1.1 Introduction: A computer is necessary in daily life for several reasons. Firstly, it allows us to access and process vast amounts of information quickly and efficiently, whether for work, education, or personal use. Computers also enable communication through email, social media, and video calls, connecting us with others around the world. They are essential for tasks such as online banking, shopping, and accessing entertainment. Additionally, computers are used in various industries for tasks like data analysis, design, and research. Overall, computers have become indispensable for modern life due to their ability to streamline tasks, facilitate communication, and provide access to a wealth of information and services.

1.2 Definition of Computer: A computer is an electronic device, operating under the control of instructions stored in its own memory that can accept data (input), process the data according to specified rules, produce information (output), and store the information for future use.

1.3 Characteristics of Computer: Some key characteristics of computers are follows:

i) **Speed:** The first and tone of the most important characteristics of computers that comes to everybody's mind is the speed of the computer. It is way faster than humans. It performs several calculations and tasks in few seconds that we take hours to solve. The speed of a computer is measure in terms of GigaHertz and MegaHertz.

ii) **Accuracy:** Accuracy plays a major role in adapting computers as they are highly accurate and can perform the calculator with extreme precision. They do not mistake like humans due to distraction, or forgetfulness.

iii) **Flexibility:** Computers can be programmed to perform a wide range of tasks, from simple calculations to complex operations. They can also be easily reprogrammed to perform new tasks, making them highly flexible.

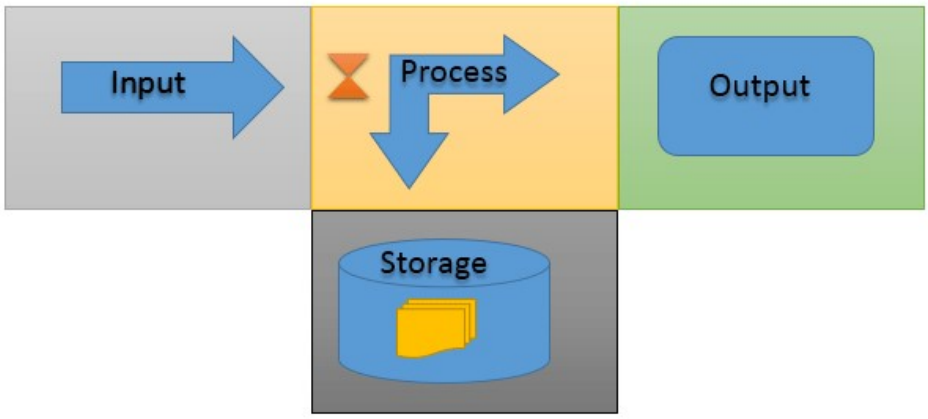
iv) **Consistency:** Computers are consistent in their performance, which means they can perform the same task repeatedly without any variation in their output. This makes them highly reliable for performing critical tasks.

v) **Data Storage Capacity:** The data storage capacity of computers are enhancing day by day although they can store huge amount of data. Modern computers can store data in terms of Terabytes where a byte is a term used for storage capacity. This will help in tasks such as graphic design, video editing, and data analysis.

vi) **Automation:** Computers can automate repetitive tasks, which can save time and improve efficiency. Automation can be achieved through software programs or hardware devices, such as robots and sensors.

vii) **Multitasking:** The computers are able to perform various tasks simultaneously which makes the user work on various projects at once. This characteristic of computers is helpful in tasks like data analysis, video editing, etc.

1.4 Functions of a Computer: A computer has four main functions, they are:



i) **Input:** Input is the data entered in to a computer from the input devices like keyboard, mouse, scanner etc. Input data can be a character, word, image etc. When you enter information (input) in to your computer a signal is send to CPU (central processing unit).

ii) **Processing:** The task of performing the operations like logical and arithmetic operations is called processing. The CPU (Central Processing Unit) will perform all types of calculations based on the instructions given. It is then send to the storage unit.

iii) **Output:** The process of producing the useful information for the user after processing input data is called output. After performing the calculations based on given instructions, the processed data is send to the output device. Output device then translates the processed data in to a form (text, image, document etc) that can understand to the user.

iv) **Storage:** The process of storing instructions and data permanently is called storage. This stored data can be retrieved whenever needed.

