changing the input data is very easy with the help of the keyboard

It is relatively Inexpensive

**Mouse :** The mouse is a pointing device. The mouse is used to control and manipulate cursor movement on the monitor. The mouse usually has three or four buttons on it and a roller ball which signals the movements made by the mouse on a flat surface. These movements are transferred to the system. The mouse is rolled on a flat surface by the user. It can be used independently, but normally it is used in conjunction with the keyboard to improve the efficiency of the input operation. The mouse can be used to select data. Also the mouse makes it possible to move fast from one part of the screen to the other.

The various types of mouse in use are:

- 1) Mechanical mouse
- 2) Optical mouse
- 3) Opt Mechanical mouse.



**Light Pen :** The light pen is a picking device. The light pen contains a photocell placed in a small tube. This photo-cell detects the presence of light on the CRT (monitor). The tip of the pen is moved on the surface of the screen to write or sketch data. The light pen is especially useful in Computer Aided Design (CAD) applications.

**Joy Stick :** The position and speed with which the joystick is moved is converted into digital signals by the use of a lever. These signals are then sent to the Computer system. This in turn controls the movement of the cursor on the screen. The joystick is mainly used in video games applications.

**Track Ball :** The track ball uses a hard sphere to control cursor movement. The ball can be rotated in any direction by hand and this is translated into a digital signal to control the cursor movement on the screen.

**Touch Screen :** A touch panel is a transparent plate which is fitted over the CRT. Input is registered when a finger or any other object comes in contact with the plate.

There are two types of touch panels:

- a) Optical touch panels
- b) Electric touch panels

**Digitizer :** A digitizer converts a graphical or pictorial data into digital form which can be directly entered and stored in a Computer. A digitizer is also called as a graphics tablet. There are two types of digitizers: **Image scan digitizer and flat bed digitizer**

In the image scan digitizer the entire image is scanned and reproduced automatically. Therefore the image scan digitizers are more powerful as compared to flat bed digitizers. Flat bed digitizers are mainly used in simple drawings, graphs etc. whereas image scan digitizers are used for photographs

and pictures.

**Scanner :**Scanner is able to directly enter text and images into the Computer memory. Therefore the duplication work of entering data is eliminated and this also results in increased accuracy. The speed of data entry also increases. There are two types of scanners : Optical Scanners



Magnetic Ink Character Recognition devices

**a) Optical Scanner:** The optical scanner uses a light source and sensor for reading the information on the paper. It can read characters, pictures, graphics from the paper. The common types of optical scanners are:

**1) The Optical Mark Reader (OMR):** This is capable of reading pre specified marks made by pencils or pens with the help of light. Light is focused on the page that is to be scanned. The reflected light pattern is detected by the device. These types of scanners are normally used where the data is preprinted for applications.

eg. answer papers of the objective tests where the answers are marked with pencils or preprinted forms.

**2) Optical Character Reader :** The Optical Character Reader (OCR) can read alphabets, characters and numbers printed on paper. These characters can



be either handwritten or typed. However special fonts are required to be used while typing. In case of handwritten data, the characters have to be of standard predefined size. The OCR reads each character as a collection of pixels. The light which is reflected from the page to be scanned is converted into binary data. OCRs are available in various sizes and speeds. These devices are expensive and are mainly used in processing where the data volumes are large.

**Bar code reader** is a device which reads bar coded data. Data which is coded in the form of light or dark lines (bars) is a bar code. Bar code readers are normally used in applications like labeling of products in retail shops, super



markets etc. A laser beam scanner is used to read the bar code.

The most commonly used bar code is the Universal Product Code (UPC). In this code the bars are coded as 10 digits. The first five digits define the manufacturer or supplier, and the remaining five digits denote the actual product of the manufacturer.

**b) Magnetic Ink Character Recognition (MICR):** A special type of input device, this mainly finds application in banking areas. A magnetic ink is used to encode the characters to be read. This ink contains iron oxide particles. When a cheque is presented in the bank, the amount is encoded by the bank employee in the lower right corner and the cheque is then processed with MICR. Special character sets like E13B and CMC7 are used by these devices to encode data. The E13B has four special character and the digits 0-9. The CMC7 has five special characters, digits 0-9, and all alphabets.

The advantages of using MICR are that they speed up data entry, and even roughly handled cheque can be processed relatively easily. However among the limitations are that special type of magnetic ink is required for encoding characters and only a limited number of digits and characters are available for encoding.

**Voice Recognition Systems :** This system allows the user to talk with the Computer. The Voice Recognition System consists of a microphone or telephone into which the operator speaks. The speech is converted into electrical signals. The signal is input as the voice of the operator. This is matched with an already entered pre-stored pattern of words called vocabulary. When the closest match is found the word is recognized. Since each operator may have a different style of speaking, all Voice Recognition systems are highly operator dependent. Also a separate vocabulary for each operator is required to be maintained. The advantages of the Voice Recognition systems are that they reduce the cost of data entry. Also the operator can move freely while talking into the Computer.

## OUTPUT DEVICES

The output device allows the computer to communicate with the outside world by accepting data from the Computer and transforming it into user readable form.

The various types of output devices are :

**Printers:** A printer produces the output from the Computer on the paper. It is the most commonly used output device. The printers produce a hard copy i.e. a permanent copy of the results which can be stored and read later. Printers are classified as :

- a) Impact Printer
- b) Non Impact Printer

**Impact Printer :** Impact printers are similar to typewriters. They use hammer

to strike a character against an inked ribbon and the impact of the hammer causes the image of the character to be printed on paper. E.g. Dot matrix printers, line printers, daisy wheel printers. Advantages of impact printers:

- a) Their functioning is relatively easy
- b) Multiple copies can be produced at the same time with the help of carbon paper.
- c) Impact printers are noisy in operation and are subject to wear and tear of mechanical parts.

### Types of impact printers :

**Dot Matrix Printers :** Dot matrix printer prints each character as a pattern of dots. The printer has a printer head with a matrix of pins (needles). Typical heads have a matrix of 7 rows and 9 columns. These pins produce a pattern of dots to form the individual characters



**A dot matrix printer, a daisy wheel and a daisy wheel printer.** These printers are relatively low in cost and print at speeds of 50- 500 characters per second. The programmer can also define the shape of characters for this printer. Therefore it is possible to print many special characters, characters in various sizes as well as charts and graphs on such printers. Dot matrix printers are very commonly used in most Computer systems.

**Daisy Wheel Printer :** These printers are also called as letter quality printers. These printers have a daisy wheel with a number of petals. A character is embossed on each wheel. There is a motor which spins the wheel at a fast rate. When the desired character is brought to the correct position, a hammer strikes the petal to produce the output. Thus these printers are impact printers. The letter quality of these printers is much superior as compared to the dot matrix printers. But they are slow and typically print in the range of 10- 50 characters per second.

**Line Printer:** Line printers are very fast printers which print at speed of 200-2500 lines per minute. These printers are impact printers and normally have 132 print positions per line. Different types of character set are available for different printers. Line printers are normally used in applications where large volumes of data are to be printed.

The two types of line printers are :

- **Drum printers :** This consists of a metallic cylinder. On the surface of this drum there are characters in bands. Each column or band on the drum contains all the characters. Opposite to each band there is a hammer located behind the

paper. The drum rotates at a fast rate. The hammer strikes the paper along with the inked ribbon and produces the output. One line is printed in each revolution of the printer.

• **Chain printers :** In the chain printers there is one print hammer for each print position on a line. There is a fast moving chain called the print chain. When this chain rotates, the print hammer and the inked ribbon strike the paper against the proper character on the chain.

**Non Impact Printer :** They use thermal, chemical, electrostatic and inkjet technologies for printing as against the hammer mechanism of impact printers. E.g. Laser printers, DeskJet printers.

**Ink Jet Printer:** Ink jet printer is a non impact printer. It prints characters by spraying ink from tiny nozzles onto the paper. A special type of ink which has a high iron content is used. This ink is charged electrically when it comes out of the nozzle. This ink is absorbed by the paper and dries instantly. The output of the ink jet printer is of a superior quality. Also it is possible to obtain colored output. A number of character styles and sizes are available. However, being a non impact printer it is not possible to prepare carbon copies with this printer.

**Laser Printers :** These printers are used where a very superior quality output is desired. The image is created on a photo sensitive drum ; with a laser beam. The laser is turned on and off when it moves back and forward across the drum. It leaves a negative charge on the drum to which a positively charged black toner powder sticks. When the paper rolls by the drum, the ink is transferred to the paper. Laser printers have a buffer memory to store entire pages and hence their speed is very fast. The biggest advantage of these printers is that no mechanical movement is involved, therefore they are noise less in operation. However there are comparatively expensive.

**Plotter : A plotter is an output device used in applications where printouts of graphs and drawings are required. Plotters are of two types :**

This plotter plots on a paper which is fixed on a rectangular flatbed table. One recording pen moves in the x direction and one in the y direction to plot on the paper. Color plotting is also possible by using pens of different colors.

**1) Drum Plotter:** In this plotter the paper on which the output is to be obtained, is placed over a drum. The drum rotates back and forth to produce motion. The pen is mounted horizontally across the drum and the horizontal motion of the pen is achieved with the help of the pen holder. The drum and the holder move simultaneously to produce output. Multi coloured printing is possible by changing the pens. The speed of plotters is very slow. Therefore normally the output is first sent to some secondary

2) storage device like a magnetic tape and then directed to the plotter.

## Video Display Terminal:



### Screen - Flat Panel Display & Monitor

**CRT:** An electron beam is moved across a phosphor coated screen to produce the image. The CRT can be monochrome or colored. This screen normally has 25 lines and 80 characters.

**Flat Panel Display :** The most common flat panel display is the Liquid Crystal Display (LCD). This does not have a picture tube. The other type of display is the gas plasma screen.

**The Video Display Terminal:** The most popular output device in direct access processing is the Video Display Terminal. These terminals display information instantaneously. The monitor and the keyboard together are called a terminal. The types of terminals are :

**Dumb Terminal:** This is a combination of a keyboard and monitor which can send or receive data, but cannot process the data.

**Smart Terminal:** A smart terminal has an inbuilt microprocessor. It can perform arithmetic, logic and control functions. They also have some memory capacity. So they can store the data before sending to the processor. They can also control the cursor movement.

**Intelligent Terminal:** This type of terminal also has an inbuilt microprocessor which can be programmed by the user. These terminals also have limited processing capability.

They can communicate with other terminals and processors.

**Computer Output Microfilm (COM):** This technology is used to record the Computer output as microscopic filmed images. Information is recorded on a roll of microfilm. A microfilm recorder displays the information onto a screen. An inbuilt camera then takes pictures of this information. A microfilm reader is used to view this information. COM devices are normally used in application where there are large volumes of data.

COM devices are much faster than the normal printers. Also since the size of

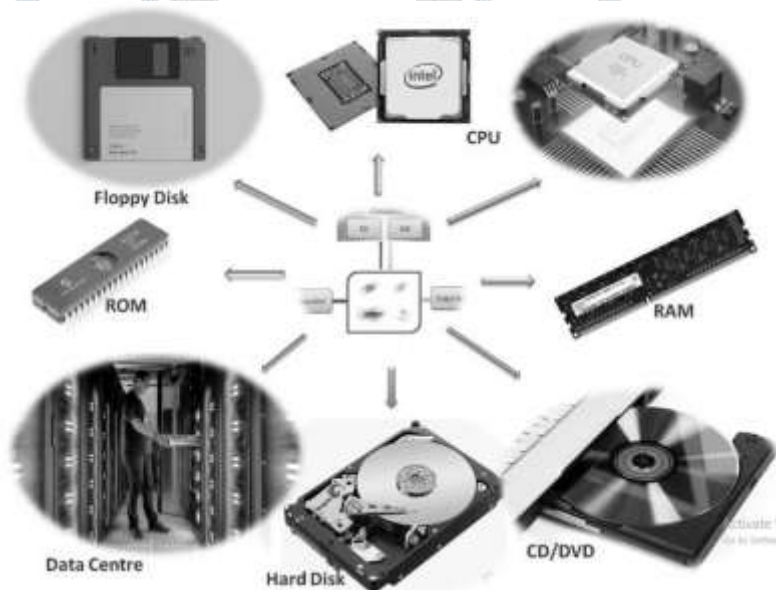


these films is very small the space required for storage is very less as compared to printed output. However since COM systems are highly sophisticated they are relatively expensive and are mainly used where there are high volumes of data.

## PRIMARY STORAGE AND SECONDARY STORAGE DEVICES

**Storage Unit:** A storage unit is that part of the Computer system which is used to store the data and instructions to be processed. There are two types of storage:

**Primary storage Secondary storage.**



Primary memory is also known as internal memory. This is a section of the CPU which holds program instructions, input data and intermediate results. Primary memory is also known as main memory.

Secondary storage is a memory that is stored external to the Computer. It is used mainly for permanent and long term storage of programs and data.

### Characteristics of Storage units:

The storage units have special characteristics which decide the :

a) Speed of operation of the Computer,

- b) Its efficiency,
- c) Cost and
- d) The amount of data which the Computer can store.

The storage unit of the Computer is graded according to the following characteristics (whether primary or secondary):

**Access time:** This is the time required to locate and retrieve a particular data from the storage unit. A fast access to data and programs always yields higher efficiency.

**Storage Capacity:** Storage capacity is the amount of data that can be stored by a storage unit. Large capacity of data storage is always desirable. As seen earlier, the smallest unit of data which the Computer understands is the bit. A group of 8 bits forms a byte. The storage capacity of a Computer system is defined in terms of bytes or words. One kilobyte (1 KB) is  $2^8$  or 1024 bytes, eg. 4 KB memory implies that it can store  $4 \times 1024$  bytes or characters.

Storage capacities of primary and secondary units are measured in Kilobytes, megabytes, gigabytes.

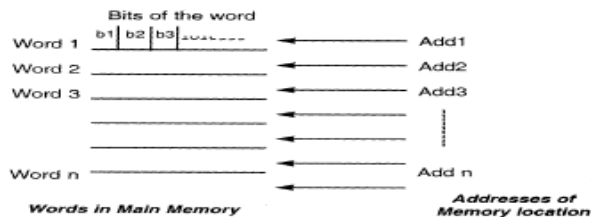
**Cost:** Low cost storage media are always desirable. Thus, storage units with faster access time, higher storage capacity and low costs are the ones which are considered to be of a superior nature.

**PRIMARY STORAGE-** Primary storage is characterized by faster access time, less storage capacity and higher costs as compared to secondary storage units. Primary storage or main memory is that part of the Computer system which stores the programs, data and intermediate results during the program execution.

A primary storage comes as an integral part of all Computer systems. It comprises of a number of small locations. Each location has a unique number assigned to it. This is called as the address of the location and it is used to identify the location. Each location has a capacity to store a fixed number of bits. The number of bits that a location can store is called as word length. Each location contains the same number of bits.

Normally, primary memory size ranges from a few kilobytes on small Computers to several thousand kilo bytes and megabytes on larger machines.

**RAM :** The primary storage is **volatile**. Whenever the power is turned off the data is lost. Primary storage is also called **Random Access Memory (RAM)**. RAM means it is possible to randomly select and use any storage location for storage and retrieval of data.



RAM is also called a read/write memory because data can both be read from and written onto these units. When the power is switched off the data stored in the RAM is lost.

**ROM:** ROM is Read Only Memory. In this type of memory the data is permanently stored. The information can only be read and new data cannot be written onto this memory. However the contents of the ROM are not lost even when the power is turned off

i.e. this memory is non-volatile. Such memories are also called as field stores, or permanent stores. There are a number of high level functions which are required to be performed by the Computer system. Such functions are performed by writing special programs called micro programs. Micro programs generally execute the low level machine functions. These programs are mainly used as a substitute for hardware. Such programs can be stored on ROMs and be used again and again. This results in reducing the hardware of the system. ROM helps to increase the efficiency of the CPU as it can perform specialized tasks. ROM comes in the form of a chip. Once information is stored on a ROM chip it cannot be changed or altered.

**PROM:** PROM is Programmable Read Only Memory. These are ROMs which can be programmed. A special PROM programmer is used to enter the program on the PROM. Once the chip has been programmed, information on the PROM cannot be altered. PROM is non volatile i.e. data is not lost when power is switched off.

**EPROM :** Another type of memory is the Erasable Programmable Read Only Memory. It is possible to erase the data which has been previously stored on an EPROM and write new data onto the chip.

**Cache Memory:** This is a very special type of high speed memory. This memory cannot be accessed by the user. The main function of this cache memory is to make the programs and data available to the CPU very fast. Access time of memory is generally very high as compared to the execution time of the GPU. Therefore a cache, which is a very small but fast memory, is used between the CPU and the main memory. This memory is also called a high speed buffer. A cache stores those segments of programs and data which are frequently needed. It makes available this data to the CPU at a very fast rate thus increasing the efficiency.

**Registers :** Registers are used to retain information temporarily. These are special memory units which are not actual parts of the main memory, but allow efficient movement of information between the various units of the Computer system. The registers receive information, hold it temporarily and make it available as and when required. A Computer uses a number of registers, where each register performs a specific function. Some of the common registers are :

**1.Memory Address Register (MAR):** The function of this register is to hold the address of the current or active memory location.

**2.Memory Buffer Register (MBR):** This register holds the contents of the address from which data is read or to which data has been written.

**3.Program Control Register :** It holds the address of the next instruction to be executed.

**Accumulator Register:** It holds the initial data, the intermediate results and the final data of the program under execution.

**4.Instruction Register:** This register holds the current instruction being executed. **Input/output Register:** The function of this register is to communicate with the Input/output devices.

The storage capacity of primary storage is limited. It is normally not sufficient to accommodate all the data. Therefore secondary storage medium is used to store large volumes of data. The cost of secondary memory is much less as compared to primary memory, however access time of primary memory is very fast. The data stored on secondary storage is transferred to the primary storage as and when required. Secondary storage is also called auxiliary memory. Secondary storage is used for storing copies of data and programs. This is a non volatile memory and is stored external to the Computer.



## SECONDARY STORAGE DEVICES

Information stored on secondary storage devices can be accessed in two ways:

**Sequential Access** **Direct Access**

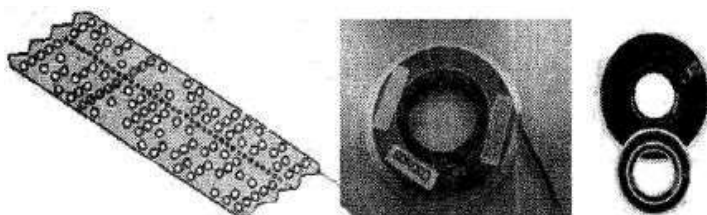


### Sequential Access Devices:

a) **Sequential or serial access** - In sequential access data can be accessed only in the sequence in which it has been stored. Typical sequential access storage device is the magnetic tape. These types of devices are useful in applications like pay slip printing where the data is to be accessed one after the other.

Types of Access Devices:

i) **Punch Paper Tape:** Punched paper tapes were the early devices of data storage. Data is coded onto a paper tape as a combination of punched holes across the width of the tape. Each row on the tape represents one character. The data has to be coded on the tapes using special coding systems. The punched paper tapes are a low cost storage medium and their storage capacity is unlimited. However, the paper is susceptible to wear and tear and mishandling. Nowadays, punched paper tapes are rarely being used wear and tear and mishandling. Nowadays, punched paper tapes are rarely being used.



*Sequential Access Devices: Paper tape, magnetic tapes*

**Magnetic Tape:** A magnetic tape is a ribbon of Mylar which is coated with a thin layer of iron oxide material on one side. This tape is stored on a cassette or cartridge, or reel. The iron oxide material can be magnetized and the data is recorded on the tape in the form of magnetized and non-magnetized spots. A magnetic tape drive is used to read data from the tape or write information to the tape. The tape drive has a read/write head to access or store information respectively.

Magnetic tape is a read write device where the data can be written as well as erased and new data recorded on the same area. The tape is divided into vertical columns and horizontal rows. The columns are called frames and the rows are called tracks. Special Computer codes are used for recording data on the tape. One character is recorded on each frame. Most modern tapes have 9 tracks, and use the EBCDIC code for data representation. The actual number of characters that can be stored on an inch of a tape is known as the density of the tape. The storage capacity of magnetic tapes is very large. This capacity is measured in terms of bytes per inch. Most common tape densities are 800 bpi, 1600 bpi. Nowadays tapes with much higher densities of the order of 6000 bpi are also available.

The records in a tape can be of any size. Also all the records in a given file need not be same in length. Thus the tapes can store fixed length and variable length records. In between two consecutive records the Computer automatically keeps a fraction of the tape blank. This blank space is called the Interlock gap. While reading from the tape, the drive takes a finite amount of time to physically stop when the end of the record is reached. Therefore this interlock gap is created to avoid loss of any data of the subsequent record that may have been stored while the drive mechanism comes to a halt.

### **Advantages of Magnetic Tapes:**

- High data density and virtually unlimited storage
- Low in cost
- Easy to handle and portable from one Computer to another.

### **Limitations are:**

- Support only Sequential access
- Tapes are sensitive to dust; humidity and temperature, hence require proper storage facilities.

### **Direct Access Storage Devices**

In random access the data at any location on the storage unit can be accessed directly without having to follow the sequence in which it has been stored. Typical devices that support direct access are the magnetic disk and magnetic drum.

**Magnetic Disk:** A magnetic disk is a thin metallic/Mylar platter circular in shape. It is coated on both sides with magnetic material. A number of these disks are mounted on a disk pack, on a central shaft. Thus all the disks in the disk pack move at the same speed, simultaneously in the same direction. These disks are also called as hard disks or fixed disks. Hard disk can be permanently installed in the drive or can also be in the form of a removable cartridge. The data are recorded as magnetic spots on the coating of the disk. The presence of a magnetic spot represents 1 and the absence represents a 0. The standard binary code, 8-bit EBCDIC is used for recording data on the disk. Information is stored on both the surfaces of the disk. Each disk is divided into a number of concentric circles called tracks. All the corresponding tracks in all the surfaces are together called a cylinder. Information is not stored on the outer surface of the upper plate and the lower surface of the bottom plate. In some of the disks the outer tracks contain more data bits since the outer circumference is greater. However, in most of the disks each track stores the same number of characters. This means that the inner tracks, with a smaller circumference are more densely packed than the outer tracks.

Magnetic disk is a random or direct access storage device. The data is read from or written onto the disk surface with the use of read/write heads. These heads are of flying type. They do not come in actual contact with the surface of the disk.

There are two types of disk systems:

1. **Moving head System:** This consists of one read/write head for each disk surface. This head is mounted on an access arm which moves in and out. Thus each head moves horizontally across the surface of the disk and can access each track individually.

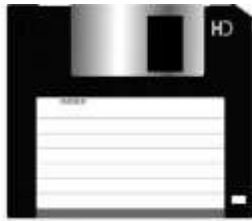
2. **Fixed head System:** In this system the access arm does not move. A large number of read/write heads one for each track are distributed over the surface of the disk. In this system the data access becomes very fast. However, extra space is needed to accommodate all the heads. The time required to access the data stored on the disk depends upon the following factors:

- a) The seek time - the time required for positioning the read/write head over the appropriate track
- b) The latency time - the time required to spin the required data under the head. This time is also called the search time.

**Floppy Disks :** Floppy disks are made up of flexible Mylar coated with iron oxide. This disk is enclosed in a square plastic jacket to protect the surface of the disk from dust. A floppy disk is to be inserted in the floppy disk drive of the Computer system to read or write information. The read/write head of the drive makes a direct contact with the floppy disk.

While accessing or storing data, Floppydisks come in various sizes

- 8 inch floppy disks
- 5 1/4 inch floppy disks
- 3 1/2 inch floppy disks



A floppy disk can be single sided or double sided i.e data can be written on a Fig. 3.4 Floppy disks: 5 1/4 inch and 3 1/2 inch single side or on both the sides. A double sided disk drive is required to read data from

a double sided disk. This disk drive has two heads, one for each side. A single sided drive has only one head. Floppy disks can also be single side double density and double side double density depending upon their storage capacity. Floppy disks are a very popular storage medium since they are small in size, relatively cheap and can store data on line. Floppy disks are also very portable. They can be carried from one place to another very easily.

