Yashwantrao
Chavan
Maharashtra
Open University

BBA 1076

Computer Application

Author: Rajashri Sonawane

UNIT 1: Introduction to Computers

UNIT 2: Basics of HTML

UNIT 3: Operating Systems

UNIT 4: Introduction to Boolean Algebra

UNIT 5: Introduction to Computer Networks

UNIT 6: Advanced Networking Concepts

UNIT 7: Structured Design Techniques

UNIT 8: Menu Design and Management Information Systems (MIS)

UNIT 9: Introduction to Windows

UNIT 10: Microsoft Office Applications

UNIT 11: Introduction to the Internet

UNIT 12: Using the Internet

UNIT 13: Database Management Systems (DBMS)

UNIT 14: Cybersecurity and Data Protection

UNIT 15: Software Development and Programming

UNIT 16: Emerging Technologies in Computing

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Production

Shri. Vilas Badhan
Head, Printing and Production center, YCMOU, Nashik

Yashwantrao Chavan Maharashtra Open University, Nashik
(*First edition of developed under DEB development grant***)**

- First Publication: Publication Code:
- Type Setting: Cover Design:
- Printed by:
- Publisher:

ISBN NO: BBA 1076

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Unit 1: Introduction to Computers

Learning Outcomes:

- Students will be able to define a computer.
- Students will be able to describe the main features of computers.
- Students will be able to outline the history and generations of computers.
- Students will be able to identify the components of computers.
- Students will be able to classify different types of computers and their uses.

Structure:

1.1 Definition of Computers

1.2 Features of Computers

- Knowledge Check 1
- Outcome-Based Activity 1

1.3 History and Generations of Computers

1.4 Components of Computers

1.5 Classification of Computers

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- Knowledge Check 2
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1.1 Definition of Computers

A computer can also be described as an electronic machine capable of inputting, processing, and storing data and outputting these processed data in a sequential and orderly manner. It achieves these operations through the integration of both the hardware and software parts. A computer performs functions with bit manipulation that involves data in the form of 0s and 1s performing typical tasks.

- **Components of Computers**

Computers are made up of any number of related individuals who are collectively capable of computation. Fixtures are consubstantial with the main parts of the computer system: the central operating unit (CPU), the memory (RAM and ROM), the input devices (keyboards and mice), the output accessories (displays and printers), and the secondary storage media (hard disk and solid-state disk). The central processing unit serves as the controlling centre that computes and controls the information flow in a computer.

- **Classification of Computers**

There are many ways of categorising computers depending on their size, the task they perform, and size. Desktop or home computers are specially intended for one person and can be met in homes and various offices. The use of laptops enables users to work from any location of their choice due to their portable nature. Computers are very powerful devices that control networks and respond to clients' demands, and servers are specialised Computers in networks. Supercomputers, on the other hand, are designed to solve very intricate problems at a very high degree of computational power, usually used in scientific and navigator research. Also, embedded computers are different from others as they are developed with specific purposes to perform concrete functions like enabling a piece of machinery or an appliance to work.

- **Impact of Computers**

It can be said that the penetration of computers into the world economy is vast; it has affected various sectors and improved them. In the business sector, computers have advanced in carrying out tasks, simplifying workflow, and enhancing communication. In education, computers have revolutionised the manner in which students learn by offering required information and interactive lessons. In general, there has been progress in medicine through the use of computers in diagnosis, record-keeping systems, and imaging. Computerisation has also affected the entertainment sector through the creation of digital media, media consumption, gaming, and virtual reality.

1.2 Features of Computers

They are a crucial component of today's society, affecting technology and culture on various levels, including communication, health, social networks, disadvantages, and education. It becomes crucial to highlight the characteristics of computers to be able to appreciate their efficiency of use. In this article, I will try to describe the main characteristics of computers; these will be performance, memory, speed and efficiency, dependability, usability and compatibility, expansibility, and appearance.