1.5 Generations of Computer: The Generation of Computer tells about the evolution of technology to distinguish the computers in terms of varying hardware and software.

Generations of Computer	Time-Period	Evolving Hardware
First Generation	1940s – 1950s	Vacuum Tube Based
Second Generation	1950s – 1960s	Transistor Based
Third Generation	1960s – 1970s	Integrated Circuit Based
Fourth Generation	1970s – Present	Microprocessor Based
Fifth Generation	Present – Future	Artificial Intelligence Based

i) First Generation of Computers

The first generation used vacuum tube technology and were built between 1946 and 1949. Vacuum tubes were expensive and produced a lot of heat, which made these computers very expensive and only affordable to large organizations. Machine language was the programming language used for these computers, and they could not multitask.

The ENIAC was the first electronic general-purpose computer that used 18,000 vacuum tubes and was built in 1943 for war-related calculations. Examples of the first generation include EDVAC, IBM-650, IBM-701, Manchester Mark 1, Mark 2, etc.

Here are two of the main advantages of first generation:

- The first generation was tough to hack and was quite strong.
- The first generation could perform calculations quickly, in just one-thousandth of a second.

Here are two of the main disadvantages of first generation:

- They consumed high amounts of energy/electricity.
- They were not portable due to their weight and size.

ii) Second Generation of Computers

The second generation of computers was developed in the late 1950s and 1960s. These computers replaced vacuum tubes with transistors making them smaller, faster and more efficient. This was done as transistors were more reliable than vacuum tubes, required less maintenance and generated less heat.

Second-generation computers were smaller and more portable, making them accessible to a wider audience. Magnetic core memory was also introduced in this generation, which was faster and more reliable. This laid the foundation for further developments, paving the way for the third generation that used integrated circuits.

Here are two of the main advantages of second generation:

- They provided better speed and improved accuracy.
- Computers developed in this era were smaller, more reliable, and capable of using less power.

Here are two of the main disadvantages of second generation:

- They were only used for specific objectives and required frequent maintenance.
- The second generation of computer used punch cards for input, which required frequent maintenance.

iii) Third Generation of Computers

The third generation of computers emerged between 1964 and 1971. This generation used microchips or integrated circuits, making it possible to create smaller, cheaper, and much faster computers.

The third generation of computers was much faster than previous generations, with computational times reduced from microseconds to nanoseconds. New input devices like the mouse and keyboard were introduced, replacing older methods like punch cards. New functionalities, like multiprogramming and time-sharing, and remote processing, were introduced, allowing for more efficient use of computer resources.

Here are two of the main advantages of third generation:

- The use of integrated circuits made them more reliable.
- Smaller in size and required less space than previous generations.

Here are two of the main disadvantages of third generation:

- Advanced technology was needed to manufacture IC chips.
- Formal training was necessary to operate third-gen computers.

iv) Fourth Generation of Computers

Fourth generation computers were developed in 1972 after third generation that used microprocessors. They used Very Large Scale Integrated (VLSI) circuits, which contained about 5000 transistors capable of performing complex activities and computations.

Fourth generation computers were more adaptable, had more primary storage capacity, were faster and more reliable than previous generations, and were also portable, small, and required less electricity. Intel was the first company to develop a microprocessor used in fourth generation computer.

Fourth generation computers used LSI chip technology and were incredibly powerful but also very small, leading to a societal revolution in the computer industry. This generation had the first supercomputers, used complex programming languages like C, C++, DBASE, etc., and could perform many accurate calculations.