**a) Winchester Disk:** In a Winchester, the disks are permanently enclosed in a sealed container. The disks are coated with a special lubricant to reduce friction with the read/write head. This technology allows for an increase in the number of tracks on the disk, and higher storage density. Winchester disks are fast and highly reliable. They are used extensively in micro Computers.

**b) Magnetic Drum:** This is a cylinder whose outer surface is coated with a thin layer of magnetic material. A motor rotates on the cylinder at a constant speed. Data is recorded on the tracks of the drum as magnetized spots. A set of stationary read/write heads are positioned slightly away from the surface of the drum. Data is read from and written onto this drum with the help of these heads. The drum rotates at relatively fast speeds of the order of a several thousand rotations per minute. Magnetic drums have faster data transfer rates as compared to disks. However their storage capacity is limited. Magnetic drums are rarely used today.



**Optical Devices :** An optical disk is made up of a rotating disk which is coated with a thin reflective metal. To record data on the optical disk, a laser beam is focused on the surface of the spinning disk. The laser beam is turned



on and off at varying rates! Due to this, tiny holes (pits) are burnt into the metal coating along the tracks. When data stored on the optical disk is to be read, a less powerful laser beam is focused on the disk surface. The storage capacity of these devices is tremendous; the Optical disk access time is relatively fast. The biggest drawback of the optical disk is that it is a permanent storage device. data once written cannot be erased. Therefore it is a read only storage medium. A typical example of the optical disk is the CD-ROM.

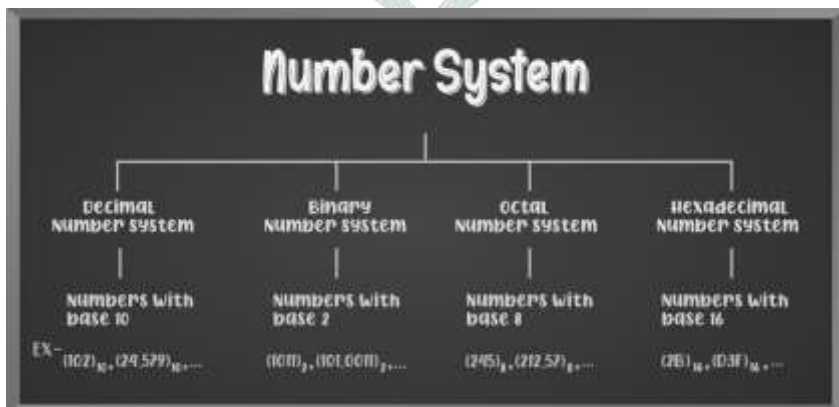
**Optical Card :** The optical card has an optical laser encoded strip which can store approximately 2 megabytes of data. These cards are the size of a credit card. Optical cards find use only in specific areas like storing credit records or medical histories of people.

**Optical Tape :** Optical tapes are similar to magnetic tapes in appearance. However optical laser techniques are used to write data on the tapes. Like optical disks optical tapes too are read only storage devices.

\*\*\*\*\*

## NUMBER SYSTEMS

We saw in the previous chapter that a Computer stores data internally in a format that is not easily readable by human beings. This is the reason why input and output (I/O) interfaces are required. Every Computer stores numbers, letters, and other special characters in coded form. Before going into the details of these codes, it is essential to have basic understanding of number system. Hence, this chapter familiarizes you with the fundamentals of number system. It also introduces some commonly used number system by Computer professionals and relationship among them. Number systems are two types – non-positional and positional.



**Non Positional Number System-** In early days, human beings counted on fingers. When counting beyond ten fingers, they used stones, pebbles, or sticks to indicate values. This method of a counting uses an additive approach or non-positional number system. In this system, we have symbols such as I for 1, II for 2, III for 3, IIII for 4, IIIII for 5, etc. Each symbol represents the same value regardless of its position in a number, and to find the value of a number, one has to count the number of symbols present in the number. Since it is very difficult to perform arithmetic with such a number system, positional number system was developed.

**Positional Number System:** In a positional number system, there are only a few symbols called digits. These symbols represent different values, depending on the position they occupy in a number. The value of each digit in such a number is determined by three considerations.

The digit itself,

The position of the digit in the number, and

The base of the number system (where base is defined as the total number of digits available in the number system).

In our day-to-day life, we use decimal number system. In this system, base is equal to 10 because there are altogether ten symbols or digit (0,1,2,3,4,5,6,7,8, and 9).

You know that in decimal number system. Successive positions to the left of the decimal point represent units, tens, hundreds, thousands, etc. However, notice that each position represents a specific power of the base (10). For example, decimal number 2586 (written as 2586) consists of digit 6 in units position, 8 in tens position, 5 in hundreds position, and 2 in thousands position, and its value can be written as:

$$(2 \times 10^3) + (5 \times 10^2) + (8 \times 10^1) + (6 \times 10^0) = 2000 + 500 + 80 + 6 \\ = 2586$$

Observe that the same digit signifies different values, depending on the position it occupies in the number. For example,

In 258610 the digit 6 signifies  $6 \times 10^0 = 6$

In 256810 the digit 6 signifies  $6 \times 10^1 = 60$

In 265810 the digit 6 signifies  $6 \times 10^2 = 600$

In 625810 the digit 6 signifies  $6 \times 10^3 = 6000$

Hence, we can represent any number by using the available digits and arranging them in various positions.

The principles that apply to decimal number system, also apply to any other positional number system. It is important to keep track of only the base of the number system in which we are working.

The value of the base in all positional number systems suggests the following characteristics:

- 1) The value of the base determines the total number of different symbols or digits available in the number system. The first of these choices is always zero.
- 2) The maximum value of a single digit is always equal to one less than the value of the base.

**Binary Number System:** Binary number system is like decimal number system, except that the base is 2, instead of 10. We can use only two symbols or digits (0 and 1) in this number system. Note that the largest single digit is 1 (one less than the base). Each position in binary number represents a power of the base<sup>2</sup> (2). Hence, in this system, the rightmost position is units (2<sup>0</sup>) position, the second position from the right is 2's (2<sup>1</sup>) position, and proceeding in this way, we have 4's (2<sup>2</sup>) position, 8's (2<sup>3</sup>) position, 16's (2<sup>4</sup>) position, and so on. Therefore, decimal equivalent of binary number 10101 (written as 10101<sub>2</sub>) is :

$$(1 \times 2^4) + (0 \times 2^3) + (1 \times 2^2) + (0 \times 2^1) + (1 \times 2^0) = 16 + 0 + 4 + 0 + 1 = 21$$

In order to be specific about which system we are referring to, it is a common practice to indicate the base as a subscript. Hence, we write "10101<sub>2</sub> = 21<sub>10</sub>"

The short form of "binary digit" is bit. Hence, "bit" in Computer terminology means either a 0 or 1.

An n-bit number is binary number consisting of 'n' bits. Below table lists all 3-bits numbers along with number can have not one of the 8 values in range 0 to 7. In fact, any decimal number in the range 0 to 2<sup>n</sup>-1 can be represented in binary form as an n-bit number.

Every Computer stores numbers, letters, and other special characters in binary form. There are several occasions when Computer professionals need to know the raw data contained in a Computer's memory. A commonly used way to do this is to print memory contents on a printer. This printout is called a memory dump. Memory dumps, which are in binary numbers, would have many pages of 0s and 1s. Working with these numbers would be very difficult and error prone for Computer professionals. Hence, two number systems – octal and hexadecimal, are often used as shortcut notations for binary. These number systems and their relationship with binary number system are explained below.

**Octal Number System:** In octal number system, the base is 8. Hence, there are only eight symbols or digits: 0,1,2,3,4,5,6, and 7 (8 and 9 do not exist in this system). The largest single digit is 7 (one less than the base 8). Each position in an octal number represents a power of the base (8). Therefore,

decimal equivalent of octal number 2057 (written as 2057) is:

$$(2 \times 8^3) + (0 \times 8^2) + (5 \times 8^1) + (7 \times 8^0) = 1024 + 0 + 40 + 7 = 1071$$

Observe that since there are only 8 digits in octal number system, 3 bits ( $2^3=8$ ) are sufficient to represent any number in binary (see the above table-4.1)

**Hexadecimal Number System:** In hexadecimal number system, the base is 16. Hence, there are 16 symbols or digits. The first 10 digits are the same digits of decimal number system – 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. The remaining six digits are denoted by the symbols A, B, C, D, E, and F, representing decimal values 10, 11, 12, 13, 14 and 15, respectively. Hence, the largest single digit is F or 15 (one less than the base 16). Each position in hexadecimal number system represents a power of the base (16). Therefore, decimal equivalent of hexadecimal number 1AF is

$$1 \times 16^2 + (A \times 16^1) + (F \times 16^0) = (1 \times 256) + (10 \times 16) + (15 \times 1) \\ = 256 + 160 + 15 = 431$$

Hence,  $1AF_{16} = 431_{10}$

Observe that since there are only 16 digits in hexadecimal number system, 4 bits ( $2^4=16$ ) are sufficient to represent any hexadecimal number in binary.

## CONVERSION

Numbers expressed in decimal number system are much more meaningful to us, than are numbers expressed in any other number system. This is because we have been using decimal numbers in our day-to-day life, right from childhood. However, we can represent any number system in any other number system. Because the input and final output values are to be in decimal, Computer professionals are often required to convert numbers in other number system to decimal and vice-versa. Many methods can be used to convert numbers from one base to another. A method of converting from another base to decimal, and a method of converting from decimal to another base are described below.

### Converting from another Base to Decimal

The following steps are used to convert a number in any other base to a base 10 (decimal) number.

Step 1 : Determine the column (positional) value of each digit (this depends on the position of the digit and the base of the number system).

Step 2 : Multiply the obtained column values (in Step 1) by the digits in the corresponding columns.

Step 3 : Sum up the products calculated in Step 2. The total is the equivalent value in decimal.

**Example**  $1100_2 = ?_{10}$

Solution:

Step 1: Determine Column values



Column Number(from right)	Column Value
1	$2^0 = 1$
2	$2^1 = 2$
3	$2^2 = 4$
4	$2^3 = 8$
5	$2^4 = 16$

**Step 2:** Multiply the column values by the corresponding column digits

16	8	4	2	1
x1	x1	x0	x0	x1
= 16	= 8	= 0	= 0	= 1

**Step 3:** Sum up the products  $16 + 8 + 0 + 0 + 1 = 25$

Hence,  $110012 = 2510$

**Example**

$4706_2 = ?_{10}$

**Solution:**

Step 1: Determine Column values

Column Number(from right)	Column Value
1	$8^0 = 1$
2	$8^1 = 8$
3	$8^2 = 64$
4	$8^3 = 512$

Step 2: Multiply the column values By the corresponding column Digits

$512 \quad 64 \quad 8 \quad 1$

$x4 \quad 2048$

$x7 \quad x0 \quad x6$

$448 \quad 0$

Step 3: Sum up the products  $2048 + 448 + 0 + 6 = 2502$

Hence,  $4706_8 = 2502_{10}$

**Example**

$1AC16 = ?_{10}$

**Solution :**

$1AC16 = 1 \times 16^2 + A \times 16^1 + C \times 16^0$

$= 1 \times 256 + 10 \times 16 + 12 \times 1$

$= 256 + 160 + 12$

$= 42810$

**Example**

$40527 = ?_{10}$

Solution :

$$\begin{aligned}
 405216 &= 4 \times 73 + 0 \times 72 + 5 \times 71 + 2 \times 70 \\
 &= 4 \times 343 + 0 \times 49 + 5 \times 7 + 2 \times 1 \\
 &= 1372 + 0 + 35 + 2 \\
 &= 140910
 \end{aligned}$$

**Example**

$$40526 = ?_{10}$$

**Example**

$$40526 = ?_{10}$$

**Solution :**

$$\begin{aligned}
 40526 &= 4 \times 6_3 + 0 \times 6_2 + 5 \times 6_1 + 2 \times 6_0 \\
 &= 4 \times 216 + 0 \times 36 + 5 \times 6 + 2 \times 1 \\
 &= 864 + 0 + 30 + 2 \\
 &= 89610
 \end{aligned}$$

Comparing this result with the obtained in Example 4.4, we find that although the digits (4052) are the same for both the numbers, their decimal equivalents are different. This is because the number in Example 4.4 is represented in base 7 number system, whereas the number in Example is represented in base 6 number system.

Solution :

$$\begin{aligned}
 40526 &= 4 \times 6_3 + 0 \times 6_2 + 5 \times 6_1 + 2 \times 6_0 \\
 &= 4 \times 216 + 0 \times 36 + 5 \times 6 + 2 \times 1 \\
 &= 864 + 0 + 30 + 2 \\
 &= 89610
 \end{aligned}$$

Compare the result with the result obtained .

**Converting from Decimal to Another Base (Division- Remainder Technique)** The Following steps are used to convert a have 10 (decimal) number to a number in another base.

**Step 1 :** Divide the decimal number by the value of the new base.**Step 2 :** Record the remainder from Step 1 as the rightmost digit (least significant digit) of the new base number.

**Step 3 :** Divide the quotient of the previous division by the newbase.

**Step 4:** Record the remainder from Step 3 as the next digit (to the left) of the new number. Repeat Steps 3 and 4, recording remainders from right to left, until the quotient becomes zero in Step 3. Note that the last remainder, thus obtained, will be most significant digit of the new base number.

**Example 4.9.**

$$42_{10} = ?_2$$

Solution :

2	42	Remainders
	21	0
	10	1
	5	0
	2	1
	1	0
	0	1

Hence,  $42_{10} = 101010_2$

**Example 4.10.**

$$952_{10} = ?_8$$

Solution :

8	952	Remainders
	119	0
	14	7
	1	6
	0	1

Hence,  $952_{10} = 1670_8$

**Example 4.11.**

$$42_{10} = ?_{16}$$

Solution : **Remainders in hexadecimal**

16	428	
	26	12 = C
	1	10 = A
	0	1 = 1

Hence,  $428_{10} = 1AC_{16}$

Compare the result with the result obtained in Example 4.3.

**Example 4.12.**

$$100_{10} = ?_5$$

Solution :

5	100	Remainders
	20	0
	4	7
	0	6

Hence,  $100_{10} = 400_5$

**Example 4.13.**

$100_{10} = ?_4$

**Solution :**

4	100	Remainders
	25	0
	6	1
	1	0
	0	1

Hence,  $100_{10} = 1210_4$ 

Compare the result with the result obtained in Example 4.12.

Hence,  $171510 = BAB12$ **Converting from a Base Other than 10 to Another Base Other Than 10**

The following steps are used to convert a number in a base other than 10, to a number in another base than 10:

**Step 1 :** Convert the original number to a base 10 (decimal) number.

**Example 4.15.**

$545_6 = ?_4$

**Solution :**

Step 1: Convert from base 6 to base 10

$$\begin{aligned}
 545 &= 5 \times 6^2 + 4 \times 6^1 + 5 \times 6^0 \\
 &= 5 \times 36 + 4 \times 6 + 5 \times 1 \\
 &= 180 + 24 + 5 \\
 &= 209_{10}
 \end{aligned}$$

Step 2: Convert  $209_{10}$  to base 4

4	209	Remainders
	52	1
	13	0
	3	1
	0	3

$209_{10} = 3101_4$

Therefore,  $545_6 = 209_{10} = 3101_4$

Hence,  $546_6 = 3101_4$



**Step 2 :** Convert the decimal number obtained in Step 1 to the newbase number.

**Example 4.16.**

$$101110_2 = ?_8$$

**Solution :**

Step 1: Convert  $101110_2$  to base 10

$$\begin{aligned} 101110_2 &= 1 \times 2^5 + 0 \times 2^4 + 1 \times 2^3 + \\ &= 1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0 \\ &= 32 + 0 + 8 + 4 + 2 + 0 \\ &= 46_{10} \end{aligned}$$

Step 2 : Convert  $46_{10}$  to base 8

8	46	Remainders
	5	6
	0	5
	$46_{10}$	$= 56_8$

$$\text{Therefore, } 101110_2 = 46_{10} = 56_8$$

$$\text{Hence, } 101110_2 = 56_8$$

**Example 4.17.**

$$11010011_2 = ?_{16}$$

**Solution:**

Step 1 : Convert  $11010011_2$  to base 10

$$\begin{aligned} 11010011_2 &= 1 \times 2^7 + 1 \times 2^6 + 0 \times 2^5 + 1 \times 2^4 + 0 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0 \\ &= 1 \times 128 + 1 \times 64 + 0 \times 32 + 1 \times 16 + 0 \times 8 + 0 \times 4 + 1 \times 2 + 1 \times 1 \\ &= 128 + 64 + 0 + 16 + 0 + 0 + 2 + 1 \\ &= 211_{10} \end{aligned}$$

Step 2 : Convert  $211_{10}$  to base 16

16	211	Remainders
	13	$3 = 3$ in Hexadecimal
	0	$13 = D$ in Hexadecimal

$$\text{Therefore, } 11010011_2 = 211_{10} = D3_{16}$$

$$\text{Hence, } 11010011_2 = D3_{16}$$

### Shortcut Method for Binary to Octal Conversion

The following steps are used in this method:

**Step1 :** Divide the binary digits into groups of three ( starting from the right).

**Step 2 :** Convert each group of three binary digits to one octal digit. Since there are only 8 digits (0 to 7) in octal number system, 3 bits ( $2^3 = 8$ ) are sufficient to represent any octal number in binary. Moreover, since decimal digits 0 to 7 are equal to the octal digits 0 to 7, we use binary to decimal conversion method in this step.

**Example 4.18.**

$$101110_2 = ?_8$$

**Solution:**

Step 1 : Divide the binary digits into groups of 3, starting from the right (LSD)

$$\underline{101} \quad \underline{110}$$

Step 2 : Convert each group into one digit of octal (use binary-to-decimal Conversion method).

$$101_2 = 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$$

$$= 4 + 0 + 1$$

$$= 5_8$$

$$110_2 = 1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0$$

$$= 4 + 0 + 1$$

$$= 6_8$$

$$\text{Hence, } 101110_2 = 56_8$$

Compare the result with the result obtained in Example 4.16.

**Example 4.19.**

$$1101010_2 = ?_8$$

**Solution:**

$$1101010_2 = \underline{001} \quad \underline{101} \quad \underline{010}$$

(Group of 3 digits from the right)

$$= 152_8 \text{ (Convert each group to an octal digit)}$$

$$\text{Hence, } 1101010_2 = 152_8$$

## Short Method for Octal to Binary Conversion

The following steps are used in this method :

**Step 1 :** Convert each octal digit to a 3 digit binary number (the octal digits may be treated as a decimal numbers for this conversion).

**Step 2 :** Combine all the resulting binary groups (of 3 digits each) into a single binary number.

**Example 4.20.**

$$562_8 = ?_2$$

**Solution :**

Step 1: Convert each Octal Digit to 3 binary digits

$$5_8 = 101_2$$

$$6_8 = 110_2$$

$$2_8 = 010_2$$

$$\text{Hence, } 562_8 = 101110010_2$$

**Example 4.21.**

$$6751_8 = ?_2$$

$$\text{Solution : } 6751_8 = \underline{110} \quad \underline{111} \quad \underline{101} \quad \underline{001}$$

$$\quad \quad \quad \underline{6} \quad \underline{7} \quad \underline{5} \quad \underline{1}$$

$$\text{Hence, } 6751_8 = 110111101001_2$$

## Shortcut Method for Binary to Hexadecimal Conversion

The following steps are used in this method:

Step 1 : Divide the binary digits into groups of four (starting from the right).

Step 2 : Convert each group of four binary digits to one hexadecimal digit.

Remember that hexadecimal digits 0 to 9 are equal to decimal digits 0 to 9 and hexadecimal digits A to F are equal to decimal values 10 to 15. Hence, for this step, we use binary to decimal conversion procedure and represent decimal values 10 to 15 as hexadecimal A to F

### Example 4.22.

$$11010011_2 = ?_{16}$$

Solution:

Step 1 : Divide the binary digits into groups of 4, starting from the right (LSD) 1101 0011

Step 2 : Convert each group into one digit of octal (use binary-to-decimal Conversion method).

$$1101_2 = 1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$$

$$= 8 + 4 + 0 + 1$$

$$= 13_{10}$$

$$= D_{16}$$

$$0011_2 = 0 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$$

$$= 0 + 0 + 2 + 1$$

$$= 3_{10}$$

$$\text{Hence, } 11010011_2 = D3_{16}$$

Compare the result with the result of Example 4.17.

### Example 4.23.

$$10110101100_2 = ?_{16}$$

Solution:

$$10110101100_2 = \underline{0101} \quad \underline{1010} \quad \underline{1100}$$

(Group 4 digits from the right)

$$= 5AC \text{ (Convert each group to a hexadecimal digit)}$$

$$\text{Hence, } 10110101100_2 = 5AC_{16}$$

## Shortcut Method for Hexadecimal to Binary Conversion

The following steps are used in this method:

Step 1 : Convert decimal equivalent of each hexadecimal digit to 4 binary digits.

Step 2 : Combine all resulting binary groups (of 4 digits each) into a single binary number.

**Example :**

$$2AB_{16} = ?_2$$

Solution :

Step 1: Convert decimal equivalent of Each hexadecimal digit to 4 binary digits

$$5_{16} = 2_{10} = 0010_2$$

$$A_{16} = 10_{10} = 1010_2$$

$$B_{16} = 11_{10} = 1011_2$$

Step 2 : Combine the binary groups.

$$1AB_{16} = \begin{array}{ccc} \underline{0010} & \underline{1010} & \underline{1011} \\ 2 & A & B \end{array}$$

$$\text{Hence, } 2AB_{16} = 001010101011_2$$

**Example 4.25.**

$$ABC_{16} = ?_2$$

Solution :

$$\begin{aligned} ABC_{16} &= \begin{array}{ccc} \underline{1010} & \underline{1011} & \underline{1100} \\ A & B & C \end{array} \\ &= 101010111100_2 \end{aligned}$$

$$\text{Hence, } ABC_{16} = 101010111100_2$$

We have summarized the relationship among decimal, hexadecimal, binary, and octal number system. Note that the maximum value for a

single digit of octal (7) is equal to the maximum value of three digits of binary. The value range of one digit of octal duplicated the value range of three digits of binary. If we substitute octal digits for binary digits, the substitution is on a one-to-three basis. Hence, Computer that print octal numbers instead of binary, while taking memory dump, save one-third of printing space and time. Similarly, note that the maximum value of one digit in hexadecimal is equal to the maximum value of the four digits in binary. Hence, the value range of one digit of hexadecimal is equivalent to the value range of four digits of binary. Therefore, hexadecimal shortcut notation is one-to-four reduction in space and time required for memory dump.



Decimal	Hexadecimal	Binary	Octal
0	0	0	0
1	1	1	1
2	2	10	2
3	3	11	3
4	4	100	4
5	5	101	5
6	6	110	6
7	7	1000	7
8	8	1001	10
9	9	1010	11
10	A	1011	12
11	B	1100	13
12	C	1101	14
13	D	1101	15
14	E	1110	16
15	F	1111	17
16	10	10000	20

Relationship among Decimal, Hexadecimal, Binary, and Octal number systems.