Processing Power:

CPU of the computer defines the processing power of the computer, and it is one of the most significant factors in computing. The CPU handles or processes instructions for the execution of an operation, does computational operations in a computer, and directs data traffic in the computer system. Some of the processing power determinants include clock speed, number of cores, caches, and instructions set architecture.

Storage Capacity:

Almost all computers use different methods of storage to facilitate the storage of data and their retrieval. Primary storage, which includes Random Access Memory (RAM), offers direct and temporary data storage for the CPU and other instructions that can be retrieved quickly. Data backup and auxiliary storage components like HDDs and SSDs are larger and non-volatile and used for permanent data storage.

Speed and Performance:

The performance and responsiveness of a computer depends upon the processors, the extent of memory and its I/O devices. The velocity and I/O of computing systems can be analysed based on various components like clock speed, cache size, memory bandwidth, and data transfer rates.

Reliability:

The second criterion is availability reliability, which is the computer's ability to deliver the right result repetitively. A computer system's reliability depends on several factors, such as the quality of the particular hardware, the ability to detect errors and means of correcting them, the degree of redundancy, and the extent of availability of backup equipment.

Versatility and Compatibility:

Computers are general-purpose devices that are compatible with various other components, sometimes known as peripherals. They can operate on multiple platforms, software programs, and peripheral devices, allowing the user to configure and tailor the computer systems according to usage.

- **Knowledge Check 1**

  Fill in the Blanks:

  1. RAM stands for _____. (Random Access Memory)
  2. The full expanded form of the abbreviation CPU is _____. (Central Processing Unit)
  3. GUI stands for _____. (Graphical User Interface)

- **Outcome-Based Activity 1**

  Make a PowerPoint presentation on the following topic: Characteristics of Computers.

1.3 History and Generations of Computers

Computers have come a long way and emerged from being just machines that increased the efficiency of large organisations to devices that have empowered individuals in modern society. A brief history of computers starts with the invention of early computers that can be regarded as the first models of today's defining machines. This goes right into the details, exploring the story of the computer and the great milestones and breakthroughs that have led to the computer age.

1. Pre-Computer Era:

- The Abacus: The counting instrument that originated in ancient Chinese civilisation was the abacus, which was used to count and perform simple arithmetic operations.
- Mechanical Calculators: Pascal and Leibniz, in the 17th and 18th centuries, respectively, can be accredited for developing mechanical calculators used in mathematics.

2. Early Computing Devices:

- The Difference Engine: Charles Babbage, of the 19th century, created the Difference Engine, which is a mechanical tool that can be used to calculate.
- The Analytical Engine: Another key person was Charles Babbage, who designed a Machine called the Analytical Engine that was a prototype for modern computers, and it contain references to what today is called loops, conditionals and memory storage.

3. Electronic Computers:

- ENIAC: The one that was in use in the early 1940s was the Electronic Numerical Integrator and Computer, which is widely known as ENIAC. This one used vacuum tubes in its computations.
- Transistors and Integrated Circuits: The transistor and the subsequent integrated circuits, which were developed in the 1950s and 1960s, helped in miniaturising the computers and decreasing the amount of power that was required for their operation.

4. Mainframe Computers:

- IBM System/360: System/360, unveiled in the year 1964, was the computer mainframe of IBM that created a major revolution in the computing industry due to the path of compatibility it offered across models and uses.
- Minicomputers: In the mid-1960s and 1970s, there were developments in smaller and more cost-effective minicomputers, which enabled the wider use of computers by the rest of society, apart from large businesses.

5. Personal Computers:

- Altair 8800: The Altair 8800 is one of the first personal computers that were available in the market and who are considered that began the PC era; it was launched to the market in 1975.
- Apple and IBM: Apple II was released in 1977, and IBM PC was released in 1981, and that brought computers to the people or, better still, brought personal computing to individuals and firms.

6. Advancements in Computing:

- Graphical User Interface (GUI): Previously, Xerox PARC's Alto and Apple's Macintosh brought more friendly and easier-to-use GUIs, changing the approach that people applied when working on computers.
- Internet and World Wide Web: The introduction of the Internet and The World Wide Web in the last decade of the Twentieth Century has changed computers into

powerful means of communication and information exchange and as a medium for carrying out business transactions.