Here are two of the main advantages of fourth generation:

- Fourth generation computers were smaller and more dependable.
- GUI (Graphics User Interface) technology was used in this generation to provide users with better comfort.

Here are two of the main disadvantages of fourth generation:

- They use complex VLSI Chips, and VLSI Chip manufacturing requires advanced technology.
- To build these computers, Integrated Circuits (ICs) were required, and to develop those, cutting-edge technology was needed.

v) Fifth Generation of Computers

The fifth generation of computers emerged after the fourth generation and is still being developed. Computers of fifth generation use artificial intelligence (AI) to perform various tasks. These computers use programming languages such as Python, R, C#, Java, etc., as input methods.

The fifth generation computers employ ULSI technology (Ultra Large Scale Integration), parallel processing, and AI to perform scientific computations and develop AI software. They can perform intricate tasks such as image recognition, human speech interpretation, natural language understanding, etc. Examples of fifth generation include laptops, desktops, notebooks, chromebooks, etc.

Here are two of the main advantages of fifth generation:

- These computers are lightweight and easy to move around.
- They are easier to repair and parallel processing technology has improved in these computers.

Here are two of the main disadvantages of fifth generation:

- Using it for spying on people.
- Fear of unemployment due to AI replacing jobs.

1.6 Computer Components: Any kind of computers consists of Hardware and Software.

1.6.1 Hardware: Computer hardware is the collection of physical elements that constitutes a computer system. Computer hardware refers to the physical parts or components of a computer such as the monitor, mouse, keyboard, computer data storage, hard drive disk (HDD), system unit (graphic cards, sound cards, memory, motherboard and chips), etc. all of which are physical objects that can be touched.

i) **Input Devices**: Input device is any peripheral (piece of computer hardware equipment to provide data and control signals to an information processing system such as a computer or other information appliance. Input device Translate data from form that humans understand to one that the computer can work with. Most common are keyboard and mouse.

Example of input devices are:

Keyboard

The keyboard is the most frequent and widely used input device for entering data into a computer. Although there are some additional keys for performing other operations, the keyboard layout is similar to that of a typical typewriter.

Mouse: The most common pointing device is the mouse. The mouse is used to move a little cursor across the screen while clicking and dragging. The cursor will stop if you let go of the mouse. The computer is dependent on you to move the mouse; it won't move by itself. As a result, it's an input device.

Joystick: A joystick is a pointing device that is used to move the cursor on a computer screen. A spherical ball is attached to both the bottom and top ends of the stick. In a socket, the lower spherical ball slides. You can move the joystick in all four directions.

Track Ball: Track Ball is an accessory for notebooks and laptops, which works on behalf of a mouse. It has a similar structure to a mouse. Its structure is like a half-inserted ball and we use fingers for cursor movement. Different shapes are used for this like balls, buttons, or squares.

Light Pen: A light pen is a type of pointing device that looks like a pen. It can be used to select a menu item or to draw on the monitor screen. A photocell and an optical system are enclosed in a tiny tube. When the tip of a light pen is moved across a monitor screen while the pen button is pushed, the photocell sensor element identifies the screen location and provides a signal to the CPU.

Scanner: A scanner is an input device that functions similarly to a photocopier. It's employed when there's information on paper that needs to be transferred to the computer's hard disc for subsequent manipulation. The scanner collects images from the source and converts them to a digital format that may be saved on a disc. Before they are printed, these images can be modified.

Optical Mark Reader (OMR): An Optical Mark Reader is a device that is generally used in educational institutions to check the answers to objective exams. It recognizes the marks present by pencil and pen.

Optical Character Reader (OCR): OCR stands for optical character recognition, and it is a device that reads printed text. OCR optically scans the text, character by character turns it into a machine-readable code, and saves it to the system memory.

Magnetic Ink Card Reader (MICR): It is a device that is generally used in banks to deal with the cheques given to the bank by the customer. It helps in reading the magnetic ink present in the code number and cheque number. This process is very fast compared to any other process.