\*\*\*\*\*

## BOOLEAN ALGEBRA AND LOGIC CIRCUITS

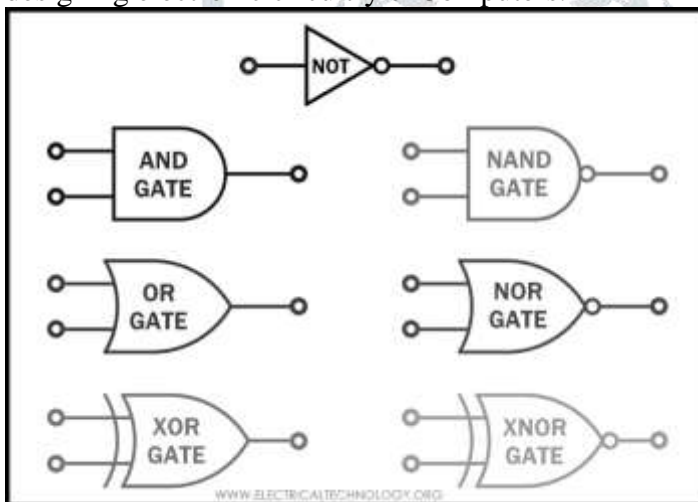
### INTRODUCTION

Boolean algebra deals with binary number system. It is very useful in designing logic circuits used in processors of Computer system. In this chapter, you will learn about this algebra and elementary logic gates used to build up logic circuits of different types for performing necessary arithmetic operations. These logic gates are the building blocks of all logic circuits in a Computer. You will also learn how to use Boolean algebra for designing simple logic circuits used frequently by arithmetic logic unit and almost all Computers.

## BOOLEAN ALGEBRA

In mid 1800, George Boole (1815-1864), an English mathematician, developed algebra for simplifying the representation and manipulation of propositional logic. It is known a Boolean algebra after its developer's name. Later, in the year 1938. Claude E. Shannon proposed the use of Boolean algebra in the design of relay switching circuits. The basic techniques described Shannon were adopted almost universally for the design and analysis of switching circuits. Owing to analogous relationship between the action of relays and modern electronic circuits, the same techniques are still used in the design of modern Computers.

Boolean algebra provides an economical and straightforward approach to the design of relay and other types of switching circuits. Just as an ordinary algebraic expression is simplified by using basic theorems, the expression describing a given switching circuit network is also simplified by using Boolean algebra. Today, Boolean algebra is used extensively in designing electronic circuitry of Computers.



### *Fundamental concepts of Boolean Algebra*

Boolean algebra is based on the fundamental concepts described below.

### *Use of Binary Digits*

In a normal algebraic expression, a variable can take any numerical value. For example, in the expression  $3A + 7B = C$ , each of the variables A, B, and C may have from the entire field of real numbers. Since, Boolean algebra deals with binary number system, the variables used in Boolean equations may have only possible values (0 or 1). For example, in the Boolean equation  $A + B = C$ , each of the variables A, B, and C may have only the values 0 or 1.

### Logical Addition

The symbol '+' is used for logical addition operator. It is also known as 'OR' operator. We can define the + symbol (OR operator) by listing all possible combinations of A and B with the resulting value of C for each combination in the equation  $A + B = C$ . Since the variables A and B can have only two possible values (0 or 1). Only four ( $2^2$ ) combinations of inputs are possible (see the table 5.1). The resulting output values for each of the four input combinations are given in the table. Such a table is known as a truth table. Hence, the below figure is the truth table for logical OR operator.

Inputs		Output
A	B	C
0	0	0
0	1	1
1	0	1
1	1	1

Truth table logical OR (+) operator.

Observe that the result is 0 only when both input variables are 0. It is 1 when any one or both of the input variables are 1. This is the reason why the + symbol does not have the "normal" arithmetic meaning, but is a logical addition operator. This concept of logical addition may be extended to any number of variables. For example, in the equation  $A + B + C + D = E$ , even if A, B, C and D, all had the value of 1, the sum of the values (the result E) would be 1 only. The equation  $A + B = C$  is normally read as "A or B equals C".

### Logical Multiplication

The symbol '.' is used for logical multiplication operator. It is also known as 'AND' operator. We can define the symbol (AND operator) by listing all possible combinations of A and B with the resulting value of C for each combination in the equation.  $A . B =$

C. table 5.2 shows the truth table for logical AND operator. Observe that the result C is equal to 1 only when both input variables A and B are 1, otherwise it is 0. The equation  $A . B = C$  is normally read as "A and B equals C".

Inputs		Output
A	B	$A \cdot B$
0	0	0
0	1	0
1	0	0
1	1	1

Truth table for logical AND ( $\cdot$ ) operator.

**Complementation :** Truth table for logical AND ( $\cdot$ ) operator. OR and AND are binary operations because they operate on two variables. Complementation is a unary operation defined on a single variable. The symbol ‘ $\neg$ ’ is used for complementation operator. It is also known as ‘NOT’ operator. Hence, we write  $\neg A$  meaning “complement” of A”, or  $(A + B)$  meaning of  $A + B$ .” Complementation of a variable is the reverse of its value. Hence, if  $A = 0$ , the  $\neg A = 1$  and if  $A = 1$ . Then  $\neg A = 0$ . Below table 5.3 shows the truth table for logical NOT ( $\neg$ ) operator.  $\neg A$  is read as “complement of A” or “not of A”.

Input	Output
A	$\neg A$
0	1
1	0

Truth table for logical NOT ( $\neg$ ) operator.

### Operator Precedence

Does  $A + B \cdot C$  mean  $(A + B) \cdot C$  or  $A + (B \cdot C)$ ? The two generate different values for  $A = 1$ ,  $B = 0$ , and  $C = 0$  because we have  $(1 + 0) \cdot 0 = 0$  and  $1 + (0 \cdot 0) = 1$ . Hence, operator precedence rules are needed to correctly evaluate Boolean expressions. The precedence rules for Boolean operators are as follows:

The expression is scanned from left to right.  
Expression enclosed within parentheses are evaluated first. All complement (NOT) operations are performed next.

All ‘ $\neg$ ’ (AND) operations are performed after that. Finally, all ‘ $+$ ’ (OR) operations are performed in the end.

According to these rules,  $A + B \cdot C$  should be evaluated as  $A + (B \cdot C)$ . Similarly, for the expression  $\neg A \cdot B$ , complement of A and B are both evaluated first and the results are then AND ed. Again, for the expression  $\neg(A + B)$ , the expression inside the parenthesis  $(A + B)$  is evaluated first and the result is then complemented.



## Principle of Duality

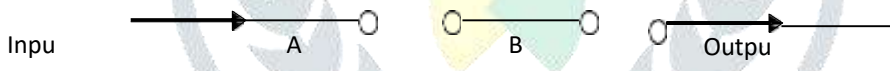
When value and operations can be paired up in a way that leaves everything important unchanged when all pairs are switched simultaneously, we call the member of each pair dual to each other. Thus 0 and 1 are dual,  $\wedge$  and  $\vee$  are dual. The duality principle asserts that Boolean

Algebra is unchanged, when all dual pairs are interchanged.

Dual of one expression is obtained by replacing AND ( $\cdot$ ) with OR ( $+$ ) and OR with AND together with replacement of 1 with 0 and 0 with 1.

**Logic Gates** – LG operations within a Computer are carried out by means of combinations of signals passing through standard blocks of built-in circuits known as logic gates. In other words, a logic gate is an electronic circuit that operates on one or more input signals to produce standard output signals. These logic gates are the building blocks of all electronic circuits in a Computer. Combinations of multiple logic gates of different types are often used to build electronic circuits in Computers. Out of many types of logic gates available, we shall study here only some of the most important ones. These are sufficient to introduce the concept of electronic logic circuit with the use of logic gates.

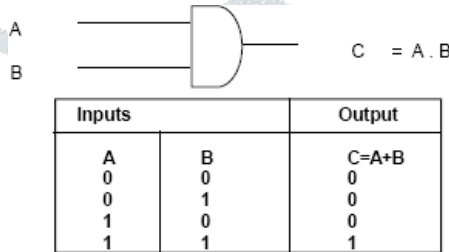
**AND Gate** : *An AND gate is the physical realization of logical multiplication (AND) operation. It is an electronic circuit that generates an output signal of 1, only if all input signals are also 1.*



### ***Two or more switches connected in series behave as an AND gate***

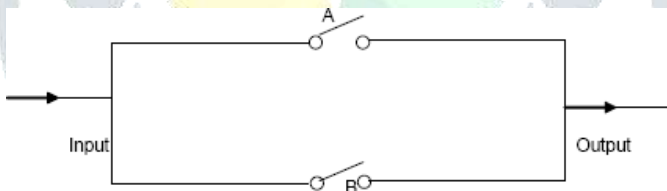
Behavior of a logic gate (the state of its output signal, depending on various combinations of input signals) is represented conveniently by means of a truth table. Below Figure shows the truth table and block diagram symbol for an AND gate for two input signals. Since there are only two inputs (A and B), only four ( $2^2$ ) combinations of inputs are possible. Notice that the output is 1 only when both inputs are in 1 state, otherwise it is 0.

#### ***Block diagram symbol and truth table 5.4 for an AND gate.***



**OR Gate-** An OR gate is the physical realization of logical addition (OR) operation. It is an electronic circuit that generates an output signal of 1, if any of the input signals is also 1.

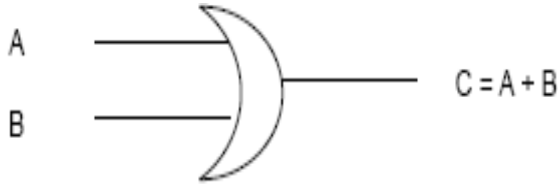
Two or more switches connected in parallel behave as an OR gate. Observe from the below Figure that the input current will reach the output point when any one of the two switches (A or B) are in



ON (1) state. There will be no output only when both the switches are in OFF (0) state.

***that demonstrates Two or more switches connected in parallel behave as an OR gate***

Shows the truth table and block diagram symbol for an OR gate fortwo input signals. Notice that the output is 1, when any of the inputsignals is n 1. It is 0 only when both inputs are 0.



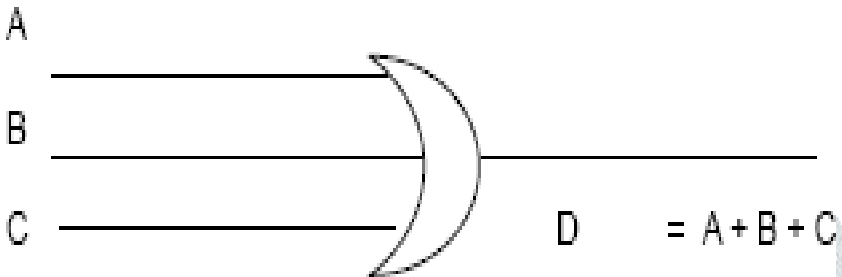
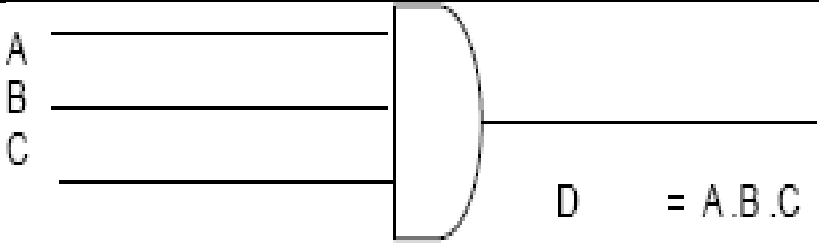
Block diagram symbol and truth table for an OR gate.

Inputs		Output
A	B	$C = A + B$
0	0	0
0	1	1
1	0	1
1	1	1

### ***Block Diagram and Truth Table for an OR Gate***

Just as + and. Operations could be extended to several variables by using associative law, AND gates and OR gates can also have more than two inputs. Above shows three-input AND a ndOR gates and the table of all input combinations for each. Notice that the output of the AND gate with inputs A,B and C is 1 only if all three inputs are 1, so that we write the output as A. B. C. Similarly, the OR gate with inputs, A,B, and C has a 1 output if anyone of the inputs is 1, so that we write the output as  $A + B + C$ .

The above argument can be extended. A four-input AND gate has a 1 output only when all four inputs are 1 and a four-input OR gate has a 1 output when any of its inputs is a 1.



Inputs			Output
A	B	C	D = A . B . C
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

(a) Three- input AND gate

Inputs			Output
A	B	C	D = A+ B + C
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

Three-input OR gate.  
Block diagram symbol and truth and truth table forThree-input AND gate and Three- input OR gate.

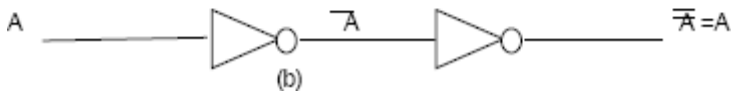
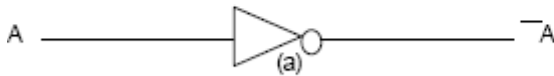
**NOT Gate :** A NOT gate is the physical realization of complementation operation. It is an electronic circuit that generates the reverse of the input signal as output signal as output signal. It is also known as an inverter because it inverts the input.

Shows the truth table and block diagram symbol for a NOT gate.

Recall that Complementation operation is unary operation defined on a single variable. Hence, a NOT Gate always has a single input. Below figure also shows that two NOT gates connected in Series given an output equal to the input. This is the gating counterpart of the law of the Double complementation.  $A = A$ .

Block diagram symbol and truth table for NOT gate.

Input	Output
A	$\overline{A}$
0	1
1	0

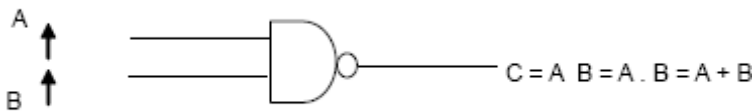


Two NOT gates in series

**NAND Gate** - A NAND gate is a complemented AND gate. That is the output of NAND gate will be 1 if any one the input is 0, and it will be 0 only when all inputs are 1.

Shows the truth table and block diagram symbol for a NAND gate. The symbol ‘ $\cdot$ ’ is usually used to represent a NAND operation in Boolean expressions.

$$A \cdot B = A \cdot B = A + B$$



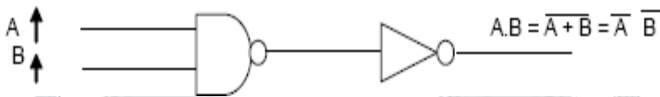
Inputs		Output
A	B	$C = A \cdot B$
0	0	1
0	1	1
1	0	1
1	1	0



Hence,

**Block diagram symbol and truth table for a NAND gate.**

An AND gate followed by a NOT gate operates as a NAND gate (see Figure above) . In the figure, the output of the AND gate will be  $A \cdot B$  that is turn is fed as input to the NOT gate. Hence, the final output will be complement of  $A \cdot B$ , which is equal to  $\overline{A \cdot B}$  or  $A + B$  or  $A \cdot B$ . in fact, the small circle on the output of NAND gate (see Figure 6.24) represents complementation.



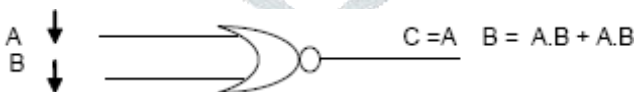
Demonstrating NAND gate realization with AND gate and a NOT gate.

Multiple-input NAND gates can be analyzed similarly. A three-input NAND gate with inputs, A,B, and C will have output equal to  $\overline{A \cdot B \cdot C}$  or  $A + B + C$  meaning that the output will be 1 if any of the inputs is a 0, and it will be 0 only when all three inputs are 1.

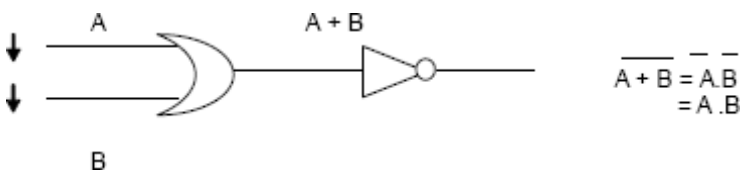
**NOR Gate :** A NOR gate is complemented OR gate. That is, the output of a NOR gate will be 1 only when all input are 0, and it will be 0 if any input is a 1. the truth table and block diagram symbol for a NOR gate. The symbol ‘ ’ is usually used to represent a NOR operation in Boolean expressions.

Hence  $A \cdot B = A + B = A \cdot B$ .

Inputs		Output
A	B	$C = A \cdot B$
0	0	1
0	1	0
1	0	0
1	1	1



**Block diagram symbol and truth table for a NOR gate**

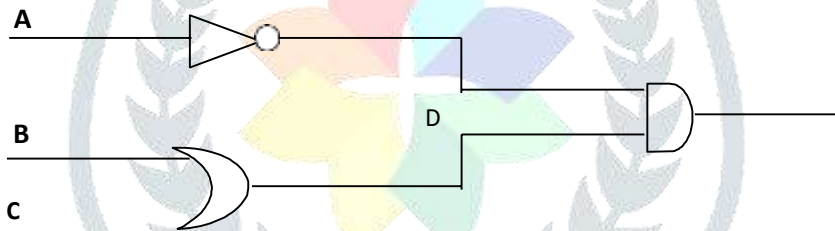


An OR gate followed by a NOT gate operates as a NOR gate (see the below figure). In the Figure the output of the OR gate will be  $A + B$  that in turn is fed as input to the NOT gate. Hence, the final output will be complement of  $A + B$ , which is equal to  $(A + B)$  or  $A.B$  or  $A B$ . In fact, the small circle on the output of NOR gate (see Figure 5.10) represents Complementation. Multiple-input NOR gates can be analyzed similarly. A three-input NOR gate with inputs  $A, B$ , and  $C$  will have an output equal to  $A + B + C$  or  $A . B . C$  meaning that the output will be only 1 when all three inputs are 0, and it will be 0 if any of the three inputs is a 1. NOR gate realization with an OR gate and a NOT gate

## LOGIC CIRCUITS

Logic gates described in the previous section are seldom used alone but are used in combinations. They are interconnected to form gating/logic networks known as combinational logic circuits. Boolean algebra expression for a given logic circuit can be derived by systematically progressing input to output on its gates. Few examples are given below. Example

Find the Boolean expression for the output of the logic circuit given below



### Solution

Input A is fed to the NOT gate, whose output will be  $A$ .

Inputs B and C are fed to the OR gate, whose output will be  $B + C$ . These two outputs ( $A$  and  $B + C$ ) are in turn fed as input to the AND gate, whose output will be  $A . (B + C)$ .

Hence,  $D = A . (B + C)$  is the Boolean expression for the output of the given logic circuit.

Find the logic expression for the output produced by the logic circuit given below.

### Solution

The output of the OR gate is  $A + B$  .....

The output of the first AND gate is  $A . B$  .....

Expression (b) is fed as input to the NOT gate, whose output will be  $A . B$

.....

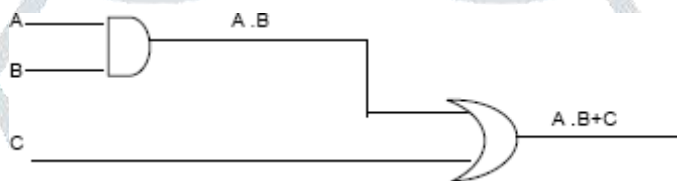
Now, expressions (a) and (c) are fed as input to the second ANDgate, whose output will be

$$(A + B) \cdot (A \cdot B)$$

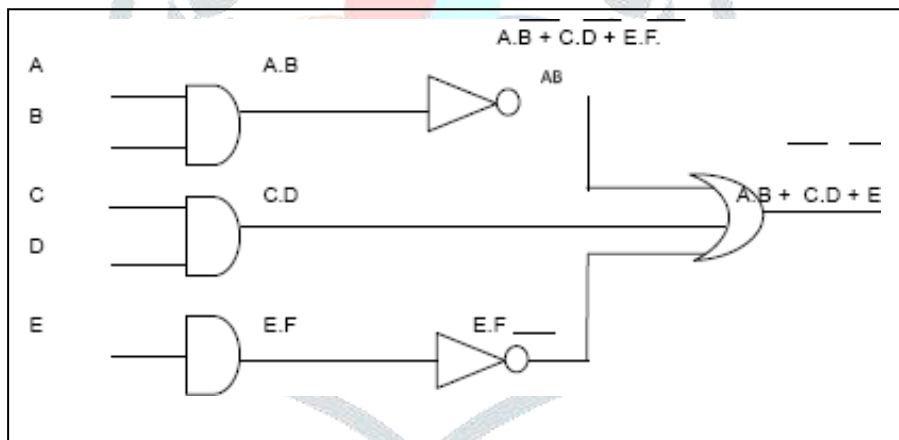
Hence,  $C = (A + B) \cdot (A \cdot B)$  is the logic expression for the output produced by the given logic circuit.

**Converting Expressions to logic circuits: The method for constructing logic circuits for Boolean expressions by using these three gates only is illustrated below with some example. Construct a logic circuit for the Boolean expression  $A \cdot B + C$**

**Solution:** method of constructing logic circuits for Boolean expressions by using



The desired logic circuit is shown above and it self-explanatory. Construct a logic circuit for the Boolean expression



## DESIGN OF COMBINATIONAL CIRCUIT

Design of a combinational circuit starts from the outline of the problem and ends in a logic circuit diagram.

- State the given problems completely and exactly.
- Interpret the problem to determine available input and required output variables.
- Assign a letter symbol to each input variable and each output variable.
- Design a truth table that defines the required relations between inputs and outputs.

- e) Obtain the simplified Boolean expression for each output
- f) Draw a logic circuit diagram to implement the Boolean expression.

The design procedure is illustrated below with the design of adder circuits because addition is the most basic arithmetic operation for any Computer system.

The following four rules summarize addition in binary number system.  $0 + 0 = 0$

$$0 + 1 = 1$$

$$1 + 0 = 1$$

$$1 + 1 = 10$$

The first three operations produce a single-digit sum, but when both augends and addend bits are equal to 1, the sum consists of two digits. The higher significant bit of this result is called a carry. When both augends and addend numbers contain more than one digit, the carry obtained from addition of two bits at any stage is added to the next pair of significant bits. A combinational circuit that performs the addition of two bits is called a half-adder. One that performs the addition of three bits (two significant bits and previous carry) is called a full-adder. The name of the former comes from that fact that two half-adders can be employed to implement of a full-adder.

***Design of Half-Adder: From the definition given above, a half-adder needs two binary inputs and two binary outputs.***

The input variables designate the augends and addend bits whereas the output variables and addend bits whereas the output variables produce the sum and carry bits. Let A and B be the two inputs and S (for sum) and C (for carry) be the two outputs. The truth table of the Figure defines the function of a half-adder.

Inputs		Output	
A	B	C	D
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

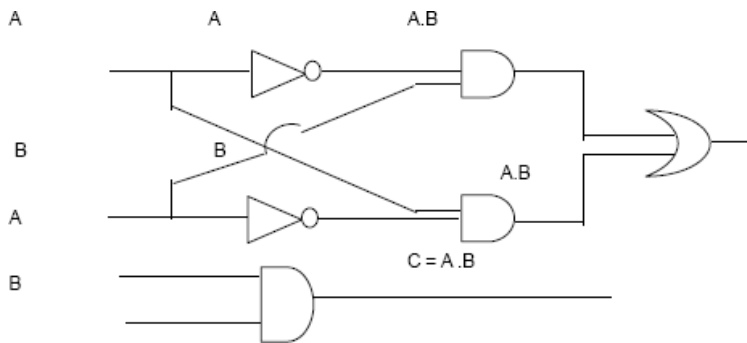
$$S = A.B + A.B$$

showing Truth table for a half-adder.

The Boolean expressions for the two outputs, obtained from the truth table, are:  $S = A.B + A.B$

$$C = A.B$$

The logic circuit diagram to implement these expressions.



### ***showing the logic circuit diagram for a half-adder***

A half-adder is limited in the sense that it can add only two single bits. Although, it generates a carry for the next higher pair of significant bits it cannot accept a carry generated from the previous pair of lower significant bits. A full-adder solves this problem.