7. Mobile Computing and Smart Devices:

- Laptops and Tablets: the popularity of laptops and tablets introduced computing on the move, allowing people to work and obtain data at any time.
- Smartphones: Smartphones can, in general, be described as game changers due to their computing and connectivity features, unlike predecessors that only had telephony capabilities.

1.4 Components of Computers

As computers have become more and more integrated into people's lives, it is important for anyone wishing to gain a solid foundational knowledge of computers to understand some fundamental principles. The processors, storage devices, and input/output peripherals are some of the subcomponents that constitute a computer system. This takes an explorative look into the structure of a computer and presents an elaborate analysis of the physical parts that make up a computer system. It is possible to examine the essence of how automatic computers actually work and understand modern technological creations even better.

1. Central Processing Unit (CPU):

The operating system is the backbone of the computer since it controls all the computer's activities by coordinating the flow of data.

- **Introduction to the CPU: Purpose and Significance**

Functions:

- The CPU contains the Control Unit, which is in charge of executing program instructions and performing arithmetic and logical operations.
- It even stores instructions in memory, understands them, and performs the instructions utilising its interior parts.

Importance

- CPU is defined as the central processor of a computer system as it performs computations and other instructions with immense accuracy and speed.
- The CPU is central to a computer's operations and benefits from its efficiency in executing programs, data processing, and the management of other components and resources.

- **CPU Components:**

Control Unit: Supervising Instruction Execution

- A control unit controls instructions and data flow in a CPU.

- It controls the flow of activities of other components of the CPU and checks that instructions are executed in a proper sequence.

Arithmetic Logic Unit (ALU): This is much more feasible if one is able to perform certain mathematical computations effectively.

The ALU contains activities of arithmetic and logic units: performing arithmetic operations such as addition, subtraction, division, and multiplication and operating AND, OR, and NOT on data.

- It deals with values and produces outputs derived from value comparison.

2. Memory (RAM and ROM):

Computer memory offers storage of data and instructions that the CPU can easily retrieve.

- **Random Access Memory (RAM):**

Volatile Nature of RAM

- RAM is cached and loses data when there is a power loss.

- It is employed to store data and instructions that are temporarily required by the CPU to process them.

- **Role in Temporary Data Storage**

- RAM holds information that is currently being processed by the operating system of the computer as well as the applications that run on it.

- This makes it efficient for the read and write operations, leading to effective data management.

- **Read-Only Memory (ROM):**

Non-Volatile Nature of ROM

ROM is another type of permanent memory. It retains the stored data even when the power supply is switched off.

- It contains the fixed control instructions and data required to boot the system and bring it to its running state.

3. Storage Devices:

Different storage media enable users to store data for long-term use, access the data, and transmit it.

- **Hard Disk Drives (HDDs):**

Mechanical structure and magnetic data storage are the two types of parameters commonly associated with magnetic recording media.

- An HDD has rotating platters, the surface of which is coated with magnetic material.
- Information is recorded magnetically on the platters and read/write heads of a hard disk.

Read/Write Heads and Platters

- The read/write heads are the ones that move across the spinning platters to read and write data.
- A platter has two surfaces, tracks, and sectors that are used to organise data on each platter.

- **Solid-State Drives (SSDs):**

Flash Memory Technology and NAND Cells

- SSDs use NAND flash memory, a type of non-volatile memory.
- Data is stored electronically in memory cells, allowing for faster access and retrieval.

Advantages of SSDs: Speed, Durability, and Efficiency

- SSDs provide faster data access and transfer speeds compared to HDDs.
- They are more resistant to physical shocks and have no moving parts, resulting in improved durability.
- SSDs consume less power and generate less heat, making them more energy-efficient.

Comparing SSDs and HDDs: Pros and Cons

- SSDs offer superior performance, but they are generally more expensive per gigabyte compared to HDDs.
- HDDs provide larger storage capacities at a lower cost, but they are slower and less durable.