Bar Code Reader: A bar code reader is a device that reads data that is bar-coded (data that is represented by light and dark lines).Bar-coded data is commonly used to mark things, number books, and so on. It could be a handheld scanner or part of a stationary scanner. A bar code reader scans a bar code image, converts it to an alphanumeric value, and then sends it to the computer to which it is connected.

Web Camera: Because a web camera records a video image of the scene in front of it, a webcam is an input device. It is either built inside the computer (for example, a laptop) or attached through a USB connection. A webcam is a computer-connected tiny digital video camera. It's also known as a web camera because it can take images and record video.

Digitizer: Digitizer is a device that is used to convert analog signals to digital signals. it converts signals into numeric values. An example of a Digitizer is Graphic Tablet, which is used to convert graphics to binary data.

Microphone: The microphone works as an input device that receives input voice signals and also has the responsibility of converting it also to digital form. It is a very common device that is present in every device which is related to music.

ii) Central Processing Unit (CPU)

A CPU is brain of a computer. It is responsible for all functions and processes. Regarding computing power, the CPU is the most important element of a computer system.

The CPU is comprised of three main parts :

* ***Arithmetic Logic Unit (ALU)***: Executes all arithmetic and logical operations.

Arithmetic calculations like as addition, subtraction, multiplication and division.

Logical operation like compare numbers, letters, or special characters

* ***Control Unit (CU):*** controls and co-ordinates computer components.

1. Read the code for the next instruction to be executed.
2. Increment the program counter so it points to the next instruction.
3. Read whatever data the instruction requires from cells in memory.
4. Provide the necessary data to an ALU or register.
5. If the instruction requires an ALU or specialized hardware to complete, instruct the hardware to perform the requested operation.

* ***Registers*** :Stores the data that is to be executed next, "very fast storage area".

iii) Primary Memory:-

a. **RAM**: Random Access Memory (RAM) is a memory scheme within the computer system responsible for storing data on a temporary basis, so that it can be promptly accessed by the processor as and when needed. It is volatile in nature, which means that data will be erased once supply to the storage device is turned off. RAM stores data randomly and the processor accesses these data randomly from the RAM storage. RAM is considered "random access" because you can access any memory cell directly if you know the row and column that intersect at that cell.

b. **ROM** (Read Only Memory): ROM is a permanent form of storage. ROM stays active regardless of whether power supply to it is turned on or off. ROM devices do not allow data stored on them to be modified.

iv) Secondary Memory:-

Stores data and programs permanently: its retained after the power is turned off

a. **Hard drive (HD):** A hard disk is part of a unit, often called a "disk drive," "hard drive," or "hard disk drive," that store and provides relatively quick access to large amounts of data on an electromagnetically charged surface or set of surfaces.

b. **Optical Disk:** An optical disc drive (ODD) is a disk drive that uses laser light as part of the process of reading or writing data to or from optical discs. Some drives can only read from discs, but recent drives are commonly both readers and recorders, also called burners or writers. Compact discs, DVDs, and Blu-ray discs are common types of optical media which can be read and recorded by such drives. Optical drive is the generic name; drives are usually described as "CD" "DVD", or "Bluray", followed by "drive", "writer", etc. There are three main types of optical media: CD, DVD, and Blu-ray disc. CDs can store up to 700 megabytes (MB) of data and DVDs can store up to 8.4 GB of data. Blu-ray discs, which are the newest type of optical media, can store up to 50 GB of data. This storage capacity is a clear advantage over the floppy disk storage media (a magnetic media), which only has a capacity of 1.44 MB.

c. **Flash Disk:** A storage module made of flash memory chips. A Flash disk has no mechanical platters or access arms, but the term "disk" is used because the data are accessed as if they were on a hard drive. The disk storage structure is emulated.

Difference between Primary memory and secondary memory:

Primary memory is used for temporarily storing data that is actively being used by the computer's CPU, while secondary memory (storage) is used for long-term data storage, such as files and programs that are not currently in use. Listed below are some other primary and secondary memory differences.