**Design of Full-Adder :** A full-adder forms the arithmetic sum of three input bits. Hence, it consists of three inputs and two outputs. Two of the input variables (A and B) represent the augends and addend bit and the third input variable (D) represents the carry from the previous lower significant position. Two outputs are necessary because the sum of three binary digits ranges from 0 to 3 and binary 2 and 3 need two digits. These two outputs are designated by the symbols S (for sum) and C (for carry). The truth table of the below Figure defines the function of a full-adder.

The 1s and 0s for the output variables are determined from the arithmetic sum of the three input variables. When all input variables are 0, the output is 0 for both C and S. The S output is equal to 1 when only one input is equal to 1, or when all three inputs are equal to 1. The C output is 1 if two or three inputs are equal to 1.



Inputs			Outputs	
A	B	D	C	S
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1

Showing Truth table for a full-adder.

The sum-of-products expressions for the two outputs can be obtained directly from the truth table and are given below.

$$S = A.B.D + A.B.D + A.B.D + A.B.D$$

$$C = A.B.D + A.B.D + A.B.D + A.B.D$$

Although, the expression for S cannot be simplified, it is possible to simplify the expression for C as follows.

$$C = A.B.D + A.B.D + A.B.D + A.B.D$$

$$= A.B.D + A.B.D + A.B.D + A.B.D + A.B.D + A.B.D$$

$$( \text{ since } x + x = x )$$

$$= (A.B.D + A.B.D) + (A.B.D + A.B.D) + (A.B.D + A.B.D)$$

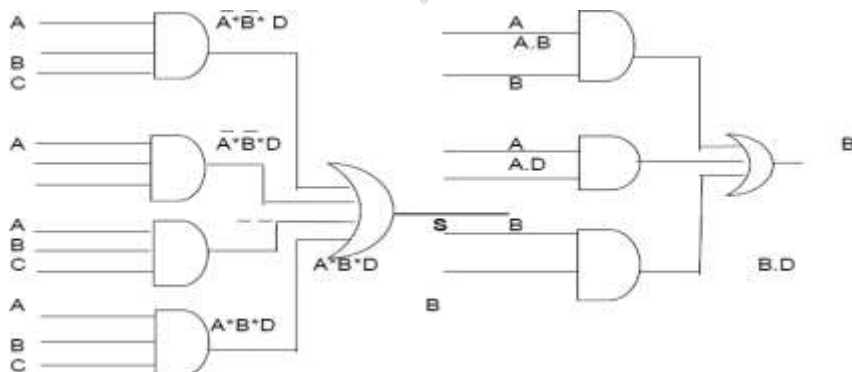
$$= (A + A) . B.D + (B + B).A.D + (D + D) . A.B$$

$$= B.D + A.D + B.D \text{ (since } x + x = x \text{)}$$

$$= A.B + A.D + B.D$$

Hence, we obtain the following expressions for the two outputs:  $S =$

$$A.B.D + A.B.D + A.B.D + A.B.D \quad C = A.B + A.D + B.D$$



a) Logic circuit diagram for sum

(b) Logic circuit diagram for carry

Figure showing the logic circuit diagrams to implement these expressions. The S output from the second half-adder is the exclusive-OR of D and the output of the first half-adder giving.

$$\begin{aligned}
 S &= (A.B. + A.B.).D + (A.B. + A.B.).D \\
 &= (A.B. + A.B.).D + A.B.D + A.B.D \\
 &= (A.B.). (A.B). D + A.B.D + A.B.D \\
 &= (A.A + A.B + A.B + B.B).D + A.B.D + A.B.D \\
 &= (A.B. + A.B.).D + A.B.D + A.B.D \\
 &= A.B.D + A.B.D + A.B.D + A.B.D \\
 &= A.B.D + A.B.D + A.B.D + A.B.D
 \end{aligned}$$

The carry output is:

$$\begin{aligned}
 C &= (A.B. + A.B.).D + A.B \\
 &= A.B.D + A.B.D + A.B.(D + D) \\
 &= A.B.D + A.B.D + A.B.D + A.B.D
 \end{aligned}$$

This can be simplified, as before, to  $C = A.B + A.D + B.D$

## COMPUTER SOFTWARE, PROGRAMMING LANGUAGES AND PROGRAM DEVELOPMENT

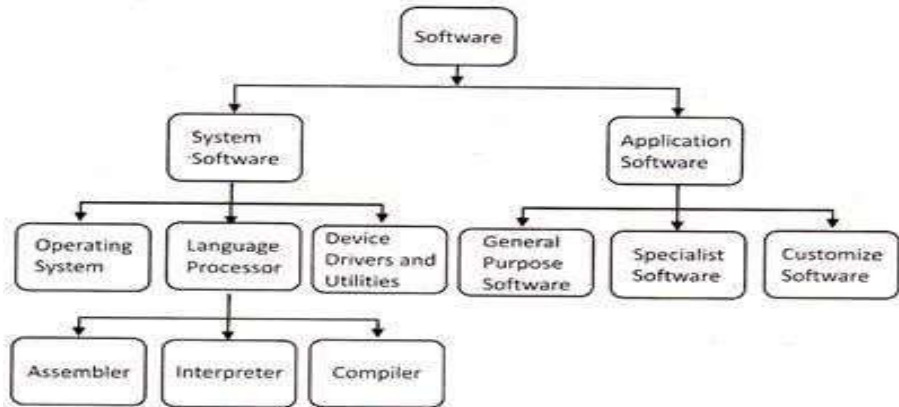
### INTRODUCTION

As is already seen, a Computer cannot do anything on its own. It has to be provided a detailed set of instructions to perform a specific task to achieve a desired goal, this set of instructions, which are written in the form which is understood by the Computer, is known as a Computer program. The program controls the processing of the Computer.

### CLASSIFICATION OF SOFTWARES

Software means a set of programs, procedures and other associated documentation which describes what the program does and how it is to be used. Hardware and software both have to work together. A number of software's can be run on the same hardware to perform different types of jobs. The software acts as an interface between the user and the Computer.

Software is mainly classified into:



## a) Application Software

## b) System Software

**Application Software:** Application software is a program or a set of programs which are written to carry out a specific application. eg. Payroll, financial accounting etc. Nowadays special application software or packages for specialized areas like drawing, engineering, manufacturing, banking, and publishing are available. The set of programs which together make an application package are called application programs.

**System Software :** The systems software controls the working of the Computer system. It helps the user to use the Computer by allowing him to communicate with the system. System software controls the working of other software's, hardware, hardware devices like printers, memory, CPU etc. Thus, they make the operation of the Computer more efficient. The programs included in system software are systems programs. Without the systems programs, it would not be possible for the application programs to work on the Computer. The systems software is generally provided by the manufacturer of the Computer hardware. Without the systems software the hardware would not work.

**Utility Software:** These are a set of programs or tools which are used in program development or for performing limited tasks, eg. scandisk.

**Firmware:** With the advances in technology it is now possible to make the software available on ROM (Read Only Memory) chips. These chips, which form a part of the software, have the programs in them. Thus programs available on hardware are called Firmware. Today not only systems software, but even some dedicated application programs are being made available on firmware.

**Programming Languages:** A programming language is a means of communication for the user to communicate with the Computer system. The programming language is a set of instructions which tell the Computer what to do. This is a language which is understood by both man and machine. There are a number of programming languages. However all these languages are designed to perform at least certain basic instructions and operations; These instructions and operations are :

### **Input/output operations,**

Arithmetic operations - mathematical operations like addition, subtraction,  
 Logical operations - Comparison for equality, inequality etc. Movement of instructions and data to and from the CPU.

To use the programming language, the programmer has to strictly follow the rules of the language including all commas, punctuation marks etc. otherwise the program will not be understood by the Computer. Thus, although the programming languages are much smaller and simpler than the natural languages, they have to be used with the greatest accuracy.

## Types of programming languages

- a) Machine Language
- b) Assembly Language
- c) High Level Language

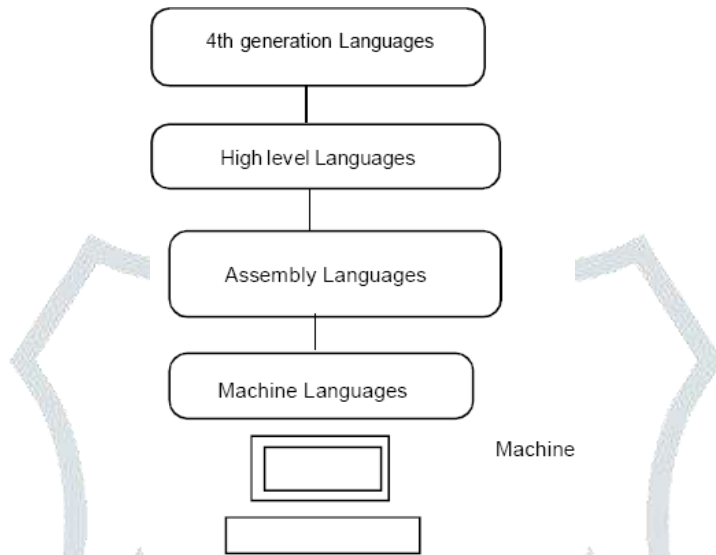


Fig 6.1

**Machine Language:** This is the only language which is understood by the Computer. This is the language nearest to the machine. In this language the programs are written in binary code i.e. the instructions are made only by a combination of binary digits 0 and 1. Machine language may vary from machine to machine depending upon the Computer architecture. Machine languages execute the fastest since they are immediately understood by the Computer. No translation of the programs is required. Also they make efficient use of primary memory. But it is very difficult to program in this binary or machine language. It is also very tedious and time consuming, since all the instructions have to represent as a series of 0s and 1s. Therefore there is always a possibility of errors.

**Assembly Language:** The 0s and 1s of the machine language were substituted by letters and symbols in assembly languages. The assembly languages use mnemonics (memory aid) in place of operation codes. The language uses symbols instead of numbers to write programs. A program written using such symbols in the assembly language is called the source program. The program written in assembly language has to be converted into machine language for use by the Computer. This is achieved with the help of the assembler. The assembler is a system program which is supplied by the manufacturer. It converts the assembly program into a machine readable program and the resulting program is called the object program. Thus the input to the assembler is the source program and the output of the assembler is the object program. The assembler translates each assembly language



instruction into a corresponding machine code.

It is relatively easy to write programs in assembly language as compared to machine language. They can be also modified relatively easily. However, like the machine language, assembly languages are also hardware dependant. When the machine changes, the program has to be changed.

Since the machine language and assembly language both are dependent on the hardware, they are referred to as low level programming languages. Both these languages require a deep understanding of the internal structure of the Computer.

**High Level Languages :** Higher level languages make use of English like words and statements and mathematical symbols for instructions. Higher level languages make programming easier, since they are relatively easy to learn. Less time is required to write programs in high level languages. The programmer is not required to know the detailed working of the Computer system in order to program in a high level language. They are machine independent. Higher level languages are also known as problem oriented languages. However a high level language is not directly understood by the Computer. It is required to be translated into machine language. Therefore they generally execute more slowly and require more memory than the same program written in assembly language.

The programs which are used to translate programs written in high level language into machine language are known as translators.

The types of translators are:

- a) Compiler
- b) Interpreter

**Compiler:** The compiler translates the entire source program into machine language program at once. The source code remains intact. Once a program is compiled it can be run as many times as required, without being required to be recompiled. A compiler can translate only those programs which have been written in the language for which it is designed. Also each machine has to have its own compiler. A compiler is a program which normally resides on the secondary storage device. It gets loaded into the CPU when the source program is to be translated. A compiler checks for errors like illegal symbols, statements etc. during compilation and gives out a list of error messages at the end of execution. This is a very valuable aid to the programmer to correct the programs. However, the compiler is incapable of detecting any logical errors in the program.

**Interpreter:** The interpreter is the program which translates a high level language program into machine language as follows :

a) it takes one statement from the high level language program  
 b) translates it into a machine instruction and the instruction is immediately executed. Since the program is translated statement by statement, the machine level program of the source program is not stored anywhere in memory. Therefore, the program has to be interpreted every time when it has to be run. Thus no object code is generated. The interpreted programs are generally slower than compiled programs. However, if any changes are made in the source program it can interpret only those statements and it is not required to compile the entire program again. Interpreters are relatively easy to write and smaller in size as compared to compilers. Thus assemblers, compilers and interpreters are systems software which translate the source program into object program i.e. program which can be understood by the Computer. These translators are also known as language processors.

#### **Fourth Generation Languages (4 GL) :**

Programming languages are sometimes classified with generations -from the lowest to the highest.

The First Generation - Machine Language The Second Generation -Assembly Language The Third Generation – High level Language. Unlike procedural languages which require that a programmer writes all the steps to complete the program and generate output, which are related to a more structural approach towards programming. It is the first standardized language.

**BASIC:** BASIC stands for Beginners All Purpose Symbolic Instruction Code. The language was developed by Prof. John Kemeny and Thomas Kurtz in USA. It is relatively easy to learn. Programs written in BASIC language are interpreted. It resembles FORTRAN in many ways, but can also be effectively used in business applications. Thus it can be used for both business and scientific applications. BASIC is one of the most popular languages for use in microcomputer systems.

**COBOL :** Common Business Oriented Language was designed especially for business applications. A COBOL program is constructed from sentences, paragraphs, sections and divisions. A COBOL program must have four divisions: the identification division, the environment division, data division, and the procedure division. Thus COBOL is a self documenting language. It is one of the most widely used commercial languages.

**RPG :** Report Generator is a general purpose, business oriented language designed to generate output reports. The language was developed by IBM and was launched for use on the IBM 1401 Computer. It is best suited for applications where large data files have to be read and extensive reports are to be output. It has limited mathematical capability and is not suited for scientific applications.

**PASCAL :**PASCAL has been named after the French mathematician Blaise Pascal; It allows the programmer to structure the programming language. The features of PASCAL allow it to be used for both scientific and business applications. It is a very powerful language. It is implemented on several Computers including microComputers and miniComputers and is also widely used to teach programming to students and beginners.

**C:** C was designed and developed at Bell Laboratories USA. It is a block structured language which allows the use of various concepts of structured programming. C also has the advantage of being able to manipulate internal processor registers of the Computer. Thus it has some powers of the assembly language. C is also very portable. C is the most popular language used for systems programming like designing compilers and operating systems.

**LISP:**LISP stands for list processing. This language is mostly used in non numeric applications which require logical rather than numerical operations. Therefore it is widely used in games, pattern recognition and artificial intelligence.

## PROGRAM DEVELOPMENT PROCESS

While writing a Computer program, it is absolutely necessary to write each and every instruction in the correct sequence. The logical control of element within the Computer program is the most important aspect of programming.

The various stages in the development of a Computer program are :

**Problem Definition:**The first step in the process of program development is the thorough understanding and identification of the problem for which the program or software is to be developed. In this step the problem has to be defined formally. All the factors like Input/output, processing requirement, memory requirements, error handling, interfacing with other programs have to be taken into consideration in this stage.

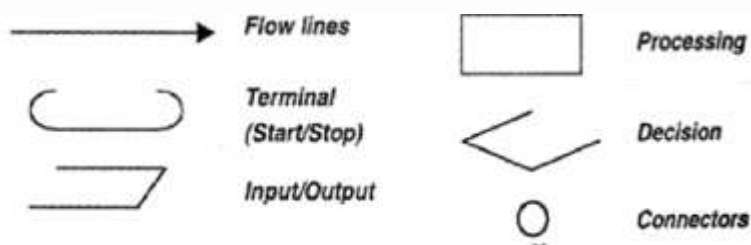
**Program Design:**The next stage is the program design. The software developer makes use of tools like algorithms and flowcharts to develop the design of the program.

**Algorithm:**An algorithm represents the logic of the processing to be performed. It is a sequence of instructions which are designed in such a way that if they are executed in the specified sequence, the desired goal is achieved. It is imperative that the result be obtained after execution of a finite number of steps.

In an algorithm,

- a) Each and every instruction has to be precise and clear.
- b) The instruction has to be executed in a finite time.
- c) When the algorithm terminates the desired result should be achieved.

**Flowchart :** A flowchart is a pictorial representation of the algorithm. It represents the steps involved in the procedure and shows the logical sequence of processing using boxes of different shapes. The instruction to be executed is mentioned in the boxes. These boxes are connected together by solid lines with arrows, which indicate the flow of operation. The first step in the design of a program is the algorithm. The algorithm is then represented in the form of a flowchart and the flowchart is then expressed in the Computer language to actually prepare the Computer program.



### Symbols used in a flowchart.

**The symbols used in the flowchart are:**

**Terminal (Start/Stop):** The symbol denotes the beginning, ending and halt operation in the program logic. Thus it is the first and the last Symbols! in any nov-chart to indicate the start and stop of the process.

**Input/output:** Indicates when an input or output operation is to performed in the process.

**Processing:** This represents the arithmetic operations like addition, subtraction etc, and the movement of data in the process

**Decision:** The decision symbol is used to represent a point where one or more alternatives is possible. The criteria for decision making are written in the decision box. On each path the condition for which the particular path is to be followed has to be written. During the execution the appropriate path will be followed depending upon the result of the decision.

**Flow lines:** These indicate the flow of operation ie. The sequence of instruction execution. Flow lines are normally drawn with arrowhead indicating the direction of flow of the program.

**Connectors:** A connector is used to indicate the logic flow from one page to another when the flowchart becomes very long. Connectors do not represent any operation. They are mainly used in the flowchart for clarity and convenience.

Types of logic used in the flowchart:

**Sequential Execution:** In this logic the instructions are executed one after the other sequentially.

**Transfer of control:** This is a logic which is used when the option to be chosen depends upon the result of the decision. The control is transferred to a particular path if the result of the decision branches to that path.

**Looping:** In looping or repetitive logic, an instruction or a number of instructions are executed more than once. The instructions are executed till the decision criteria is true. The decision criteria can be placed before the loop or after the loop depending upon the statements which are to be executed in the loop.

Let us see some examples of writing algorithms and flowcharts.

Write an algorithm and develop a flowchart to convert the temperature input in Celsius scale to Fahrenheit scale.

**Solution :** First write a detailed stepwise algorithm to do the conversion

**Step 1:** Start.

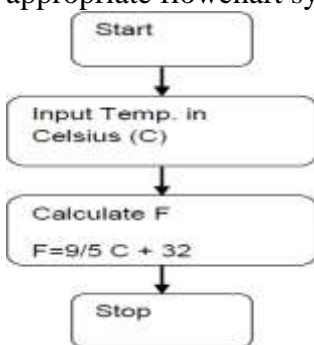
**Step 2:** Input temperature in Celsius (C).

**Step 3:** Convert to Fahrenheit (F) using the formula  $F = 9/5 * C + 32$ .

**Step 4:** Print the temperature in Fahrenheit (F).

**Step 5:** Stop.

Next on the basis of this step wise algorithm develop the flowchart using the appropriate flowchart symbols as follows:



**Write an algorithm and flowchart to read two numbers A and B and compare them. If**

**A is greater than B print, A is greater than B else print B is greater than**



## A. Algorithm :

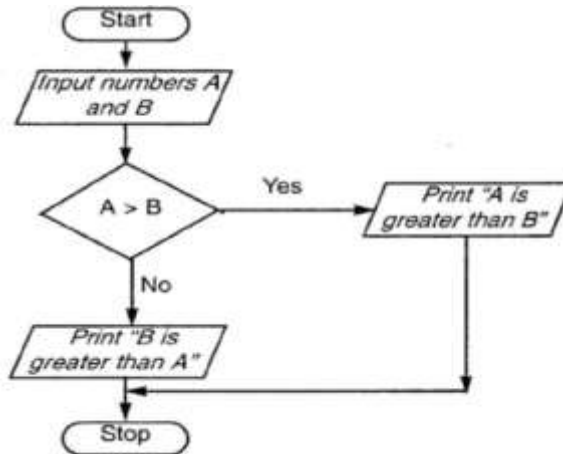
**Step 1:** Start.

**Step 2:** Input values of A and B.

**Step 3:** Compare values of A and B (Is  $A > B$ ?).

**Step 4:** If yes then print "A is greater than B".

**Step 5:** If no, the print "B is greater than A". Now draw the flowchart for the above.



**Other techniques which can be useful in designing of the programare:**

**Modular Programming:** Using this method the entire program is divided into smaller manageable modules so that the smaller modules can be designed, coded and debugged separately.

**Top-Down Design:** Here the overall problem is first defined in terms of general subtask. These subtasks are divided into further sub tasks.

**Coding:** Once the design process is complete, the actual Computer program is written, i.e. the instructions are written in a Computer language. Coding is generally a very small part of the entire program development process and also a less time consuming activity in reality. In this process all the syntax errors i.e. errors related to spelling, missing commas, undefined labels etc. are eliminated. For effective coding some of the guidelines which are applied are

- a) Use of meaningful names and labels of variables,
- b) Simple and clear expressions,
- c) Modularity with emphasis on making modules generalized,
- d) Making use of comments and indenting the code properly,
- e) Avoiding jumps in the program to transfer control.

**Debugging:** *At this stage the errors in the programs are detected and corrected. This stage of program development is an important process. Debugging is also known as program validation.*

Some common errors which might occur in the programs include:

- a) Un initialization of variables,
- b) Reversing of order of operands, c) Confusion of numbers and characters,
- d) Inverting of conditions eg jumping on zero instead of on not zero.

**The tools or methods which can be used to debug the programs include:**

**Simulator** - This is a Computer program which simulates the execution of the program on another Computer.

**Logic Analyzers:** This test instrument detects the states of digital signals during each clock cycle and stores them in memory. It then displays this data on the monitor.

**Breakpoints:** This is introduced in the program to halt the execution at some intermediate point. At this point, the values of the various inputs, outputs, variables etc. can be checked.

**Software interrupts:** This is an instruction which saves the current value of the program counter and then branches to a specific memory location. At this location there is the debugging program which displays the status information.

**Memory dump:** This gives a listing of the current contents of a section of the memory. Memory dumps are common in most simulator programs, and microComputer systems.

**Trace routine:** This program prints the current status of the processor at specified intervals.

**Testing (Validation):** The program is tested on a number of suitable test cases. A test plan of the program has to be done at the stage of the program design itself. This ensures a thorough understanding of the specifications. The most trivial and the most special cases should be identified and tested. It is always useful to include the maximum and minimum values of all variables as test data.

**Documentation:** Documentation is a very essential step in the program development. Documentation helps the users and the people who maintain the software. This ensures that future modification if required can be done easily. Also it is required during redesigning and maintenance.

**Maintenance:** Updating and correction of the program for changed conditions and field experience is accounted for in maintenance. Maintenance becomes essential in following situations:

Change in specification, Change I/O equipment,  
Errors which are found during the actual execution of the program.  
Modularity, structured programming, thorough testing and debugging and  
proper documentation greatly reduce the time and cost of maintenance of the  
software

# INTRODUCTION TO OPERATING SYSTEMS

## INTRODUCTION

The operating system acts as an interface between the humans and the Computer. the operating system ensures smooth and efficient operation of a Computer.



## DEFINITION

An Operating system is defined as an integrated set of programs which manage the various resources and operations of a Computer system. The operating system acts as an interface between the humans and the Computer. The operating system ensures smooth and efficient operation of a Computer.

- a) Memory management:** Allocation of main memory and other storage to the system programs and the user data and programs.
- b) Input/output management:** Management of the input/output devices and their assignment to the various programs that are being executed
- c) File management:** The files have to be stored in various storage devices. They have to be transferred from one storage device to another. This is taken care of by the Operating System.
- d) Data security and integrity:** The data and programs have to be handled in such a way that they do not interfere with each other.
- e) Assigning priority to jobs:** The operating system is the one which has to decide and allot priority to the jobs which are to be executed.

**f) Interpret commands and detect errors:** Each of these functions are performed by a program or a set of programs and all the programs together make the operating system. Normally, there is one control program of the operating system that resides in the main memory of the Computer. This program is known as the resident program. The other programs known as transient programs or service programs reside on the disk and are accessed as and when required. The total amount of work performed by the operating system over a period of time is known as throughput.