- **Optical Drives:**

CD, DVD, and Blu-ray Drives

Flash Memory Technology and NAND Cells

-SSDs employ NAND flash memory, which is a type of non-volatile storage. Data is stored in electronic memory cells, which facilitate retrieval in the event it is required.

Advantages of SSDs: In this case, the three characteristics are speed, durability, and efficiency.

- SSDs allow the computer or device to access data and transfer it at higher rates than what is associated with HDDs.

-They can withstand physical shock much better and do not possess any moving parts, which leads to better reliability.

- SSDs use less energy and produce less heat than their counterparts; hence, they are more energy efficient.

Comparing SSDs and HDDs: SWOT

- SSDs are faster but are normally more costly per GB than HDDs.

- On the advantages and disadvantages of HDDs, it is worth noting that they offer more storage space for less money than SSDs but are less efficient and more likely to fail.

- **Optical Drives:**

CD, DVD, and Blu-ray Drives/Recorders

- A CD/DVD/Blu-ray drive is an optical drive that reads the information stored in optical discs like CDs, DVDs, etc.

- Data stored as microscopic pits in the disc's surface is read with the help of laser technology.

- **Flash Drives**:

Small and Easy to Carry Data Storage

- Specifically, flash drives, also referred to as USB drives or thumb drives, are portable storage devices.

- They incorporate flash memory to store and transfer data; these devices are handy to transport files from one location to another.

USB and Flash Memory Integration

- Flash drives plug into the USB slots of computers so as to enable the transfer of data easily.

- The connectors of USB interfaces have also changed over the years, and the latest ones are USB 3. 0 and USB Type C, which give better data transfer rates and compatibility.

4. Motherboard: The motherboard is a main circuit board which links different components of the hardware and allows for their mutual exchange of information.

- **Components of the Motherboard:**

CPU Socket: Connecting the Processor to the Motherboard

- The CPU socket provides the physical interface for the CPU to connect to the motherboard.
- It ensures proper alignment and electrical contact between the CPU and the motherboard's circuits.

RAM Slots: Inserting Memory Modules

- RAM slots are where memory modules, such as DIMMs or SO-DIMMs, are inserted.
- These slots provide electrical connections for the memory modules to communicate with the CPU and other components.

5. Input Devices

Input devices allow users to interact with the computer and provide data or commands.

- **Keyboard:**

QWERTY Layout and Key Switch Mechanisms

- The QWERTY layout is the most widely used keyboard layout, named after the arrangement of its top row of letters.
- Key switch mechanisms, such as membrane switches or mechanical switches, determine the tactile feedback and typing experience.

Specialty Keys and Keyboard Shortcuts

- **Mouse:**

Optical and Laser Technology

- Optical mice use LED sensors to track movement, while laser mice employ laser sensors for increased precision.
- These technologies allow the mouse cursor to move across the screen based on physical movement.

Clicks, Wheel and Pointer Drag

- A normal mouse has a left button, a right button, a central wheel for scrolling in the up and down direction, and other buttons for the different functions assigned to it.
- Mouse movement corresponds directly with the cursor that is displayed on any provided screen, allowing the user to manipulate it in the direction they desire.

6. Output Devices

Output devices convey the processed data/information for usage by the user of the computer system involved.

- **Display Monitors:**

  Evolution to CRT, LCD, LED, and OLED Technologies

  - Some of the types of monitor displays are CRT, Flat panel (LCD), LED, and OLED.
  - They have their features; some produce clearer images and respond faster, while others consume less power than others.

- **Printers:**

  In keeping with this, Inkjet, Laser, and Dot Matrix printing are three types of printing.

  - I am aware of a specific type of printer known as Inkjet printers, which use ink cartridges to print on paper, and one can get quality and colourful prints.
  - Laser printers employ the use of toner and laser to produce crisp prints within a short time.

- **Speakers and Headphones:**

The availability of power-optimised ability, innovative setting features, and audio output and sound reproduction further enhances the position.