Comparison Parameters	Primary Memory	Secondary Memory
Storage validity	Primary memory is the main memory and stores data temporarily.	Secondary memory is the external memory and stores data permanently.
Access	The CPU can directly access the data.	The CPU cannot directly access the data.
Volatility	Primary memory is volatile. It loses data in case of a power outage.	Secondary memory is non-volatile; data is stored even during a power failure.
Storage	Data is stored inside costly semiconductor chips.	Data is stored on external hardware devices like hard drives, floppy disks, etc.
Division	It can be divided into RAM and ROM	They do not have such a classification. Secondary memories are permanent storage devices like CDs, DVDs, etc.
Speed	Faster	Slower

Stored data	It saves the data that the computer is currently using.	It can save various types of data in various formats and huge sizes.

Difference between RAM and ROM:

The difference between RAM and ROM are as follows:

Points of difference	Random Access Memory (RAM)	Read Only Memory (ROM)
Storage	RAM is used to temporarily store data.	ROM is used to store data permanently
Usage	To ensure that programs execute smoothly RAM enables computers to read data fast.	OM holds all of the apps required to boot the computer for the first time. It just supports reading.
Cost	In comparison to ROM, Random Access Memory (RAM) is more expensive.	The cost of ROM is cheaper than RAM.
Capacity	Compared to ROM, Random Access Memory (RAM) has a larger capacity.	ROM has a lesser capacity than RAM.
Volatility	RAM is volatile memory, therefore its contents are lost when the device is turned off.	it has non-volatile memory means that even when the device is turned off, its contents are kept.
Speed	The speed of Random Access Memory (RAM) is faster than that of ROM.	Read-only Memory (ROM) operates at a slower pace than RAM.
Accessibility	The RAM can make information accessible with ease. Direct access to the data from the RAM by the CPU.	The CPU cannot read data from the ROM directly. It transfers data from the ROM to RAM so that the CPU may access it.
Read/Write	RAM is a read-write memory, which means that the information contained in RAM can be changed.	ROM is a read-only memory, which means that the data stored on it cannot be altered.
Electricity Requirement	RAM requires electricity to flow and sustain information	Electricity is not required to transmit and store data.

Function	Used to temporarily store data that is currently being processed by the CPU.	Read-only memory (ROM) storage is used to permanently store data on personal computers (PCs) and other electronic resources.

v) **Output devices:** An output device is any piece of computer hardware equipment used to communicate the results of data processing carried out by an information processing system (such as a computer) which converts the electronically generated information into human-readable form.

Example of output devices are:

Monitor: Monitors, also known as Visual Display Units (VDUs), are a computer's primary output device. It creates images by arranging small dots, known as pixels, in a rectangular pattern. The amount of pixels determines the image's sharpness.

Printer: Printers are output devices that allow you to print information on paper.

Speakers: Speakers are devices that produce sound after getting a command from a computer. Nowadays, speakers come with wireless technology also like Bluetooth speakers.

Projector: Projectors are optical devices that have the work to show visuals on both types of screens, stationary and moving both. It helps in displaying images on a big screen. Projectors are generally used in theatres, auditoriums, etc.

Plotter: Plotter is a device that helps in making graphics or other images to give a real view. A graphic card is mandatorily required to use these devices. These are the pen-like devices that help in generating exact designs on the computer.

Braille Reader: Braille Reader is a very important device that is used by blind users. It helps people with low vision or no vision to recognize the data by running their fingers over the device to understand easily. It is a very important device for blind persons as it gives them the comfort to understand the letters, alphabets, etc which helps them in study.

Video Card: A video Card is a device that is fitted into the motherboard of the computer. It helps in improvising digital content in output devices. It is an important tool that helps people in using multiple devices.