**g)** The response time is the time interval between the time the user submits request and the time he receives the response. Response time is also known as turn around time. The efficiency of a Computer system depends upon the throughput and the response time.

**h) Functions of the Operating Systems :** The operating systems are designed to perform the following functions:

**i) Processor management:** A process is a program in execution. The processor is a hardware device which processes a sequence of instructions. Assigning of processors to the different tasks being executed by the Computer is process management.

## COMPUTER PROCESSING TECHNIQUES

**Batch Processing:** In batch processing, a number of jobs are collected by the operator offline and when a batch of jobs gets collected they are input to the Computer for processing. The jobs are then processed without user intervention. Typical applications of batch processing include applications like payroll, preparation of bills etc. where the information is not to be updated frequently.

**Spooling:** Spooling is used to improve the processing speed of batch processing. Spooling means Simultaneous Peripheral Output on Line. The process of storing input data and output results on secondary storage is known as spooling. The input data is stored on magnetic disks and is fed to the CPU when it is not too busy. The processor then processes the data and the resulting output is again stored on secondary storage device. Thus in spooling, the magnetic storage media acts as a buffer between the memory and the input/output devices.

In many Computers special purpose input/output processors which can function independent of the CPU are provided, thus leaving the main processor free once the program execution is over. The I/O processors then print the spooled data from the tape or disk on the printer. Thus spooling improves the efficiency of use of memory and CPU.

**Multiprogramming:** In multiprogramming the CPU is capable of running more than one program concurrently. More than one programs can reside in the main memory at any given time, however the processor is able to execute only one instruction at a time. The, operating speed of the CPU is much faster than that of the I/O devices. Therefore when one program is busy with I/O operations, the CPU is able to allocate time to other programs instead of remaining idle. Thus a number of users can share CPU time.

A number of programs can reside in the main memory of the Computer system. The place in memory where a program resides is known as partition. Depending upon the operating system, the actual number of partitions in the memory and the number of programs that can reside simultaneously is decided. Thus in multiprogramming it is possible to run a number of programs in much less time than would be required to execute them one after the other.

Multiprogramming increases both the throughput and response time of the Computer system. However operating systems which can support multiprogramming are required to have high memory capacity and at the same time effective mechanism of protecting the memory.

**Multiprocessing:** In multiprocessing systems, two or more CPUs are connected together. Therefore it is possible to execute instructions from different programs at the same time. Thus more than one instruction can be executed simultaneously. The idle time of the Computer reduces, since there is not user intervention in between jobs.

**The disadvantages of batch processing are:**

- a) The data has to be first accumulated and then processed. Therefore there is a possibility of delay in execution of jobs,
- b) It is not possible to change priority of jobs. If both jobs have the same priority, one of them has to wait in the batch till the complete execution of the other.

Execute different instructions of the same program. Different multiprocessing systems use different types of memory configurations. Some systems have a Common main memory for all the CPUs, in some systems each system has its own main memory while in still others each CPU can have its own memory as well as share a common memory with other processors. Multiprocessing systems require a very complex and sophisticated operating system to coordinate all the activities of the multiple CPUs and other devices. Multiprocessing systems are also very expensive.

**Time Sharing:** In time sharing, it is possible for multiple users to run more than one application at the same time on the Computer. This is accomplished by providing a separate terminal to each user. All these terminals are connected



to the main Computer. The GPU time is divided among all the users on a scheduled basis. The time that each user gets is called a time slice. The CPU switches from one user to the another, and executes a part of the process in the time slice. This process continues till the job is executed. In time sharing, like in multiprogramming only one program is in control of the CPU at any given time. In time sharing environment, it is not always possible that all the programs of all the users reside in the main memory. Only the control program and some programs reside in the main memory. The remaining programs are loaded from the secondary memory as and when they are to be executed.

**On line Processing:** In on line processing the transaction data is directly sent to secondary on-line storage devices by the CPU without sorting, from the point where data is generated. The accessing and retrieval of data is very fast. In these systems-devices are directly connected to the CPU for input or inquiry.

**Real Time Processing:** Real time processing is an on line processing system where the records are updated and data is processed as soon as the transaction takes place-Real time systems allow the users to communicate with the Computer during the processing itself. Typical examples of real time systems are the air line reservation market systems etc. In real time systems a number of terminals may be linked to a single CPU. A number of remote stations are connected to the Computer with communication lines and several stations operate simultaneously. The transactions update records. In off line processing, the data processing is not directly controlled by the CPU. In mini Computers a number of terminals are used to enter the data onto a secondary storage like a tape or disk. The data is validated, and then entered into the main CPU in batch mode for processing.

## POPULAR OPERATING SYSTEM

### INTRODUCTION

An operating system, which is a kind of system software and the programs of it provides interaction between user and Computer components. Students, this chapter gives a brief introduction of some popular operating systems. After learning this chapter you will be able to discuss the following operating systems

- UNIX
- MS-DOS
- Windows XP
- Windows Vista
- Windows 9
- Linux

There are various Operating systems available.



**OPERATING SYSTEM :** An operating system is a software component of a Computer system that is responsible for the management of various activities of the Computer and the sharing of Computer resources. It hosts the several applications that run on a Computer and handles the operations of Computer hardware. Users and application programs access the services offered by the operating systems, by means of system calls and application programming interfaces. Users interact with operating systems through Command Line Interfaces (CLIs) or Graphical User Interfaces known as GUIs. In short, operating system enables user interaction with Computer systems by acting as an interface between users or application programs and the Computer hardware. Here is an overview of the different types of operating systems.

### *Types of Operating System.*

**Real-time Operating System:** It is a multitasking operating system that aims at executing real-time applications. Real-time operating systems often use specialized scheduling algorithms so that they can achieve a deterministic nature of behavior. The main object of real-time operating systems is their quick and predictable response to events. They either have an event-driven or a time-sharing design. An event-driven system switches between tasks based on their priorities while time-sharing operating systems switch tasks based on clock interrupts.

**Multi-user and Single-user Operating Systems:** The operating systems of this type allow a multiple users to access a Computer system concurrently. Time-sharing system can be classified as multi-user systems as they enable a multiple user access to a Computer through the sharing of time. Single-user operating systems, as opposed to a multi-user operating system, are usable by a single user at a time. Being able to have multiple accounts on a Windows operating system does not make it a multi-user system. Rather, only the network administrator is the real user. But for a Unix-like operating system, it is possible for two users to login at a time and this capability of the OS makes it a multi-user operating system.

**Multi-tasking and Single-tasking Operating Systems:** When a single program is allowed to run at a time, the system is grouped under a single-tasking system, while in case the operating system allows the execution of multiple tasks at one time, it is classified as a multi-tasking operating system. Multi-tasking can be of two types namely, pre-emptive or co-operative. In pre-emptive multitasking, the operating system slices the CPU time and dedicates one slot to each of the programs. Unix-like operating systems such as Solaris and Linux support pre-emptive multitasking.

*Distributed Operating System:* An operating system that manages a group of independent Computers and makes them appear to be a single Computer is known as a distributed operating system. The development of networked Computers that could be linked and communicate with each other, gave rise to distributed computing. Distributed computations are carried out on more than one machine. When Computers in a group work in cooperation, they make a distributed system.

*Embedded System:* The operating systems designed for being used in embedded Computer systems are known as embedded operating systems. They are designed to operate on small machines like PDAs with less autonomy. They are able to operate with a limited number of resources. They are very compact and extremely efficient by design. Windows CE, FreeBSD and Minix 3 are some examples of embedded operating systems.

The operating systems thus contribute to the simplification of the human interaction with the Computer hardware. They are responsible for linking application programs with the hardware, thus achieving an easy user access to the Computers.

## UNIX OPERATING SYSTEM

**Unix** (officially trademarked as **UNIX**, sometimes also written as UNIX with small caps) is a Computer operating system originally developed in 1969 by a group of AT&T employees at Bell Labs, including Ken Thompson, Dennis Ritchie, Brian Kernighan, Douglas McIlroy, and Joe Ossanna. Today's Unix systems are split into various branches, developed over time by AT&T as well as various commercial vendors and non-profit organizations.

UNIX operating systems are widely used in both servers and workstations. The UNIX environment and the client-server program model were essential elements in the development of the Internet and the reshaping of computing as centered in networks rather than in individual Computers. Both Unix and the C programming language were developed by AT&T and distributed to government and academic institutions, which led to both being ported to a wider variety of machine families than any other operating system. As a result, UNIX became synonymous with "open systems".

UNIX was designed to be portable, multi-tasking and multi-user in a time-sharing configuration. Unix systems are characterized by various concepts: the use of plain text for storing data; a hierarchical file system; treating devices and certain types of inter-process communication (IPC) as files; and the use of a large number of software tools, small programs that can be strung together through a command line interpreter using pipes, as opposed to using

a single monolithic program that includes all of the same functionality. These concepts are known as the Unix philosophy.

Under Unix, the “operating system” consists of many of these utilities along with the master control program, the kernel. The kernel provides services to start and stop programs, handles the file system and other common “low level” tasks that most programs share, and, perhaps most importantly, schedules access to hardware to avoid conflicts if two programs try to access the same resource or device simultaneously. To mediate such access, the kernel was given special rights on the system, leading to the division between user-space and kernel-space.

### *Components List of Unix programs*

The Unix system is composed of several components that are normally packaged together. By including — in addition to the kernel of an operating system — the development environment, libraries, documents, and the portable, modifiable source-code for all of these components, Unix was a self-contained software system. This was one of the key reasons it emerged as an important teaching and learning tool and has had such a broad influence. The inclusion of these components did not make the system large — the original V7 UNIX distribution, consisting of copies of all of the compiled binaries plus all of the source code and documentation occupied less than 10MB, and arrived on a single 9-track magnetic tape.

The names and file system locations of the Unix components have changed substantially across the history of the system. Nonetheless, the V7 implementation is considered by many to have the canonical early structure:

**Kernel** — source code in /user/sys, composed of several sub-components:

**conf** — configuration and machine-dependent parts, including bootcode

**dev** — device drivers for control of hardware (and some pseudo-hardware)

**Sys** — operating system “kernel”, handling memory management, process scheduling, system calls, etc.

**h** — header files, defining key structures within the system and important system-specific invariables

**Development Environment** — Early versions of Unix contained a development environment sufficient to recreate the entire system from source code:

**cc** — C language compiler (first appeared in V3 Unix)

**as** — machine-language assembler for the machine

**ld** — linker, for combining object files

**lib** — object-code libraries (installed in /lib or /usr/lib) libc, the system library with C run-time support, was the primary library, but there have always been additional libraries for such things as mathematical functions (libm) or database access. V7 Unix introduced the first version of the modern “Standard I/O” library stdio as part of the system library. Later implementations increased the number of libraries significantly.



**make** — build manager (introduced in PWB/UNIX), for effectively automating the build process

**include** — header files for software development, defining standard interfaces and system invariants

**Other languages** — V7 Unix contained a Fortran-77 compiler, a programmable arbitrary-precision calculator (bc, dc), and the awk “scripting” language, and later versions and implementations contain many other language compilers and toolsets. Early BSD releases included Pascal tools, and many modern Unix systems also include the GNU Compiler Collection as well as or instead of a proprietary compiler system.

**Commands** — Unix makes little distinction between commands (user-level programs) for system operation and maintenance (e.g. cron), commands of general utility (e.g. grep), and more general-purpose applications such as the text formatting and typesetting package. Nonetheless, some major categories are:

**sh** — The “shell” programmable command line interpreter, the primary user interface on Unix before window systems appeared, and even afterward (within a “command window”).

**Utilities** — the core tool kit of the Unix command set, including cp, ls, grep, find and many others. **Subcategories include:**

**System utilities** — administrative tools such as mkfs, fsck, and many others

**User utilities** — environment management tools such as passwd, kill, and others.

**Document formatting** — Unix systems were used from the outset for document preparation and typesetting systems, and included many related programs such as nroff, troff, tbl, eqn, refer, and pic. Some modern Unix systems also include packages such as TeX and Ghostscript.

**Graphics** — The plot subsystem provided facilities for producing simple vector plots in a device-independent format, with device-specific interpreters to display such files. Modern UNIX systems also generally include X11 as a standard windowing system and GUI, and many support OpenGL.

**Communications** — Early UNIX systems contained no inter-system communication, but did include the inter-user communication programs mail and write. V7 introduced the early inter-system communication system UUCP, and systems beginning with BSD release 4.1c included TCP/IP utilities.

The ‘man’ command can display a manual page for any command on the system, including itself.

**Documentation** — Unix was the first operating system to include all of its documentation online in machine readable form. The documentation included:

**man** — manual pages for each command, library component, systemcall, header file, etc.

**doc** — longer documents detailing major subsystems, such as the C language.

### *Features of Unix Operating System*

1. The Unix system had significant impact on other operating systems. It was written in high level language rather than assembly language.
2. Unix had a drastically simplified file model compared to many contemporary operating systems, treating all kinds of files as simple byte arrays. The file system hierarchy contained machine services and devices (such as printers, terminals, or disk drives).
3. Making the command interpreter an ordinary user-level program, with additional commands provided as separate programs, was another Multics innovation popularized by Unix. The Unix shell used the same language for interactive commands as for scripting.
4. Over time, text-based applications have also proven popular in application areas, such as printing languages (PostScript, ODF), and at the application layer of the Internet protocols, e.g., Telnet, FTP, SSH, SMTP, HTTP, SOAP and SIP.
5. Unix popularized syntax for regular expressions that found widespread use. The Unix programming interface became the basis for a widely implemented operating system interface standard (POSIX, see above).
6. Unix provided the TCP/IP networking protocol on relatively inexpensive computers, which contributed to the Internet explosion of worldwide real-time connectivity, and which formed the basis for implementations on many other platforms. This also exposed numerous security holes in the networking implementations.

### *Free Unix-like operating systems*

In 1983, Richard Stallman announced the GNU project, an ambitious effort to create a free software Unix-like system; “free” in that everyone who received a copy would be free to use, study, modify, and redistribute it. The GNU project’s own kernel development project, GNU Hurd, had not produced a working kernel, but in 1992 Linus Torvalds released the Linux kernel as free software under the GNU General Public License. In addition to their use in the Linux operating system, many GNU packages — such as the GNU Compiler Collection (and the rest of the GNU toolchain), the GNU C library and the GNU core utilities — have gone on to play central roles in other free Unix systems as well.

Linux distributions, comprising Linux and large collections of compatible software have become popular both with individual users and in business. Popular distributions include Red Hat Enterprise Linux, Fedora, SUSE Linux Enterprise, openSUSE, Debian GNU/Linux, Ubuntu, Mandriva Linux, Slackware Linux and Gentoo.

## DOS [DISK OPERATING SYSTEM]

In July 1980 IBM assigned Microsoft to develop a 18-bit operating system for the personal Computer for the fee of 188,000 dollars. Although the company Digital Research of Gary Kildall already had with **CP/M 88** such a 18-bit version, but by circumstances no contract has been established with IBM. Microsoft did not have yet any operating system; Microsoft licensed CP/M from Digital Research in November 1977 for 50,000 dollars.

The command interpreter is integrated in the file command.com with the internal commands for MS-DOS. Together with the file io.sys for simple device routines like the access to the monitor, keyboard, fixed storage disks and interfaces as well as the booting code these form the base operating system. DOS works very hardware near.

1988 was MS-DOS established and had reached measured on the market share a monopoly in the DOS market. The number of the MS-DOS installations grew worldwide to about 80 million and surpassed all other systems with that amount. Almost every software company offered standard applications like word processing, calculation or also special solutions like measurement tools, CAD (Computer Aided Design) or image processing for MS-DOS. The PC manufacturers designed her systems compatible to MS-DOS except for few manufacturers.

**Small reference of internal DOS commands** **del, erase** - delete files

**rd, rmdir** - delete directories **dir** - show content of directories **cd, chdir** - change current directory **cls** - clear the screen

**md, mkdir** - create a directory **copy** - copy of one or several files **ren, rename**

- rename of files or directories **type** - shows the content of text files

**et** - shows the DOS environment variables or defines a new one **ver**

- shows the DOS version number

**vol** - shows the name of the storage drive

**Small reference of external DOS commands** **attrib** - shows the attributes of files or set one of those **fdisk** - partitioning or modify of the hard disk

**move** - move of files

**mem** - shows the occupancy of working memory **tree** - shows the directory structure

**format** - format of storage drives

## WINDOWS XP

Windows XP is a line of operating systems produced by Microsoft for use on personal Computers, including home and business desktops, laptops, and media centers. The name "XP" is short for "experience". Windows XP is the successor to both Windows 2000

### *Editions of Windows XP*

The two major editions are Windows XP Home Edition, designed for home users, and Windows XP Professional, designed for business and power-users. XP Professional contains advanced features that the average home user would not use. However, these features are not necessarily missing from XP Home. They are simply disabled, but are there and can become functional. These releases were made available at retail outlets that sell Computer software, and were preinstalled on Computers sold by major Computer manufacturers.

Microsoft also released Windows XP Embedded, an edition for specific consumer electronics, set-top boxes, kiosks/ATMs, medical devices, arcade video games, point-of-sale terminals, and Voice over Internet Protocol (VoIP) components. In July 2008, Microsoft released Windows Fundamentals for Legacy PCs, a thin client version of Windows XP Embedded which targets older machines (as early as the original Pentium). It is only available to Software Assurance customers. It is intended for corporate customers who would like to upgrade to Windows XP to take advantage of its security and management capabilities, but can't afford to purchase new hardware.

### *Languages*

Windows XP is available in many languages. In addition, MUI packs and Language Interface Packs translating the user interface are also available for certain languages.

### *ATMs*

Automated teller machine (ATM) vendors NCR Corporation and Diebold Incorporated have both adopted Microsoft Windows XP as their migration path from OS/2. Diebold initially shipped XP HomeEdition exclusively, but, following extensive pressure from customer banks to support a common operating system, switched to support XP Professional to match their primary competitor, NCR Corporation.

## **Features of Window XP**

- a) Faster start-up and hibernation sequences
- b) The ability to discard a newer device driver in favor of the previous one (known as driver rollback), should a driver upgrade not produce desirable results
- c) A new, arguably more user-friendly interface, including the framework for developing themes for the desktop environment
- d) Fast user switching, which allows a user to save the current state and open applications of their desktop and allow another user to login without losing



that information

e) The ClearType font rendering mechanism, which is designed to improve text readability on Liquid Crystal Display (LCD) and similar monitors.

f) Remote Desktop functionality, which allows users to connect to a Computer running Windows XP Pro from across a network or the Internet and access their applications, files, printers, and devices.

g) Support for most DSL modems and IEEE 802.11 connections, as well as networking over FireWire, and Bluetooth.

***User interface : Windows XP features a new task-based graphical user interface. The Start menu and***

Windows indexing service were redesigned and many visual effects were added, including:

- A translucent blue selection rectangle in Explorer
- Drop shadows for icon labels on the desktop
- Task-based sidebars in Explorer windows (“common tasks”)
- The ability to group the taskbar buttons of the windows of one application into one button
- The ability to lock the taskbar and other toolbars to prevent accidental changes
- The highlighting of recently added programs on the Start menu
- Shadows under menus (Windows 2000 had shadows under mouse pointers, but not menus)

The Windows 2000 “classic” interface can be used instead if preferred. Several third party utilities exist that provide hundreds of different visual styles. Microsoft licensed technology from WindowBlinds creator Stardock to create its visual styles in XP.

### ***System requirements***

Designed for Windows XP Computer hardware logo

System requirements for Windows XP Home and Professional editions as follows: For many workloads that involve Web browsing, e-mail, and other activities, 84 MB of RAM will provide [the] user experience equivalent or superior to that of Windows Me running on the same hardware.”

***Service packs*** : Microsoft occasionally releases service packs for its Windows operating systems to fix problems and add features. Each service pack is a superset of all previous service packs and patches so that only the latest service pack needs to be installed, and also includes new revisions. Older



service packs need not be removed before application of the most recent one. The service pack details below only apply to the 32-bit editions. Windows XP Professional x84 Edition was based on Windows Server 2003 Service Pack 1 and claimed to be “SP1” in system properties from the initial release. It is updated by the same service packs and hot fixes as the x84 edition of Windows Server 2003.



### *Service Pack 1*

#### **Set Program Access and Defaults was added in Service Pack 1.**

Service Pack 1 (SP1) for Windows XP was released on September 9, 2002. It contains post-RTM security fixes and hot-fixes, compatibility updates, optional

.NET Framework support, enabling technologies for new devices such as Tablet PCs, and a new Windows Messenger 4.7 version. The most notable new features were USB 2.0 support and a Set Program Access and Defaults utility that aimed at hiding various middleware products. Users can control the default application for activities such as web browsing and instant messaging, as well as hide access to some of Microsoft’s bundled programs. This utility was first brought into the older Windows 2000 operating system with its Service Pack 3. This Service Pack supported SATA and hard drives that were larger than 137GB (48-bit LBA support) by default.

### *Service Pack 2*

#### **Windows Security Center was added in Service Pack 2.**

Windows XP, including a firewall, improved Wi-Fi support, such as WPA encryption compatibility, with a wizard utility, a pop-up ad blocker for Internet Explorer 8, and Bluetooth support. The new welcome screen during the kernel boot removes the subtitles “Professional”, “Home Edition” and “Embedded” since Microsoft introduced new Windows XP editions prior to the release of SP2.

The green loading bar in Home Edition and the yellow one in Embedded were replaced with the blue bar, seen in Professional and other versions of Windows XP, making the boot-screen of operating systems resemble each other. Colors in other areas, such as Control Panel and the Help and Support tool, remained as before. Service Pack 2 also added new security enhancements, which included a major revision to the included firewall that

was renamed to Windows Firewall and is enabled by default, additionally; security-related improvements were made to e-mail and web browsing. Windows XP Service Pack 2 includes the Windows SecurityCenter, which provides a general overview of security on the system, including the state of antivirus software, Windows Update, and the new Windows Firewall. Third-party anti-virus and firewall applications can interface with the new Security Center.

### *Service Pack 3*

Windows XP Service Pack 3 (SP3) was released to manufacturing on April 21, 2008 and to the public via both the Microsoft Download Center and Windows Update on May 8, 2008. It began being automatically pushed out to Automatic Update users on July 10, 2008. A feature set overview which details new features available separately as standalone updates to Windows XP, as well as back ported features from Windows Vista has been posted by Microsoft. A total of 1,174 fixes have been included in SP3. Service Pack 3 can be installed on systems with Internet Explorer versions 8 or 7.

## **WINDOWS VISTA**

### *New or changed features*

Windows Vista revised and incorporated new features and functionalities not present in its predecessors, especially those from Windows XP.

### *Windows Aero:*

The new hardware-based graphical user interface is named Windows Aero, which Jim Allchin stated is an acronym for Authentic, Energetic, Reflective, and Open. The new interface is intended to be cleaner and more aesthetically pleasing than those of previous Windows versions, including new transparencies, live thumbnails, live icons, and animations, thus providing a new level of eye candy.

Laptop users report, however, that battery life is shortened with the feature enabled.

*Windows Shell:* The new Windows shell is significantly different from Windows XP, offering a new range of organization, navigation, and search capabilities. Windows Explorer's task pane has been removed, integrating the relevant task options into the toolbar. A "Favorite links" pane has been added, enabling one-click access to common directories. The address bar has been replaced with a breadcrumb navigation system. The preview pane allows users to see thumbnails of various files and view the contents of documents. The details pane shows information such as file size and type, and allows viewing and editing of embedded tags in supported file formats. The Start menu has changed as well; it no longer uses ever-expanding boxes

when navigating through Programs. The word “Start” itself has been removed in favor of a blue Windows Pearl.

**Instant Search:** Windows Vista features a new way of searching called Instant Search, which is significantly faster and more in-depth (content-based) than the search features found in any of the previous versions of Windows.