  - Headphones and speakers are also devices that are able to decode electrical signals and turn them into sound waves.
  - They can reproduce the sound produced by the computer; it enables the users to listen to music, watch videos, or even communicate.

1.5 Classification of Computers

These are application-specific and come in different sizes depending on the user needs for the specific application. Knowledge of the existing types of computers assists a person in selecting the best computer for their needs. In this article, the different classifications of computers and their features shall be discussed in detail.

1. Supercomputers:

Supercomputers are some of the most potent and sophisticated computers on the market. They are intended to handle large volumes of data and make sophisticated computations within the shortest time. Scientists and researchers at meteorological agencies in cryptography and simulating applications widely employ supercomputers. These are composed of many processors and vast storage capacity to solve a load of computational problems.

2. Mainframe Computers:

Mainframe computers are large computers which are premeditated for multiple users concurrently. These are attributed to its structural features, which include robustness, efficacy and reliability in high-performance technology. The term mainframes is usually associated with large-scale organisations, including government and substantial corporations, where the gaining and storage of humongous quantities of data and running of sensitive applications is involved. It features enhanced security and large form-factor storage and is easier to manage through system centralisation.

3. Minicomputers:

Midrange computers, also often called minicomputers, are computers that are smaller than mainframe computers but larger than microcomputers. These are not as large and not as potent as mainframe computers, but they are capable of significant computing. Minicomputers can be used in medium-sised companies where the company needs a powerful computer to support the work of a large number of users, for example, performing such operations as creating and updating the database, carrying out a large number of calculations for scientific purposes, or other intensive network communication.

4. Microcomputers:

There are three main types of computers, and out of these, the most famous and most commonly known is the microcomputer or the personal computer (PC). They are generally compact, inexpensive, and are for single use most of the time. Microcomputers, too, maybe in various forms like handhelds, notebooks, palmtops, hand-helds, pocket PCs, ultramobile PCs, laptops, PDAs, broadband phones, Tablet PCs, cell phones, and tower PCs. They are used in areas such as browsing the Internet, accomplishing office duties, gaming, and using information content. Many microcomputer manufacturers use processors from different companies, such as AMD and Intel, and the latter can be customised.

5. Quantum Computers:

Quantum computers are relatively new digital computers that are built with the principles of quantum mechanics. It is predicted that they can solve multifaceted issues millions of times faster than those of classical computers. Quantum computers are even now in their experimental phase, and most are used only for research purposes.

1.6 Input-Output Devices

Communication devices, both input and output, are major subunits of the overall computer system that enhance the user-interpatch. Here's a detailed look at both types of devices:

Input Devices

An input device is an apparatus that allows data and control signals to be fed into the computer. They enable users to feed data and instructions into the system.

General Input Devices

1. Keyboard: A kind of peripheral hardware that is commonly employed in producing characters or keystrokes.
2. Mouse: A hardware device that is used to navigate or manipulate graphical objects usually displayed on a computer screen or monitor.
3. Touchscreen: This is an output device that also works as an input device, enabling users to manipulate what is displayed directly.
4. Scanner: Makes paper and photographs digital.
5. Microphone: Records sound either for making a conversation or for providing a voice command.

Output Devices

Output devices accept information from computers in a variety of formats that can be touched, seen, or heard by the user.

Common Output Devices

1. Monitor: This function provides the user with visible material, such as the graphical user interfaces and applications the computer hosts.
2. Printer: Creates a paper printout of digital papers and pictures.
3. Speakers: Audio, which helps the user listen to the sounds produced on the computer.
4. Headphones: Provide personal audio output for listening to the SLPs and clients and group materials for group-sharing purposes.

1.7 Types of Computer Memory

Computer storage is a vital element of a computer system since it holds data and instructions suitable for processing activities. On the basis of characteristics and usage, memory can be of the following types. Here is an overview of the primary types of computer memory:

1. Primary Memory

The primary and most important classification of the computer's memory is the main memory, which includes random access memory, also called primary memory. This memory is directly accessible by the CPU and holds data and instructions that are actively being used by the computer.