Global Positioning System (GPS): Global Positioning System helps the user in terms of directions, as it uses satellite technology to track the geometrical locations of the users. With continuous latitudinal and longitudinal calculations, GPS gives accurate results. Nowadays, all smart devices have inbuilt GPS.

Headphones: Headphones are just like a speaker, which is generally used by a single person or it is a single-person usable device and is not commonly used in large areas. These are also called headsets having a lower sound frequency.

1.6.2 Software: Software is a generic term for organized collections of computer data and instructions, often broken into two major categories: system software that provides the basic non-task-specific functions of the computer, and application software which is used by users to accomplish specific tasks.

Software Types

A. System software is responsible for controlling, integrating, and managing the individual hardware components of a computer system so that other software and the users of the system see it as a functional unit without having to be concerned with the low-level details such as transferring data from memory to disk, or rendering text onto a display. Generally, system software consists of an operating system and some fundamental utilities such as disk formatters, file managers, display managers, text editors, user authentication (login) and management tools, and networking and device control software.

B. **Application software** is used to accomplish specific tasks other than just running the computer system. Application software may consist of a single program, such as an image viewer; a small collection of programs (often called a software package) that work closely together to accomplish a task, such as a spreadsheet or text processing system; a larger collection (often called a software suite) of related but independent programs and packages that have a common user interface or shared data format, such as Microsoft Office, which consists of closely integrated word processor, spreadsheet, database, etc.; or a software system, such as a database management system, which is a collection of fundamental programs that may provide some service to a variety of other independent applications.

Difference between System Software and Application Software

Aspect	System Software	Application Software
Purpose	Manages and controls computer hardware and resources	Performs specific tasks for end users
Design	General-purpose software	Specific-purpose software
Interaction	Interfaces between hardware and application software	Interfaces between system software and end users
Examples	Operating systems, device drivers, utility programs	Web browsers, word processors, spreadsheet software
Functionality	Enables application programs to run and interact correctly	Performs specialized tasks such as data organization
Programming Language	Typically written in low-level languages	Usually written in high-level languages
Size	Smaller in size compared to application software	Bigger in size due to its specific functionalities

Speed	Fast operating speed	May have varying speeds depending on the specific task
User Interaction	Less interactive with end users	More interactive with end users
Importance for Computer	Essential for the computer to function correctly	Enhances the computer's usefulness but not essential

1.7 Operating System: An **operating system** (**OS**) is system software that manages computer hardware and software resources, and provides common services for computer programs.

Operating System is a fully integrated set of specialized programs that handle all the operations of the computer. It controls and monitors the execution of all other programs that reside in the computer, which also includes application programs and other system software of the computer. Examples of Operating Systems are Windows, Linux, Mac OS, etc.

1.8 Functions of the Operating System

- **Resource Management:** The operating system manages and allocates memory, CPU time, and other hardware resources among the various programs and processes running on the computer.
- **Process Management:** The operating system is responsible for starting, stopping, and managing processes and programs. It also controls the scheduling of processes and allocates resources to them.
- **Memory Management:** The operating system manages the computer's primary memory and provides mechanisms for optimizing memory usage.
- **Security:** The operating system provides a secure environment for the user, applications, and data by implementing security policies and mechanisms such as access controls and encryption.
- **Job Accounting:** It keeps track of time and resources used by various jobs or users.
- **File Management:** The operating system is responsible for organizing and managing the file system, including the creation, deletion, and manipulation of files and directories.
- **Device Management:** The operating system manages input/output devices such as printers, keyboards, mice, and displays. It provides the necessary drivers and interfaces to enable communication between the devices and the computer.
- **Networking:** The operating system provides networking capabilities such as establishing and managing network connections, handling network protocols, and sharing resources such as printers and files over a network.
- **User Interface**: The operating system provides a user interface that enables users to interact with the computer system. This can be a Graphical User Interface (GUI), a Command-Line Interface (CLI), or a combination of both.
- **Backup and Recovery:** The operating system provides mechanisms for backing up data and recovering it in case of system failures, errors, or disasters.
- **Virtualization:** The operating system provides virtualization capabilities that allow multiple operating systems or applications to run on a single physical machine. This can enable efficient use of resources and flexibility in managing workloads.