**Windows Sidebar:** A transparent panel anchored to the side of the screen where a user can place Desktop Gadgets, which are small applets designed for a specialized purpose (such as displaying the weather or sports scores). Gadgets can also be placed on other parts of the desktop.

**Windows Internet Explorer 7:** New user interface, tabbed browsing, RSS, a search box, improved printing, Page Zoom, Quick Tabs (thumbnails of all open tabs), Anti-Phishing filter, a number of new security protection features, Internationalized Domain Name support (IDN), and improved web standards support. IE7 in Windows Vista runs in isolation from other applications in the operating system (protected mode); exploits and malicious software are restricted from writing to any location beyond Temporary Internet Files without explicit user consent.

**Windows Media Player 11,** a major rev amp of Microsoft’s program for playing and organizing music and video. New features in this version include word wheeling (or “search as you type”), a new GUI for the media library, photo display and organization, the ability to share music libraries over a network with other Windows Vista machines, Xbox 360 integration, and support for other MediaCenter Extenders.

**Backup and Restore Center:** Includes a backup and restore application that gives users the ability to schedule periodic backups of files on their Computer, as well as recovery from previous backups. Backups are incremental, storing only the changes each time, minimizing disk usage. It also features Complete PC Backup (available only in Ultimate, Business, and Enterprise versions) which backs up an entire Computer as an image onto a hard disk or DVD. Complete PC Backup can automatically recreate a machine setup onto new hardware or hard disk in case of any hardware failures. Complete PC Restore can be initiated from within Windows Vista or from the Windows Vista installation CD in the event the PC is so corrupt that it cannot start up normally from the hard disk.

**Windows Mail:** A replacement for Outlook Express that includes a new mail store that improves stability, and features integrated Instant Search. It has the Phishing Filter like IE7 and Junk mail filtering that is enhanced through regular updates via Windows Update.

**Windows Mobility Center:** Windows Mobility Center is a control panel that centralizes the most relevant information related to mobile computing (brightness, sound, battery level / power scheme selection, wireless network, screen orientation, presentation settings, etc.).

**Windows Meeting Space** replaces NetMeeting. Users can share applications (or their entire desktop) with other users on the local network, or over the Internet using peer-to-peer technology (higher versions than Starter and Home Basic can take advantage of hosting capabilities, Starter and Home Basic editions are limited to “join” mode only)

**Shadow Copy** automatically creates daily backup copies of files and folders. Users can also create “shadow copies” by setting a System Protection Point using the System Protection tab in the System control panel. The user can be presented multiple versions of a file throughout a limited history and be allowed to restore, delete, or copy those versions. This feature is available only in the Business, Enterprise, and Ultimate editions of Windows Vista and is inherited from Windows Server 2003.

#### ***Windows Update with Windows Ultimate Extras***

**Windows Update:** Software and security updates have been simplified, now operating solely via a control panel instead of as a web application. Windows Mail’s spam filter and Windows Defender’s definitions are updated automatically via Windows Update. Users who choose the recommended setting for Automatic Updates will have the latest drivers installed and available when they add a new device.

**Parental controls:** Allows administrators to control which websites, programs and games each Limited user can use and install. This feature is not included in the Business or Enterprise editions of Vista.

**Windows SideShow:** Enables the auxiliary displays on newer laptops or on supported Windows Mobile devices. It is meant to be used to display device gadgets while the Computer is on or off.

**Speech recognition** is integrated into Vista. It features a redesigned user interface and configurable command-and-control commands. Unlike the Office 2003 version, which works only in Office and WordPad, Speech Recognition in Windows Vista works for any accessible application. In addition, it currently supports several languages: British and American English, Spanish, French, German, Chinese (Traditional and Simplified) and Japanese.

New fonts, including several designed for screen reading, and improved Chinese (Yahei, JhengHei), Japanese (Meiryo) and Korean (Malgun) fonts. ClearType has also been enhanced and enabled by default.



Improved audio controls allow the system-wide volume or volume of individual audio devices and even individual applications to be controlled separately. New audio functionalities such as Room Correction, Bass Management, Speaker Fill and Headphone virtualization have also been incorporated.

**Problem Reports and Solutions**, a control panel which allows users to view previously sent problems and any solutions or additional information that is available.

**Windows System Assessment Tool** is a tool used to benchmark system performance. Software such as games can retrieve this rating and modify its own behavior at runtime to improve performance. The benchmark tests CPU, RAM, 2-D and 3-D graphics acceleration, graphics memory and hard disk space.

**Windows Ultimate Extras**: The Ultimate edition of Windows Vista provides, via Windows Update, access to some additional features. These are a collection of additional MUI language packs, Texas Hold 'Em (a Poker game) and Microsoft Tinker (a strategy game where the character is a robot), BitLocker and EFS enhancements which allow users to back up their encryption key online in a Digital Locker, and Windows Dream scene, which enables the use of videos in MPEG and WMV formats as the desktop background. On April 21, 2008, Microsoft launched two more Ultimate Extras; three new Windows sound schemes, and a content pack for Dream scene. Various Dream Scene Content Packs have been released since the final version of Dream Scene was released.

**Reliability and Performance Monitor** includes various tools for tuning and monitoring system performance and resources activities of CPU, disks, network, memory and other resources. It shows the operations on files, the opened connections, etc.

### *Removed Features*

Some notable Windows XP features and components have been replaced or removed in Windows Vista, including Windows Messenger, NTBackup, the network Messenger Service, HyperTerminal, MSN Explorer, Active Desktop, and the replacement of NetMeeting with Windows Meeting Space. Windows Vista also does not include the Windows XP "Luna" visual theme, or most of the classic color schemes which have been part of Windows since the Windows 3.x era. The "Hardware profiles" startup feature has also been removed, along with support for older motherboard technologies like the EISA bus, APM and Game port support (though on the 32-bit version game port support can be enabled by applying an older driver). IP over FireWire (TCP/IP over IEEE 1394) has been removed as well. The IPX/SPX Protocol has also been removed, although it can be enabled by a third-party plug-in.



## WINDOWS 8

Windows 8 is a version of Microsoft Windows (an operating system developed by Microsoft) for use on personal Computers, including home and business desktops, laptops, tablets, and home theater PCs. Development of Windows 8 started before the release of its predecessor, Windows 7, in 2009.

Windows Explorer, which has been renamed File Explorer, now includes a ribbon in place of the command bar. File operation dialog boxes have been updated to provide more detailed statistics, the ability to pause file transfers, and improvements in the ability to manage conflicts when copying files. A new "File History" function allows incremental revisions of files to be backed up to and restored from a secondary storage device, while Storage Spaces allows users to combine different sized hard disks into virtual drives and specify mirroring, parity, or no redundancy on a folder-by-folder basis.

Task Manager has also been redesigned, including a new processes tab with the option to display fewer or more details of running applications and background processes, a heat map using different colors indicating the level of resource usage, network and disk counters, grouping by process type (e.g. applications, background processes and Windows processes), friendly names for processes and a new option which allows users to search the web to find information about obscure processes. Additionally, the Blue Screen of Death has been updated with a simpler and modern design with less technical information displayed.

### *Removed Features*

Several notable features have been removed in Windows 8, beginning with the traditional Start menu. Support for playing DVDs has been removed from Windows Media Player due to the cost of licensing the necessary decoders (especially for devices which do not include optical disc drives at all) and the prevalence of streaming services such as Netflix. For the same reasons, Windows Media Center will no longer be included by default on Windows 8, but the software (which also includes support for DVD playback) can be purchased in the "Pro Pack" (for the base version of Windows 8, which also upgrades the system to Windows 8 Pro) or "Media Center Pack" (for Windows 8 Pro) add-ons. Windows 8 will still support third-party DVD playback software.

Backup and Restore, the former backup app of Windows, is deprecated. It still ships with Windows 8 and continues to work on preset schedules, but is pushed

to the background and can only be accessed through a Control Panel applet called "Windows 7 File Recovery". Shadow, a component of Windows Explorer that once saved previous versions of changed files, no longer protects local files and folders. It can only access previous versions of shared files stored on a Windows Server Computer. The subsystem, on which these components worked, however, is still available for other software to use.

## LINUX OPERATING SYSTEM

Linux (commonly pronounced) is a generic term referring to Unix-like Computer operating systems based on the Linux kernel. Their development is one of the most prominent examples of free and open source software collaboration; typically all the underlying source code can be used, freely modified, and redistributed by anyone under the terms of the GNU GPL and other free software licenses.

Linux is predominantly known for its use in servers, although it is installed on a wide variety of Computer hardware, ranging from embedded devices and mobile phones to superComputers. Linux distributions, installed on both desktop and laptop Computers, have become increasingly commonplace in recent years, partly owing to the popular Ubuntu distribution and the emergence of net books. The name “Linux” ( listen (help·info)) comes from the Linux kernel, originally written in 1991 by Linus Torvalds

### *User interface*

Users can control a Linux-based system through a command line interface (or CLI), a graphical user interface (or GUI), or through controls attached to the associated hardware (this is common for embedded systems). For desktop systems, the default mode is usually graphical user interface.

A Linux system typically provides a CLI through a shell, which is the traditional way of interacting with a Unix system. A Linux distribution specialized for servers may use the CLI as its only interface. A “headless system” run without even a monitor can be controlled by the command line via a remote-control protocol such as SSH or telnet.

Most low-level Linux components, including the GNU user land, use the CLI exclusively. The CLI is particularly suited for automation of repetitive or delayed tasks, and provides very simple inter-process communication. A graphical terminal emulator program is often used to access the CLI from a Linux desktop.

Linux distributions have mainly been used as server operating systems, and have risen to prominence in that area.

Components of IBM Roadrunner, the world’s fastest superComputer 2008, which runs Linux. Linux distributions are the cornerstone of the LAMP server-software combination (Linux, Apache, MySQL, Perl/PHP/Python) which has achieved popularity among developers, and which is one of the more common platforms for website hosting.

Linux distributions are also commonly used as operating systems for superComputers: as of June 2009, out of the top 500 systems, 443 (88.8%) run a Linux distribution.

## WINDOW 10

Windows 10 is a major release of the Windows NT operating system developed by Microsoft. It is the successor to Windows 8.1, which was released nearly two years earlier, and itself was released to manufacturing on July 15, 2015, and broadly released for the general public on July 29, 2015. Windows 10 received generally positive reviews upon its original release. Critics praised Microsoft's decision to provide the desktop-oriented interface in line with previous versions of Windows, contrasting the tablet-oriented approach of Windows 8, although Windows 10's touch-oriented user interface mode was criticized for containing regressions upon the touch-oriented interface of its predecessor. Critics also praised the improvements to Windows 10's bundled software over Windows 8.1, Xbox Live integration, as well as the functionality and capabilities of the Cortana personal assistant and the replacement of Internet Explorer with Microsoft Edge. However, media outlets have been critical of the changes to operating system behaviors, including mandatory update installation, privacy concerns over data collection performed by the OS for Microsoft and its partners, and adware-like tactics used to promote the operating system on its release.

### Features of Window 10

**User interface and desktop-** A new iteration of the Start menu is used on the Windows 10 desktop, with a list of places and other options on the left side, and tiles representing applications on the right. The menu can be resized, and expanded into a full-screen display, which is the default option in Tablet mode. A new virtual desktop system was added by a feature known as Task View, which displays all open windows and allows users to switch between them, or switch between multiple workspaces. Universal apps, which previously could be used only in full screen mode, can now be used in self-contained windows similarly to other programs. Program windows can now be snapped to quadrants of the screen by dragging them to the corner. When a window is snapped to one side of the screen, Task View appears and the user is prompted to choose a second window to fill the unused side of the screen (called "Snap Assist"). The Windows system icons were also changed.

**System security-** Windows 10 incorporates multi-factor authentication technology based upon standards developed by the FIDO Alliance. The operating system includes improved support for biometric authentication through the Windows Hello platform. Devices with

supported cameras (requiring infrared illumination, such as Intel RealSense) allow users to log in with iris or face recognition, similarly to Kinect. Devices with supported readers allow users to log in through fingerprint recognition. Support was also added for palm-vein scanning through a partnership with Fujitsu in February 2018.[79] Credentials are stored locally and protected using asymmetric encryption. Windows 10 was first introduced, multi-factor authentication was provided by two

components: Windows Hello and Passport (not to be confused with the Passport platform of 1998). Later, Passport was merged into Windows Hello.

The enterprise edition of Windows 10 offers additional security features; administrators can set up policies for the automatic encryption of sensitive data, selectively block applications from accessing encrypted data, and enable Device Guard—a system which allows administrators to enforce a high- security environment by blocking the execution of software that is not digitally signed by a trusted vendor or Microsoft. Device Guard is designed to protect against zero-day exploits, and runs inside a hypervisor so that its operation remains separated from the operating system itself.

**Command Line-** The console windows based on Windows Console (for any console app, not just PowerShell and Windows Command Prompt) can now be resized without any restrictions, can be made to cover the full screen by pressing Alt+↵ Enter, and can use standard keyboard shortcuts, such as those for cut, copy, and paste. Other features such as word wrap and transparency were also added. These functions can be disabled to revert to the legacy console if needed.

**Storage Requirement-** To reduce the storage footprint of the operating system, Windows 10 automatically compresses system files. The system can reduce the storage footprint of Windows by approximately 1.5 GB for 32-bit systems and 2.6 GB for 64- bit systems. The level of compression used is dependent on a performance assessment performed during installations or by OEMs, which tests how much compression can be used without harming operating system performance. Furthermore, the Refresh and Reset functions use runtime system files instead, making a separate recovery partition redundant, allowing patches and updates to remain installed following the operation, and further reducing the amount of space required for Windows 10 by up to 12 GB. These functions replace the WIMBoot mode introduced on Windows 8.1 Update, which allowed OEMs to configure low-capacity devices with flash-based storage to use Windows system files out of the compressed WIM image typically used for installation and recovery. Windows 10 also includes a function in its Settings app that allows users to view a breakdown of how their device's storage capacity is being used by different types of files, and determine whether certain types of files are saved to internal storage or an SDcard by default.

**Multimedia and gaming-** Windows 10 provides greater integration with the Xbox ecosystem. Xbox SmartGlass is succeeded by the Xbox Console Companion (formerly the Xbox app), which allows users to browse their game library (including both PC and Xbox console games), and Game DVR is also available using a keyboard shortcut, allowing users to save the last 30 seconds of gameplay as a video that can be shared to Xbox Live, OneDrive, or elsewhere. Windows 10 also allows users to control and play



games from an Xbox One console over a local network. The Xbox Live SDK allows application developers to incorporate Xbox Live functionality into their apps, and future wireless Xbox One accessories, such as controllers, are supported on Windows with an adapter. Microsoft also intends to allow cross-purchases and save synchronization between Xbox One and Windows 10 versions of games; Microsoft Studios games such as ReCore and Quantum Break are intended as being exclusive to Windows 10 and Xbox One. Candy Crush Saga and Microsoft Solitaire Collection are also automatically installed upon installation of Windows 10.

## Ubuntu

Ubuntu is a Linux based OS that comes with everything that you are looking for in an operating system. It is perfect for organizations, schools, and home use. It is free to download, use, and share and that alone should be worth checking this app out. It is backed by Canonical which is a global software company, and now by the leading Ubuntu service providers.

## Features

- Ubuntu is an Open Source software, which allows it to be freely downloaded, used and shared by its users.
- It comes with a built-in firewall and virus protection software, by making it the most secure OS around.
- You get five years of security patches and updates.
- Ubuntu is fully translated into 50 different languages.
- It works and is compatible with all the latest laptops, desktops and touch screen devices.

Verdict: Ubuntu is a great option for those with holes for pockets. Its open-source feature is enticing enough to attract many users. But, it also makes up in quality by providing a robust interface, and security features that are too hard to pass on.

## Mac OS

The Mac OS has been the staple of almost all Apple devices as we can remember. It has evolved with time to include the features that first and foremost define innovation. In recent years, the MAC operating systems have been completely free with the occasional free upgrade by its developers. For Apple users, there is no other option except the MAC OS.

## Features

- The new dark mode gives your desktop interface a more dramatic look which is easier on the eyes.
- A dynamic desktop which helps to automatically organize your desktop files by kind, date or tag.
- Continuity camera that scans or photographs a document nearby your



iPhone and automatically appears on your mac.

- Discover handpicked apps with the MAC app store.
- New iTunes that allows users to search for songs with few lyrics.
- Prevent websites from tracking your Mac by making your profile more anonymous online.

**Verdict:** Mac's biggest accomplishment is how dynamic the look and design of its interface appears. It is probably one of the best looking OS today. Now, Apple is allowing its users to get their hands on this OS and all its upgrades for free, and this has alleviated a lot of burden from Apple users who are already paying hefty for the Apple devices.

## **Fedora**

Fedora is another Linux based system which gives Ubuntu's open-source features a run for the money. Fedora is reliable, user-friendly and makes for a powerful operating system for any laptop and desktop Computer. Fedora is the Operating system that is for casual users and caters to students, hobbyists, and professionals working in corporate environments.

## **Features**

- A sleek new user interface that allows the developers to focus on their code on Gnome 3 environment.
- It offers a complete open-source toolbox with languages, tools, and utilities in all just a click or commands away.
- Allows digging into powerful virtualization tools to get virtual machines up and running.
- Containerize the own applications or deploy applications out of the box with OCI (Open Container Initiative) image support.

**Verdict:** Although also good for personal use, fedora works best for developers in the corporate environment. It has all the tools and utilities that a developer needs to work on in their projects and is free of cost!

## **Solaris**

Solaris is a UNIX based operating system which was originally developed by Sun Microsystems in the mid-'90s. In 2010 it was renamed as Oracle Solaris after Oracle acquired Sun Microsystems. It is known for its scalability and several other features that made it possible such as Dtrace, ZFS and Time Slider.

## **Features**

- Provides the most advanced security features in the world such as process and user rights management, thereby allowing you to secure mission-critical data.
- It offers indisputable performance advantages for web, database, and java-based services.
- Delivers high-performance networking without any modification.

- Unlimited capacity for helping in managing file system and databases.
- Allows seamless inter-operability for solving hundreds of hardware and software problems.

Verdict: Oracle Solaris is considered as one of the best free open source OS in the industry by most of them. It allows for scalability, interoperability, data management and security that are all critical for businesses with the need for high-end operating software.

## Free BSD

FreeBSD, as the name suggests is a free UNIX based open-source software. It is compatible with a variety of platforms and mainly focuses on features such as speed, and stability. The most fascinating part about this software is its origin. It was built in the University of California by a large community.

### Features

- Advanced networking, compatibility, and security features which are still missing in many OS today.
- Ideal for internet and intranet services and can handle large loads and manages memory efficiently to maintain good responses for multiple simultaneous users.
- Advanced embedded platform catering to higher-end Intel- based appliances.
- Easy to install using CD-ROM, DVD or directly over the network using FTP and NPS.

Verdict: Free BSD's biggest appeal is its ability to deliver a robust operating system, given the fact that it was built by a large community of students. It is best for networking, and is compatible across multiple devices and is very simple to install. Hence, give it a try.

## Chrome OS

Chrome OS is another Linux-kernel based operating software that is designed by Google. As it is derived from the free chromium OS, it uses the Google Chrome web browser as its principal user interface. This OS primarily supports web applications.

### Features

- An integrated media player that enables the users to play MP3's, view JPEG'S and handle other multimedia files while offline.
- Remote application access and virtual desktop access.
- Chrome OS is designed to be compatible with all the Android applications.
- With Chrome OS it is possible to run Linux applications.

Verdict: Chrome OS is an operating software that works fine, but there is still a lot of promise to what it might eventually become. For now, it is good for multi-media, Linux and Android applications. For the other features, we will

have to just wait and watch.

## CentOS

The CentOS is another community-driven open source free software that allows robust platform management. It is best for developers who are looking for an operating system that simply helps them to perform their coding tasks. That's not to say that it has nothing to offer those who simply want to use it for mundane purposes.

### Features

- Extensive resources for coders looking to build, test and release their codes.
- Advanced networking, compatibility, and security features that are still missing in many OS today.
- It allows for seamless interoperability by solving hundreds of hardware and software problems.
- It provides the most advanced security features in the world such as process and user rights management, thereby allowing you to secure mission-critical data.

Verdict: We recommend CentOS to coders than for personal and home use. CentOS makes their coding work simpler and faster. Moreover, it is free.

## Debian

Debian is again a Linux kernel-based free open-source OS. It comes with over 59000 packages and is a pre-compiled software bundled in a nice format. It is easy to install and offers a user-friendly interface.

### Features

- Faster and lighter than the other OS, irrespective of the processor speed.
- It comes with in-built security firewalls to protect valuable data.
- Easy to install through any medium.
- Advanced networking, compatibility, and security features which are still missing in many OS today.

Verdict: Debian might not be the most versatile of the Operating systems mentioned above, but its free open source feature makes it something that you should try if you are short on cash.

## Deepin

Deepin is an open-source operating system based on Debian's stable branch. It features DDE, (Deepin Desktop Environment built on QT. It has been praised for its beautiful aesthetics and very appealing interface.

### Features

- User-Friendly and Robust Aesthetics.
- Advanced security features.
- Simple Installation Procedure.
- Home to custom-tailored Deepin apps like font installer, file manager, screenshot, Deepin screen recorder, voice recorder, image and movie viewer,

etc.

Verdict: Deepin can very well qualify as its own little niche OS. It is free and improves upon many shortcomings of Debian. With more modifications, it will compete with the top operating systems like Windows and Mac in no time.

## ABBREVIATION

<b>AI</b>	Artificial intelligence	<b>ALGOL</b>	Algorithmic Language	<b>ARP</b>	Address resolution Protocol
<b>ASCII</b>	American Standard Code for InformationInterchange				
<b>BINAC</b>	Binary Automatic Computer				
<b>BCC</b>	Blind Carbon Copy				
<b>Bin</b>	Binary				
<b>BASIC</b>	Beginner All-purpose Symbolic Instruction Code				
<b>BIOS</b>	Basic Input Output System				
<b>Bit</b>	Binary Digit				
<b>BSNL</b>	Bharat Sanchar Nigam Limited				
<b>CC</b>	Carbon Copy				
<b>CAD</b>	Computer Aided Design				
<b>COBOL</b>	Common Business Oriented Language				
<b>CD</b>	Compact Disc				
<b>CRT</b>	Cathode Ray Tube				
<b>CDR</b>	Compact Disc Recordable				
<b>CDROM</b>	Compact Disc				
<b>Read Only Memory</b>	<b>CDRW</b>	Compact Disc Rewritable		<b>CDR/W</b>	Compact Disk Read/Write
<b>DBA</b>	Data Base Administrator		<b>DBMS</b>	Data Base Management System	
<b>DNS</b>	Domain Name System				
<b>DPI</b>	Dots Per Inch				
<b>DRAM</b>	Dynamic Random Access Memory				
<b>DVD</b>	Digital Video Disc/Digital Versatile Disc				
<b>DVDR</b>	DVD Recordable				
<b>DVDROM</b>	DVD Read Only				
<b>DVDRW</b>	DVD Rewritable				
<b>DVR</b>	Digital Video Recorder				
<b>DOS</b>	Disk Operating System				
<b>EBCDIC</b>	Extended Binary Coded Decimal Interchange Code				
<b>EDP</b>	Electronic Data Processing				
<b>EEPROM</b>	Electrically Erasable Programmable Read Only Memory				
<b>ENIAC</b>	Electronic Numerical Integrator and Computer				

<b>EPROM</b>	Erasable Programmable Read Only Memory
<b>FAX</b>	Far Away Xerox/ facsimile
<b>FDC</b>	Floppy Disk Controller
<b>FDD</b>	Floppy Disk Drive
<b>FORTRAN</b>	Formula Translation
<b>FS</b>	File System
<b>FTP</b>	File Transfer Protocol
<b>Gb</b>	Gigabit
<b>GB</b>	Gigabyte
<b>GIF</b>	Graphics Interchange Format
<b>GSM</b>	Global System for Mobile Communication
<b>HDD</b>	Hard Disk Drive
<b>HP</b>	Hewlett Packard
<b>HTML</b>	Hyper Text Markup Language
<b>HTTP</b>	Hyper Text Transfer Protocol
<b>IBM</b>	International Business Machine
<b>IM</b>	Instant Message
<b>IMAP</b>	Internet Message Access Protocol
<b>JPEG</b>	Joint Photographic Experts Group K
<b>Kb</b>	Kilobit
<b>KB</b>	Kilobyte
<b>KHz</b>	Kilohertz
<b>Kbps</b>	Kilobit Per Second
<b>LCD</b>	Liquid Crystal Display
<b>LED</b>	Light Emitting Diode
<b>LPI</b>	Lines Per Inch
<b>LIS</b>	Large Scale Integration
<b>Mb</b>	Megabit
<b>MB</b>	Megabyte
<b>MPEG</b>	Moving Picture Experts Group
<b>MMS</b>	Multimedia Message Service
<b>MICR</b>	Magnetic Ink Character reader
<b>MIPS</b>	Million Instructions Per Second
<b>NIC</b>	Network Interface Card
<b>NOS</b>	Network Operating System
<b>OMR</b>	Optical Mark Reader
<b>OOP</b>	Object Oriented Programming
<b>OSS</b>	Open Source Software
<b>PAN</b>	Personal Area Network
<b>PC</b>	Personal Computer
<b>PDA</b>	Personal Digital Assistant
<b>PDF</b>	Portable Document Format



<b>POS</b>	Point Of Sale
<b>PNG</b>	Portable Network Graphics
<b>PPM</b>	Pages Per Minute
<b>PPP</b>	Point-to-Point Protocol
<b>PROM</b>	Programmable Read Only Memory
<b>PING</b>	Packet Internet Gopher
<b>RAM</b>	Random Access Memory
<b>RDBMS</b>	Relational Data Base Management System
<b>RTF</b>	Rich Text Format
<b>SMTP</b>	Simple Mail Transfer Protocol
<b>SQL</b>	Structured Query Language
<b>SRAM</b>	Static Random Access Memory
<b>SNMP</b>	Simple Network Management Protocol
<b>TCP</b>	Transmission Control Protocol
<b>TB</b>	Tera Bytes
<b>UPS</b>	Uninterrupted Power Supply
<b>URI</b>	Uniform Resource Identifier
<b>URL</b>	Uniform Resource Locator
<b>USB</b>	Universal Serial Bus
<b>ULSI</b>	Ultra Large Scale Integration
<b>UNIVAC</b>	Universal Automatic Computer
<b>VAR</b>	Variable
<b>VGA</b>	Video Graphics Array
<b>VSNL</b>	Videsh Sanchar Nigam Limited
<b>VDU</b>	Visual Display Unit
<b>WiFi</b>	Wireless Fidelity
<b>WLAN</b>	Wireless Local Area Network
<b>WPA</b>	Wi-Fi Protected Access
<b>WWW</b>	World Wide Web
<b>WORM</b>	Write Once Read Many
<b>ZB</b>	Zeta Byte
<b>OCR</b>	Optical Character Readers
<b>ODBC</b>	Open Data Base Connectivity
<b>OLE</b>	Object Linking And Embedding
<b>OMR</b>	Optical Mark Reader
<b>ONE</b>	Open Network Architecture
<b>OOA</b>	Object Orient Analysis
<b>OOAD</b>	Object Oriented Analysis And Design
<b>OOP</b>	Object Oriented Programming
<b>OOPS</b>	Object Oriented Programming System
<b>OPEN GL</b>	Open Graphics Library
<b>OS</b>	Operating System

<b>OSI</b>	Open System Interconnection
<b>PC</b>	Personal Computer
<b>PCI</b>	Peripheral Component Interconnect
<b>PCMCIA</b>	Personal Computer Memory Card International Association
<b>PDF</b>	Portable Document Format
<b>PDL</b>	Page Description Language
<b>PDU</b>	Protocol Data Unit
<b>PIC</b>	Programming Interrupt Control
<b>PILOT</b>	Programmed Inquiry Learning Or Teaching
<b>PLA</b>	Programmable Logic Array
<b>PLC</b>	Programmable Logic Controller
<b>PNG</b>	Portable Network Graphics
<b>PNP</b>	Plug And Play
<b>PPP</b>	Peer To Peer Protocol
<b>PPTP</b>	Point To Point Tunneling Protocol
<b>PROM</b>	Programmable Read Only Memory
<b>PS</b>	Post Script
<b>RADSL</b>	Rate Adaptive Digital Subscribes Line
<b>RAID</b>	Redundant Array Of Independent Disks
<b>RAM</b>	Random Access Memory
<b>RAMDAC</b>	Random Access Memory Digital To Analog Converter
<b>RAS</b>	Remote Access Network
<b>RD RAM</b>	Rambus Dynamic Random Access Memory
<b>RDP</b>	Remote Desktop Protocol
<b>RFC</b>	Request For Comments
<b>RGB</b>	Red Green Blue
<b>RICS</b>	Reduced Instruction Set Computer
<b>RIP</b>	Raster Image Processor
<b>RISC</b>	Reduced Instruction Set Computer
<b>ROM</b>	Read Only Memory
<b>RPC</b>	Remote Procedure Call
<b>RTC</b>	Real Time Clock
<b>RTF</b>	Rich Text Format
<b>RTOS</b>	Real Time Operating System
<b>SACK</b>	Selective Acknowledgements
<b>SAM</b>	Security Access Manager
<b>SAP</b>	Service Access Point, Systems Applications Products
<b>SDK</b>	Software Development Kit
<b>SDL</b>	Storage Definition Language

<b>SDN</b>	Integrated Service Digital Network
<b>SDSL</b>	Symmetric Digital Subscribes Line
<b>SG RAM</b>	Synchronous Graphics Random Access Memory
<b>SIMD</b>	Single Instruction Multiple Data
<b>SISD</b>	Single Instruction Single Data
<b>SIU</b>	Serial Interface Unit
<b>SMP</b>	Symmetric Multi-Process
<b>SMS</b>	Short Message Service
<b>SMTP</b>	Simple Mail Transfer Protocol
<b>SNA</b>	System Network Architecture
<b>SNAP</b>	Sub Network Access Protocol
<b>SNMP</b>	Simple Network Management Protocol
<b>SPX</b>	Sequenced Packet Exchange
<b>SQA</b>	Statistical Quality Assurance
<b>SQL</b>	Structured Query Language
<b>SRAM</b>	Static Random Access Memory
<b>SRS</b>	Software Requirements Specification
<b>SVVP</b>	Software Verification And Validation Plan
<b>TAPI</b>	Telephony Application Program Interface
<b>TCP</b>	Transmission Control Protocol
<b>TCPIP</b>	Transmission Control Protocol Internet Protocol
<b>TDMA</b>	Time Division Multiple Access
<b>TPM</b>	Transactions Processing Monitor
<b>TSR</b>	Terminate And Stay Residents
<b>UDD</b>	User Datagram Protocol
<b>UDP</b>	User Datagram Protocol
<b>UI</b>	User Interface
<b>UML</b>	Unified Modelling Language
<b>UNC</b>	Universal Naming Convention
<b>UNIX</b>	Uniplexed Information And Computer Systems
<b>USB</b>	Universal Serial Bus
<b>USRT</b>	Universal Synchronous Receiver Transmitted
<b>VAN</b>	Virtual Area Network
<b>VAST</b>	Very Small Aperture Terminal
<b>VC++</b>	Visual C++
<b>VCD</b>	Video Compact Disc
<b>VDL</b>	View Definition Language
<b>VGA</b>	Video Graphics Array
<b>VHS</b>	Video Home System
<b>VLIW</b>	Very Long Instruction Words
<b>VRAM</b>	Video Random Access Memory
<b>VVR</b>	Software Validation And Validation Report

<b>W3C</b>	World Wide Web Consortium
<b>WAP</b>	Wireless Application Protocol
<b>WBEM</b>	Web Base Enterprise Management
<b>WDM</b>	Wave Division Multiplexing

## Practice Set

- 1) The term 'Computer' is derived from.....
  - a. Latin
  - b. German
  - c. French
  - d. Arabic
- 2) Who is the inventor of "Difference Engine"?
  - a. Allen Turing
  - b. Charles Babbage
  - c. Simur Cray
  - d. Augusta Adaming
- 3) Who is the father of Computer?
  - a. Allen Turing
  - b. Charles Babbage
  - c. Simur Cray
  - d. Augusta Adaming
- 4) Who is the father of Computer science?
  - a. Allen Turing
  - b. Charles Babbage
  - c. Simur Cray
  - d. Augusta Adaming
- 5) Who is the father of personal Computer?
  - a. Edward Robert
  - b. Allen Turing
  - c. Charles Babbage
  - d. None of these
- 6) A CPU contains
  - a. a card reader and a printing device
  - b. an analytical engine and a control unit
  - c. a control unit and an arithmetic logic unit
  - d. an arithmetic logic unit and a card reader

7) Which of the following controls the process of interaction between the user and the operating system?

- a. User interface
- b. User interface
- c. Platform
- d. Screen saver

8) The first Computers were programmed using

- a. assembly language
- b. machine language
- c. source code
- d. object code

9) \_\_\_\_\_ is a combination of hardware and software that facilitates the sharing of information between computing devices.

- a. network
- b. peripheral
- c. expansion board
- d. digital device

10) Coded entries which are used to gain access to a Computersystem are called

- a. Entry codes
- b. Passwords
- c. Security commands
- d. Code words

11) Which of the following statements is true ?

- a. Mini Computer works faster than Micro Computer
- b. Micro Computer works faster than Mini Computer
- c. Speed of both the Computers is the same
- d. The speeds of both these Computers cannot be compared with the speed of advanced

12) You organize files by storing them in

- a. archives
- b. folders
- c. indexes
- d. lists

13) What type of resource is most likely to be a shared common resource in a Computer Network?

- a. Printers
- b. Speakers
- c. Floppy disk drives
- d. Keyboards

14) Which device is required for the Internet connection?

- a. Joystick
- b. Modem
- c. CD Drive
- d. NIC Card



15) What is a light pen?

- a. Mechanical Inputdevice      b. Optical input device
- c. Electronic input device      d. Optical output device

16) UNIVAC is

- a. Universal Automatic Computer      b. Universal Array Computer
- c. Unique Automatic Computer      d. Unvalued Automatic Computer

17) CD-ROM stands for

- a.a. Compactable Read Only Memory
- b.b. Compact Data Read Only Memory
- c.c. Compactable Disk Read Only Memory
- d.d. Compact Disk Read Only Memory

18) ALU is

- a. Arithmetic Logic Unit      b. Array Logic Unit
- c. Application Logic Unit      d. None of above

19) VGA is

- a. Video Graphics Array      b. Visual Graphics Array
- c. Volatile Graphics Array      d. Video GraphicsAdapter

20) IBM 1401 is

- a.a. First Generation Computer
- b.b. Second Generation Computer
- c.c. Third Generation Computer
- d.d. Fourth Generation Computer

21) MSI stands for

- a. Medium Scale Integrated Circuits
- b Medium System Integrated Circuits
- c. Medium Scale Intelligent Circuit
- d. Medium System Intelligent Circuit

22) The capacity of 3.5 inch floppy disk is

- a. 1.40 MB
- b. 1.44 GB
- c. 1.40 GB
- d. 1.44 MB

23) WAN stands for

- a. Wap Area Network
- b. Wide Area Network
- c. Wide Array Net
- d. Wireless Area Network

24) MICR stands for

- a. Magnetic Ink Character Reader
- b. Magnetic Ink Code Reader
- c. Magnetic Ink CasesReader
- d. None

25) EBCDIC stands for

- a. Extended Binary Coded Decimal Interchange Code
- b. Extended Bit Code Decimal Interchange Code
- c. Extended Bit Case Decimal Interchange Code
- d. Extended Binary Case Decimal Interchange Code

26) Which of the following is a part of the Central Processing Unit?

- a. Printer
- b. Keyboard
- c. Mouse
- d. Arithmetic & Logic unit

27) CAD stands for

- a.a. Computer aided design
- b.b. Computer algorithm for design
- c.c. Computer application in design
- d. Computer analogue design

28) Junk e-mail is also called

- a. spam
- b. spoof
- c. sniffer script
- d. spool

29) Hackers

- a. all have the same motive
- b. break into other people's Computers
- c. may legally break into Computers as long as they don't do any damage
- d. are people who are allergic to Computers

30) What type of Computers are client Computers (most of the time) in a client-server system?

- a. Mainframe
- b. Mini-Computer
- c. Micro Computer
- d. PDA

31) A Computer cannot 'boot' if it does not have the \_\_\_\_\_

- a. Compiler
- b. Loader
- c. Operating System
- d. Assembler

32) The amount of vertical space between lines of text in a document is called \_\_\_\_\_

- a. double-space
- b. line spacing
- c. single space
- d. vertical spacing

33) Example of non-numeric data is

- a. Employee address
- b. Examination Score
- c. Bank Balance
- d. All of these

34) What is embedded system?

- a. The programme which arrives by being wrapped in box.
- b. The programme which is the permanent part of the Computer
- c. The Computer which is the part of a big Computer
- d. The Computer and software system that control the machine

35) First page of Website is termed as-

- a. Homepage
- b. Index
- c. Java Script
- d. Bookmark

36) Is the appearance of typed characters?

- a. Size
- b. Format
- c. Point
- d. Colour

37) When a file is saved for the first time

- a. a copy is automatically printed
- b. it must be given a name to identify it
- c. it does not need a name
- d. it only needs a name if it is not going to be printed

38) Office LANS, which are scattered geographically on largescale, can be connected by the use of corporate

- a. CAN
- b. LAN
- c. DAN
- d. WAN

39) Where are data and programme stored when the processor uses them?

- a. Main memory
- b. Secondary memory
- c. Disk memory
- d. Programme memory

40) represents raw facts, where is data made meaningful.

- a. Information, reporting
- b. Data, information
- c. Information, bits
- d. Records, bytes

41) What characteristic of read-only memory (ROM) makes it useful?

- a. ROM information can be easily updated.
- b. Data in ROM is non-volatile, that is, it remains there even without electrical power.
- c. ROM provides very large amounts of inexpensive data storage.
- d. ROM chips are easily swapped between different brands of Computers.

42) What do you call the boot diskettes programs that are used to find out possible faults and their causes?

- a. operating system extensions.
- b. cookies
- c. diagnostic software
- d. boot diskettes.

43) Which programming languages are classified as low level languages?

- a. BASIC, COBOL
- b. Prolog
- c. C, C++
- d. Assembly languages

44) Which of the following is not anti-virus software?

- a. NAV
- b. F-Prot
- c. Oracle
- d. McAfee

45) Which device is required for the Internet connection?

- a. Joystick
- b. Modem
- c. CD Drive
- d. NIC Card

46) What does DMA stand for?

- a. Distinct Memory Access      b. Direct Memory Access
- c. Direct Module Access      d. Direct Memory Allocation

47) Which of the following is a storage device?

- a. Tape      b. Hard Disk
- c. Floppy Disk      d. All of the above

48) When did John Napier develop logarithm?

- a. 1416      b. 1614
- c. 1641      d. 1804

49) A normal CD- ROM usually can store up to \_\_\_\_\_ data?

- a. 680 KB      b. 680 Byte
- c. 680 MB      d. 680 GB

50) MIS is designed to provide information needed for effective decision making by?

- a. Consumer      b. Workers
- c. Foremen      d. Manager

51) What is a light pen?

- a. Mechanical Input device      b. Optical input device
- c. Electronic input device      d. Optical output device

52) BCD is

- a. Binary Coded Decimal      b. Bit Coded Decimal
- c. Binary Coded Digit      d. Bit Coded Digit

53) ASCII stands for

- a. American Stable Code for International Interchange
- b. American Standard Case for Institutional Interchange
- c. American Standard Code for Information Interchange
- d. American Standard Code for Interchange Information



- 54) Which of the following is first generation of Computer?
- EDSAC
  - IBM-1401
  - CDC-1604
  - ICL-2900
- 55) Chief component of first generation Computer was
- Transistors
  - Vacuum Tubes
  - Integrated Circuits
  - None of above
- 56) FORTRAN is
- File Translation
  - Format Translation
  - Formula Translation
  - Floppy Translation
- 57) EEPROM stands for
- Electrically Erasable Programmable Read Only Memory
  - Easily Erasable Programmable Read Only Memory
  - Electronic Erasable Programmable Read Only Memory
  - None of the above
- 58) Second Generation Computers were developed during
- 1949 to 1955
  - 1956 to 1965
  - 1965 to 1970
  - 1970 to 1990
- 59) The Computer size was very large in
- First Generation
  - Second Generation
  - Third Generation
  - Fourth Generation
- 60) Microprocessors as switching devices are for which generation Computers
- First Generation
  - Second Generation
  - Third Generation
  - Fourth Generation
- 61) Which of the following devices can be used to directly image printed text?
- OCR
  - OMR
  - MICR
  - All of above
- 62) The output quality of a printer is measured by
- Dot per inch
  - Dot per sq. inch
  - Dots printed per unit
  - All of above

**63) In analogue Computer**

- a. Input is first converted to digital form
- b. Input is never converted to digital form
- c. Output is displayed in digital form
- d. All of above

**64) In latest generation Computers, the instructions are executed**

- a. Parallel only
- b. Sequentially only
- c. Both sequentially and parallel
- d. None of these

**65) Who designed the first electronics Computer – ENIAC?**

- a. Van-Neumann
- b. Joseph M. Jacquard
- c. J. Presper Eckert and John W. Mauchly
- d. All of above

**66) Who invented the high level language “C”?**

- a. Dennis M. Ritchie
- b. Niklaus Wirth
- c. Seymour Papert
- d. Donald Knuth

**67) Personnel who design, program, operate and maintain Computer equipment refers to**

- a. Console-operator
- b. Programmer
- c. Peopleware
- d. System Analyst

**68) When did arch rivals IBM and Apple Computers Inc. decide to join hands?**

- a. 1978
- b. 1984
- c. 1990
- d. 1991

**69) Human beings are referred to as Homo sapiens, which device is called Silicon Sapiens?**

- a. Monitor
- b. Hardware
- c. RPBAT
- d. Computer

**70) An error in software or hardware is called a bug. What is the alternative Computer jargon for it?**

- a. Leech
- b. Squid
- c. Slug
- d. Glitch

71) Modern Computer are very reliable but they are not

- a. Fast
- b. Powerful
- c. Infallible
- d. Cheap

72) What is the name of the display feature that highlights are of the screen which requires operator attention?

- a. Pixel
- b. Reverse Video
- c. Touch Screen
- d. Cursor

73) Personal Computers use a number of chips mounted on a main circuit board. What is the common name for such boards?

- a. Daughter board
- b. Motherboard
- c. Father board
- d. Breadboard

74) In most IBM PCs, the CPU, the device drives, memory expansion slots and active components are mounted on a single board. What is the name of this board?

- a. Motherboard
- b. Breadboard
- c. Daughter board
- d. Grandmother board

75) What is meant by a dedicated Computer?

- a. Which is used by one person only
- b. Which is assigned one and only one task
- c. Which uses one kind of software
- d. Which is meant for application software

76) The system unit of a personal Computer typically contains all of the following except:

- a. Microprocessor
- b. Disk controller
- c. Serial interface
- d. Modem

77) A Computer program that converts an entire program into machine language is called a/an

- a. Interpreter
- b. Simulator
- c. Compiler
- d. Commander

78) Computer program that translates one program instructions at a time into machine language is called a/an

- a. Interpreter                      b. CPU
- c. Compiler                        d. Simulator

79) A small or intelligent device is so called because it contains within it a

- a. Computer                        b. Micro Computer
- c. Programmable                d. Sensor

80) A fault in a Computer program which prevents it from working correctly is known as

- a. Boot                                b. Bug
- c. Biff                                d. Strap

81) A self replicating program, similar to a virus which was taken from a 1970s science fiction novel by John Bruner entitled the Shockwave Rider is

- a. Bug                                b. Vice
- c. Lice                                d. Worm

82) A state. is a bi-stable electronic circuit that has

- a. Multivibrator                    b. Flip-flop
- c. Logic gates                      d. laten

83) Unwanted repetitious messages, such as unsolicited bulk e-mail is known as

- a. Spam                                b. Trash
- c. Calibri                            d. Courier

84) DOS stands for

- a. Disk Operating System        b. Disk operating session
- c. Digital Operating System      d. Digital Open system

85) Who is the chief of Microsoft

- a. Chales Babbage                b. Bill Gates
- c. Bill Clinton                      d. none of these

86) Which of the following are input devices?

- a. Keyboard                        b. Mouse
- c. Card reader                      d. Any of these

87) Examples of output devices are

- a. Screen
- b. Printer
- c. Speaker
- d. All of these

88) Which of the following is also known as brain of Computer

- a. Processing Control unit
- b. Central processing unit
- c. Arithmetic and language unit
- d. Monitor

89) IBM stands for

- a. Internal Business Management
- b. International Business Management
- c. International Business Machines
- d. Internal Business Machines

90) Translates and Executes program at run time line by line

- a. Compiler
- b. Interpreter
- c. Linker
- d. Loader

91) \_\_\_\_\_ is an OOP principle

- a. Structured programming
- b. Procedural programming
- c. Inheritance
- d. Linking

92) COBOL is widely used in applications

- a. Commercial
- b. Scientific
- c. Space
- d. Mathematical

93) RAM stands for

- a. Random origin money
- b. Random only memory
- c. Read only memory
- d. Random access memory

94) 1 Byte = ?

- a. 8 bits
- b. 4 bits
- c. 2 bits
- d. 9 bits



95) SMPS stands for

- a. Switched mode Power Supply
- b. Start mode power supply
- c. Store mode powersupply
- d. Single mode power supply

96) The device used to carry digital data on analogue lines is called as

- a. Modem
- b. Multiplexer
- c. Modulator
- d. Demodulator

97) VDU is also called

- a. Screen
- b. Monitor
- c. Both 1 & 2
- d. printer

98) BIOS stands for

- a. Basic Input Output system
- b. Binary Input output system
- c. Basic Input Off system
- d. all the above

99) Father of 'C' programming language

- a. Dennis Ritchie
- b. Prof John Keenly
- c. Thomas Kurtz
- d. Bill Gates

100) The instructions that tell a Computer how to carry out the processing tasks are referred to as Computer.....

- a. programs
- b. processors
- c. input devices
- d. memory modules

101) An area of a Computer that temporarily holds data waiting to be processed is.....

- a. CPU
- b. Memory
- c. Storage
- d. File

102) \_\_\_\_\_ is the key to close a selected drop -down list; cancel a command and close a dialog box.