- **Performance Monitoring:** The operating system provides tools for monitoring and optimizing system performance, including identifying bottlenecks, optimizing resource usage, and analyzing system logs and metrics.
- **Time-Sharing:** The operating system enables multiple users to share a computer system and its resources simultaneously by providing time-sharing mechanisms that allocate resources fairly and efficiently.
- **System Calls:** The operating system provides a set of system calls that enable applications to interact with the operating system and access its resources. System calls provide a standardized interface between applications and the operating system, enabling portability and compatibility across different hardware and software platforms.
- **Error-detecting Aids:** These contain methods that include the production of dumps, traces, error messages, and other debugging and error-detecting methods.

1.9 Objectives of Operating Systems

Let us now see some of the objectives of the operating system, which are mentioned below.

- **Convenient to use:** One of the objectives is to make the computer system more convenient to use in an efficient manner.
- **User Friendly:** To make the computer system more interactive with a more convenient interface for the users.
- **Easy Access:** To provide easy access to users for using resources by acting as an intermediary between the hardware and its users**.**
- **Management of Resources:** For managing the resources of a computer in a better and faster way.
- **Controls and Monitoring:** By keeping track of who is using which resource, granting resource requests, and mediating conflicting requests from different programs and users.
- **Fair Sharing of Resources:** Providing efficient and fair sharing of resources between the users and programs.

1.10 Types of Operating Systems

- **Batch Operating System:** A Batch Operating System is a type of operating system that does not interact with the computer directly. There is an operator who takes similar jobs having the same requirements and groups them into batches.
- **Time-sharing Operating System:** Time-sharing Operating System is a type of operating system that allows many users to share computer resources (maximum utilization of the resources).
- **Distributed Operating System:** Distributed Operating System is a type of operating system that manages a group of different computers and makes appear to be a single computer. These operating systems are designed to operate on a network of computers. They allow multiple users to access shared resources and communicate with each other over the network. Examples include Microsoft Windows Server and various distributions of Linux designed for servers.
- **Network Operating System:** Network Operating System is a type of operating system that runs on a server and provides the capability to manage data, users, groups, security, applications, and other networking functions.
- **Real-time Operating System:** Real-time Operating System is a type of operating system that serves a real-time system and the time interval required to process and respond to inputs is very small. These operating systems are designed to respond to events in real

time. They are used in applications that require quick and deterministic responses, such as embedded systems, industrial control systems, and robotics.

- **Multiprocessing Operating System:** Multiprocessor Operating Systems are used in operating systems to boost the performance of multiple CPUs within a single computer system. Multiple CPUs are linked together so that a job can be divided and executed more quickly.
- **Single-User Operating Systems:** Single-User Operating Systems are designed to support a single user at a time. Examples include Microsoft Windows for personal computers and Apple macOS.
- **Multi-User Operating Systems:** Multi-User Operating Systems are designed to support multiple users simultaneously. Examples include Linux and Unix.
- **Embedded Operating Systems:** Embedded Operating Systems are designed to run on devices with limited resources, such as smartphones, wearable devices, and household appliances. Examples include Google's Android and Apple's iOS.
- **Cluster Operating Systems:** Cluster Operating Systems are designed to run on a group of computers, or a cluster, to work together as a single system. They are used for high-performance computing and for applications that require high availability and reliability. Examples include Rocks Cluster Distribution and OpenMPI.

Suggested Readings:

1. ITLESL, Introduction to Computer Science, Pearson Education.
2. ITLESL, Introduction to Information Technology, Pearson Education.
3. Sinha&Sinha, Fundamentals of Computers, BPB Publication.
4. Rajaraman, Fundamentals of Computers, PHI.