- a. TAB
- b. SHIFT
- c. ESC
- d. F10

- 103) \_\_\_\_\_ is the key we use to run the selected command.
- SHIFT
  - TAB
  - ENTER
  - CTRL
- 104) \_\_\_\_\_ is the functional key to display save-as box.
- F5
  - F6
  - F9
  - F12
- 105) Data becomes ..... when it is presented in a format that people can understand and use
- processed
  - graphs
  - information
  - presentation
- 106) The term \_\_\_\_\_ designates equipment that might be added to a Computer system to enhance its functionality.
- digital device
  - system add-on
  - disk pack
  - peripheral device
- 107) A \_\_\_\_\_ is a microprocessor -based computing device.
- personal Computer
  - mainframe
  - workstation
  - server
- 108) RAM can be treated as the ..... for the Computer's processor
- Factory
  - Operating room
  - Waiting room
  - Planning room
- 109) Which of the following are the functions of a operating system
- Allocates resources
  - Monitors Activities
  - Manages disks and files
  - All of the above
- 110) To move a copy of file from one Computer to another over a communication channel is called?
- File transfer
  - File encryption
  - File modification
  - File copying

- 111) The primary function of the is to set up the hardware and load and start an operating system.
- System Programs
  - BIOS
  - CP
  - Memory
- 112) What kind of memory is both static and non-volatile?
- RAM
  - ROM
  - BIOS
  - CACHE
- 113) \_\_\_\_\_ is Computer software designed to operate the Computer hardware and to provide platform for running application software.
- Application software
  - System software
  - Software
  - Operating system
- The \_\_\_\_\_ is the amount of data that a storage device can move from the storage medium to the Computer per second.
- data migration rate
  - data digitizing rate
  - data transfer rate
  - data access rate
- 114) A device, which is not connected to CPU, is called as .....
- land-line device
  - On-line device
  - Off-line device
  - Device
- 115) What is the other name for programmed chip?
- RAM
  - ROM
  - LSIC
  - PROM
- 116) On-line real time systems become popular in generation.
- First Generation
  - Second Generation
  - Third Generation
  - Fourth Generation
- 117) You use a(n), such as a keyboard or mouse, to input information
- output device
  - input device
  - storage device
  - processing device

- 118) \_\_\_\_\_ is the ability of a device to "jump" directly to the requested data
- Sequential access
  - Random access
  - Quick access
  - All of the above
- 119) Provides process and memory management services that allow two or more tasks, jobs, or programs to run simultaneously.
- Multitasking
  - Multithreading
  - Multiprocessing
  - Multicomputing
- 120) The task of performing operations like arithmetic and logical operations is called.....
- Processing
  - Storing
  - Editing
  - Sorting
- 121) ALU and Control Unit jointly known as
- RAM
  - ROM
  - CPU
  - PC
- 122) RAM is an example of
- Secondary memory
  - Primary memory
  - Main memory
  - Both (1) and (2)
- 123) Magnetic disk is an example of
- Secondary memory
  - Primary memory
  - Main memory
  - Both (1) and (2)
- 124) Which one of the following is NOT a Computer language.
- MS-Excel
  - BASIC
  - COBOL
  - C++
- 125) RAM is also called as
- Read / Write Memory
  - Long Memory
  - Permanent Memory
  - Primary Memory
- 126) Store data or information temporarily and pass it on as directed by the control unit
- Address
  - Register
  - Number
  - Memory

- 127) Select the Odd one
- a. Operating system
  - b. Interpreter
  - c. Compiler
  - d. Assembler
- 128) A\_\_\_\_\_is an additional set of commands that the Computer displays after you make a selection from the mainmenu.
- a. dialog box
  - b. submenu
  - c. menu selection
  - d. All of the above
- 129) COBOL is an acronym for.....
- a. Common Business Oriented Language
  - b. Computer Business Oriented Language
  - c. Common Business Operated Language
  - d. Common Business OrganizedLanguage
- 130) All of the following are examples of real security and privacyrisks EXCEPT
- a. hackers
  - b. Spam
  - c. Viruses
  - d. identity theft
- 131) Which of the following is NOT one of the four major data processing functions of a Computer?
- a. gathering data
  - b. processing data into information
  - c. analyzing the data or information
  - d. storing the data or information
- 132) All of the following are examples of storage devices EXCEPT:
- a. hard disk drives
  - b. printers
  - c. floppy disk drives
  - d. CD drives
- 133) The CPU and memory are located on the :
- a. expansion board
  - b. motherboard
  - c. storage device
  - d. output device



- 134) \_\_\_\_\_ is the science that attempts to produce machines that display the same type of intelligence that humans do
- Nanoscience
  - Nanotechnology
  - Simulation
  - Artificial intelligence
- 135) Servers are Computers that provide resources to other Computers connected to a :
- networked
  - mainframe
  - super computer
  - client
- 136) When creating a Computer program, the designs the structure of the program.
- End user
  - System Analyst
  - Programmer
  - All of the above
- 137) A Computer program that converts an entire program into machine language at one time is called a/ an
- Interpreter
  - simulator
  - characters
  - compiler
- 138) Computers process data into information by working exclusively with :
- multimedia
  - word
  - numbers
  - characters
- 139) The difference between people with access to Computers and the Internet and those without this access is known as the :
- digital divide
  - Internet divide
  - Web divide
  - E-illiteracy
- 140) Computers manipulate data in many ways, and this manipulation is called.....
- upgrading
  - processing
  - batching
  - utilizing
- 141) The ability to recover and read deleted or damaged files from a criminal's Computer is an example of a law enforcement speciality called:
- robotics
  - simulation
  - Computer forensics
  - animation

- 142) Where does most data go first with in a Computer memory hierarchy ?
- RAM
  - ROM
  - BIOS
  - CACHE
- 143) The \_\_\_\_\_ data mining technique derives rules from real-world case examples.
- Rule discover
  - Signal processing
  - Neural nets
  - Case-based reasoning
- 144) \_\_\_\_\_ are used to identify a user who returns to a Website
- Cookies
  - Plug-ins
  - Scripts
  - ASPs
- 145) Codes consisting of lines of varying widths or lengths that are Computer-readable are known as-
- an ASCII code
  - a magnetic tape
  - an OCR scanner
  - a bar code
- 146) Why is it unethical to share copyrighted files with your friends?
- It is not unethical, because it is legal.
  - It is unethical because the files are being given for free.
  - Sharing copyrighted files without permission breaks copyright laws.
  - It is not unethical because the files are being given for free.
- 147) Reusable optical storage will typically have the acronym-
- CD
  - DVD
  - ROM
  - RW
- 148) The most common type of storage devices are-
- Steel
  - Optical
  - Magnetic
  - Flash
- 149) A device that connects to a network without the use of cables is said to be-
- Distributed
  - free
  - centralized
  - none of these

- 150) A person who used his or her expertise to gain access to other people's Computers to get information illegally or do damage is a-
- a. Hacker
  - b. spammer
  - c. instant messenger
  - d. programmer
- 151) To access properties of an object, the mouse technique to use is-
- a. Dragging
  - b. dropping
  - c. right-clicking
  - d. shift-clicking
- 152) A DVD is an example of a (n)-
- a. hard disk
  - b. optical disc
  - c. output device
  - d. solid-state storage device
- 153) The process of transferring files from a Computer on the Internet to your Computer is called
- a. Downloading
  - b. uploading
  - c. FTP
  - d. JPEG
- 154) \_\_\_\_\_ is the process of dividing the disk into tracks and sectors.
- a. Tracking
  - b. Formatting
  - c. Crashing
  - d. Allotting
- 155) Help Menu is available at which button?
- a. End
  - b. Start
  - c. Turn off
  - d. Restart
- 156) The technology that stores only the essential instructions on a microprocessor chip and thus enhances its speed is referred to as
- a. CISC
  - b. RISC
  - c. CD -ROM
  - d. Wi-Fi
- 157) Which is not a basic function of a computer?
- a. Store data
  - b. Accept input
  - c. Process data
  - d. Copy Text

- 158) ASCII is a coding system that provides
- a. 256 different characters
  - b. 512 different characters
  - c. 1024 different characters
  - d. 128 different characters
- 159) Which part of the Computer is directly involved in executing the instructions of the Computer program?
- a. The scanner
  - b. The main storage
  - c. The secondary storage
  - d. The processor
- 160) When a Computer is switched on, the booting process performs.
- a. Integrity Test
  - b. Power-On Self-Test
  - c. Correct Functioning Test
  - d. Reliability Test
- 161) A Computer system that is old and perhaps not satisfactory is referred to as a(n)
- a. Ancient system
  - b. Historical system
  - c. Age old system
  - d. Legacy system
- 162) Which of the following is not a binary number?
- a. 001
  - b. 101
  - c. 202
  - d. 110
- 163) Which of the following does not store data permanently?
- a. ROM
  - b. RAM
  - c. Floppy Disk
  - d. Hard Disk
- 164) Which of the following is the smallest storage?
- a. Megabyte
  - b. Gigabyte
  - c. Terabyte
  - d. None of these
- 165) Which of the following contains permanent data and gets updated during the processing of transactions?
- a. Operating System File
  - b. Transaction file
  - c. Software File
  - d. Master file

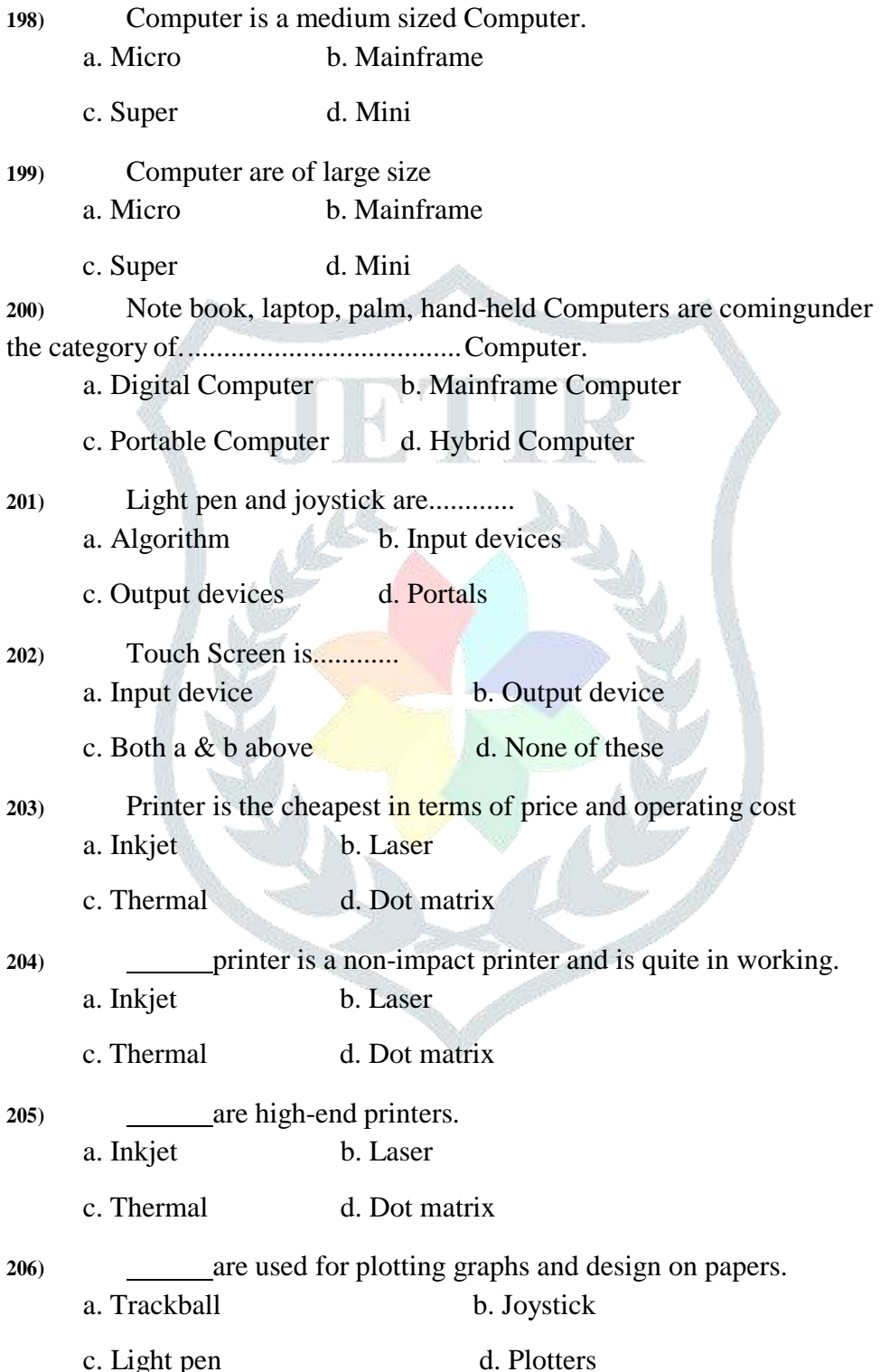
- 166) Which of the following helps to protect floppy disks from data getting accidentally erased?
- Access notch
  - Write-protect notch
  - Entry notch
  - Input notch
- 167) A modem is connected to
- a telephone line
  - a keyboard
  - a printer
  - a monitor
- 168) Large transaction processing systems in automated organisations use
- Online processing
  - Batch Processing
  - Once-a-day Processing
  - End-of-day processing
- 169) In a Computer, most processing takes place in
- Memory
  - RAM
  - Motherboard
  - CPU
- 170) Which of the following is not a storage medium?
- Hard disk
  - Flash drive
  - DVD
  - scanner
- 171) The Computer abbreviation KB usually means
- Key Block
  - Kernel Boot
  - Kilo Byte
  - Kit Bit
- 172) The typical Computer criminal is a(n):
- Young hacker.
  - Trusted employee with no criminal record.
  - Trusted employee with a long, but unknown criminal record.
  - Overseas young cracker.
- 173) The common name for the crime of stealing passwords is:
- Jacking
  - Identity theft
  - Spoofing
  - Hacking

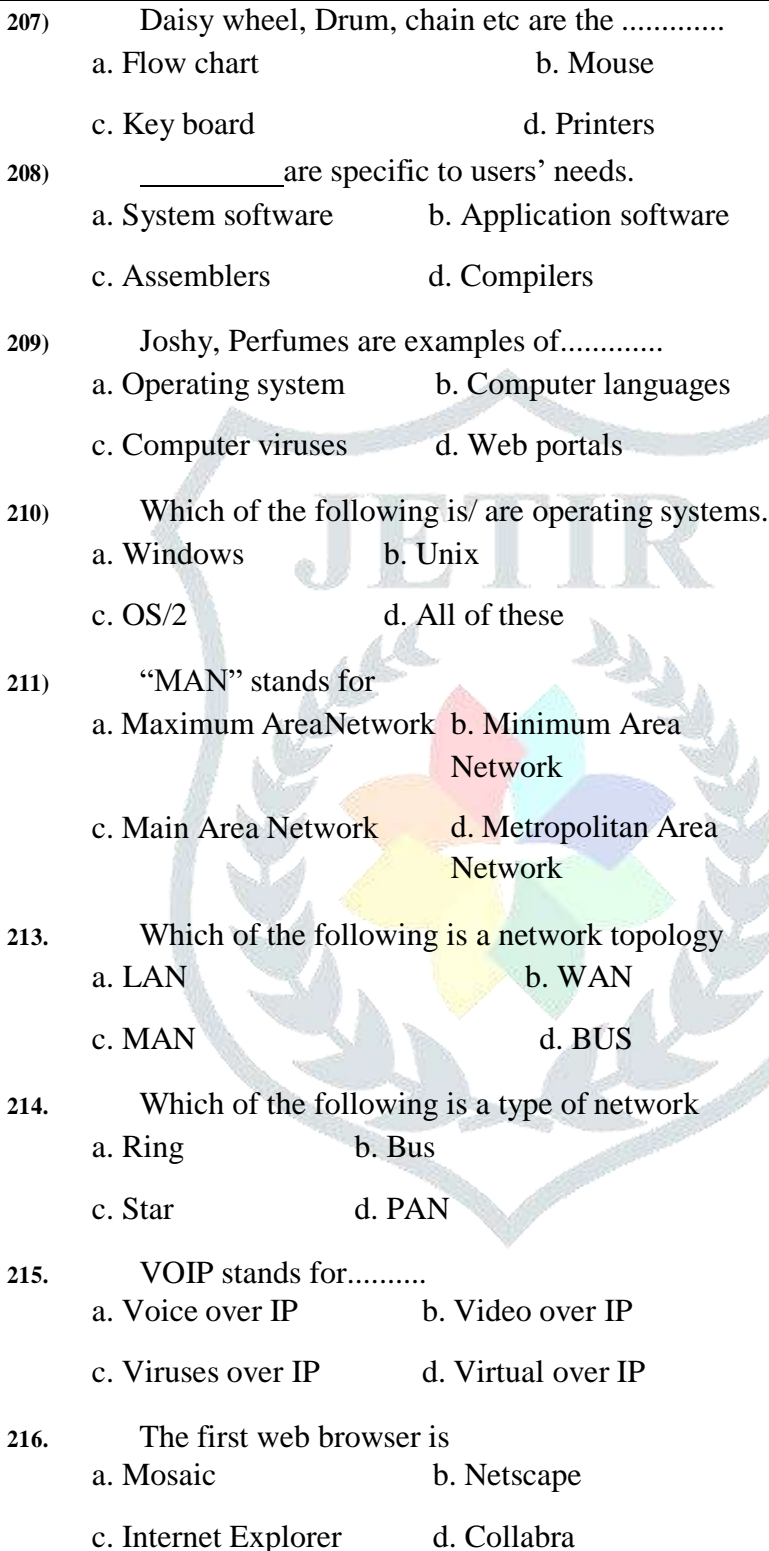


- 174) Collecting personal information and effectively posing as another individual is known as the crime of:
- a. Spooling                      b. Identity theft
  - c. Spoofing                      d. Hacking
- 175) Malicious software is known as:
- a. Bad ware                      b. Malware
  - c. Malicious ware              d. Illegal ware
- 176) A program that performs a useful task while simultaneously allowing destructive acts is a:
- a. Worm                              b. Trojan horse
  - c. Virus                              d. Macro virus
- 177) An intentionally disruptive program that spreads from program to program or from disk to disk is known as a:
- a. Trojan horse.                  b. Virus.
  - c. Time bomb                      d. Time-related bomb sequence
- 178) In 1999, the Melissa virus was a widely publicised:
- a. E-mail virus                      b. Macro virus.
  - c. Trojan horse.                      d. Time bomb.
- 179) What type of virus uses Computer hosts to reproduce itself?
- a. Time bomb                      b. Worm
  - c. Melissa virus                      d. Macro virus
- 180) The thing that eventually terminates a worm virus is a lack of:
- a. Memory or disk space.          b. Time
  - c. CD drives space                  d. CD-RW.
- 181) When a logic bomb is activated by a time-related event, it is known as a:
- a. Time-related bomb sequence.      b. Virus.
  - c. Time bomb.                      d. Trojan horse.

- 182) A logic bomb that was created to erupt on Michelangelo's birthday is an example of a:
- a. Time-related bomb                      b. Virus.
  - sequence.
  - c. Time bomb.                                  d. Trojan horse.
- 183) What is the name of an application program that gathers user information and sends it to someone through the Internet?
- a. A virus    b. Spybot
  - c. Logic bomb                                  d. Security patch
- 184) \_\_\_\_\_ is the measurement of things such as fingerprints and retinal scans used for security access.
- a. Biometrics                                      b. Bio measurement
  - c. Computer security                              d. Smart weapon machinery
- 185) What is the most common tool used to restrict access to a Computer system?
- a. User logins                                      b. Passwords
  - c. Computer keys                                  d. Access-control software
- 186) Hardware or software designed to guard against unauthorized access to a Computer network is known as a(n):
- a. Hacker-proof program.                      b. Firewall.
  - c. Hacker-resistant server.                      d. Encryption safe wall.
- 187) The scrambling of code is known as:
- a. Encryption                                      b. A firewall
  - c. Scrambling                                      d. Password proofing
- 188) To prevent the loss of data during power failures, use a(n):
- a. Encryption program                              b. Surge protector
  - c. Firewall    d. UPS.

- 189) Is defined as any crime completed through the use of Computer technology.
- Computer forensics
  - Computer crime
  - Hacking
  - Cracking
- 190) \_\_\_\_\_ refers to electronic trespassing or criminal hacking.
- Cracking
  - Jacking
  - Spoofing
  - Smarming
- 191) The first electronic Computer was developed by
- J.V. Attansoff
  - Bill Gates
  - Simur Cray
  - Winton Serf
- 192) Snowbol is an/a \_\_\_\_\_.
- Operating system
  - HLL
  - Software
  - Search engine
- 193) Switching device of fifth generation Computer is \_\_\_\_\_.
- Vacuum tubes
  - Transistors
  - IC
  - VLSI
- 194) Computers operates essentially by counting
- Portable Computer
  - Hybrid Computer
  - Analog Computer
  - Digital Computer
- 195) Computer is small general purpose micro Computer, but larger than portable Computer.
- Hybrid
  - Digital
  - Desktop
  - Laptop
- 196) Cathode Ray Tube is a form of.....
- Keyboard
  - Mouse
  - Monitor
  - Mother board
- 197) Trackball is a.....
- Input device
  - Output device
  - Programming language
  - Software







217. LAN stands for.....

- a. Limited Area Network      b. Logical Area Network
- c. Local Area Network      d. Large Area Network

218. \_\_\_\_\_ are set of rules and procedures to control the data transmission over the internet

- a. IP address      b. Domains
- c. Protocol      d. Gateway

219. NOS stands for

- a. Node operating system      b. Non-open software
- c. Network Operatingsystem      d. Non-operating software

220. \_\_\_\_\_ are system software to facilitate editing of text and data

- a. MS Word      b. Editors
- c. PowerPoint      d. MS publisher

221. Computers, combine both measuring and counting, are called :

- a. Analog      b. Digital
- c. Hybrid      d. All of these

222. In world today, most of the Computers are :

- a. Digital      b. Hybrid
- c. Analog      d. Complex

223. Physical structure of Computer is called :

- a. Software      b. Hardware
- c. Human ware      d. All of these

224. In which type of Computer, data are represented as discrete signals.

- a. Analog Computer      b. Digital Computer
- c. Both      d. Hybrid Computer

225. Which of the following is available in the form of a PC now?

- a. Mainframe                      b. Micro Computer  
c. Mini Computer                d. Both B and C

226. PARAM is an example of:

- a. Super Computer                b. PC  
c. Laptop                              d. PDA

### Answers

<u>Q.No</u>	<u>Ans</u>	<u>Q.No</u>	<u>Ans</u>	<u>Q.No</u>	<u>Ans</u>	<u>Q.No</u>	<u>Ans</u>	<u>Q.No</u>	<u>Ans</u>
1	a	55	b	109	d	163	c	217	c
2	b	56	c	110	a	164	b	218	c
3	b	57	c	111	b	165	d	219	c
4	a	58	b	112	b	166	d	220	b
5	a	59	a	113	b	167	b	221	c
6	c	60	d	114	c	168	a	222	a
7	a	61	a	115	c	169	b	223	b
8	b	62	b	116	c	170	d	224	b
9	a	63	b	117	c	171	d	225	b
10	b	64	c	118	b	172	c	226	a
11	a	65	c	119	b	173	b		
12	b	66	a	120	a	174	c		
13	a	67	c	121	a	175	b		
14	b	68	d	122	c	176	b		
15	b	69	d	123	b	177	b		
16	a	70	d	124	a	178	b		
17	a	71	c	125	a	179	a		
18	a	72	b	126	a	180	b		
19	a	73	b	127	b	181	a		
20	b	74	a	128	a	182	c		
21	a	75	b	129	a	183	c		
22	d	76	d	130	a	184	b		
23	b	77	c	131	b	185	a		
24	a	78	a	132	c	186	b		
25	a	79	d	133	b	187	b		
26	d	80	b	134	b	188	a		
27	a	81	d	135	d	189	d		
28	a	82	b	136	b	190	b		
29	b	83	a	137	b	191	a		
30	c	84	a	138	c	192	a		
31	c	85	b	139	c	193	b		

32	b	86	d	140	a	194	d
33	a	87	d	141	b	195	d
35	a	89	c	143	a	197	c
36	b	90	b	144	c	198	a
37	b	91	c	145	a	199	d
38	d	92	a	146	d	200	b
39	a	93	d	147	c	201	c
40	b	94	a	148	d	202	b
41	b	95	a	149	b	203	c
42	c	96	a	150	d	204	d
43	d	97	c	151	a	205	a
44	c	98	a	152	c	206	b
45	b	99	a	153	b	207	d
46	b	100	a	154	a	208	d
47	d	101	b	155	b	209	b
48	b	102	c	156	b	210	c
49	c	103	c	157	b	211	d
50	d	104	d	158	d	212	d
51	b	105	c	159	c	213	d
52	a	106	d	160	d	214	d
53	c	107	a	161	b	215	a
54	a	108	c	162	d	216	a