- **Types of primary memory**

Random Access Memory (RAM):

- Dynamic RAM (DRAM): This is prevalent in computers' main memory and must be refreshed at least a few thousand times per second.
- Static RAM (SRAM): This type of RAM is slower than SRAM but faster than DRAM and, at the same time, more expensive. It is used in cache memory.
- Read-Only Memory (ROM): Read-only storage that is employed to contain firmware or software that is frequently updated once in a while.
- Programmable ROM (PROM): This may be programmed only once after the manufacturing has been done.
- Erasable Programmable ROM (EPROM): It can be wiped clean with ultraviolet light and rewritable.

- Electrically Erasable Programmable ROM (EEPROM): This may cause programming to be lost and rewritten with a new programming code by using an electrical charge.

2. Secondary Memory

Other types of memory, called secondary auxiliary or external memory, are not part of the CPU. They are mostly used to store large amounts of data for extended periods.

- **Types of Secondary Memory**

The following are kinds of Secondary Memory:

- Hard Disk Drives (HDDs): Disk drives with magnetic platters are relatively inexpensive and storage intensive, with high storage density added to the disks.
- Solid-state Drives (SSDs): These implement flash memory for storing data; as such, the memory type provides faster access to data and has a longer lifespan than HDDs.
- Optical Discs: These products incorporate CDs, DVDs, and Blu-ray discs, and they use laser technology to read and write data.
- USB Flash Drives: External storage devices that employ flash memory. They are convenient, easy to use and mobile.
- External Hard Drives: These are able to supply more storage space and are often components that can be connected to a computer through a USB or other port.

3. Cache Memory

Cache memory is a special type of memory that is small in size but fast and situated near the CPU to store commonly used data and commands. It assists in decreasing the time when locating a given data in the main memory, which will be of the essence.

Cache Memory can be of several types depending on the functionality it is being designed to perform.

- L1 Cache (Level 1): Located inside the CPU chip, It is the fastest but has the least storage capacity.
- L2 Cache (Level 2): Slower than L1 but more often situated on the CPU or in a different chip beside the CPU.
- L3 Cache (Level 3): Much bigger and much slower than L2, for use by many processor cores at one time.

4. Virtual Memory

Virtual memory is a system where a program is partially resident in the main memory, and to recall a process, the operating system must provide it. Employing hardware and software makes it possible for a computer to override an instance when there is a real physical memory constraint and to transfer data from the RAM to disk storage.

1.8 Hardware and Software Overview

Computer hardware, on the other hand, means the physical equipment that is used in a computer to make up a computer system with the ability to perform computation tasks. These are itemised as the CPU, memory, storage devices, input and output devices, among other vital parts. Here's an overview of the primary components of computer hardware:

Central Processing Unit (CPU)

- Function: The Central Processing Unit, or CPU, sometimes known as the processor, is the heart of any computer where calculations and almost every command from a program are processed.
- Arithmetic Logic Unit (ALU): Faults illustrate the performing of mathematical calculations and logical operations.
- Control Unit (CU): This controls the activities within the computer in the sense that it performs the instructions that are already stored in memory.
- Motherboard
- Function: The main printed circuit board that has the CPU and memory incorporated in it together with other components and connectors for other accessories.
- Components:
- Chipset: As a part of this chip, it controls the communication of data between the CPU, memory and peripherals.
- BIOS/UEFI: Software that initialises the hardware when a computer system boots.

Memory

Types:

- Random Access Memory (RAM): Temporary storage used in a microprocessor, which permits the CPU to access data and instructions quickly.

- Read-Only Memory (ROM): ROMS previously employed to store the 'Bios' and other system software through which the computer is booted up.
- Function: Enhances the data access rate and instructions for the CPU, which in turn has a very strong influence on system performance.

Input Devices

- Keyboard: Contains the text field that can accept the user's input as well as commands.
- Mouse: A peripheral device that has topographic contact and converts the motion into a signal for the GUI.
- Scanner: It scans real paper documents and images and uploads them to digital storage.
- Microphone: Records the sound for recording or actual use in a certain communication.
- Output Devices
- Monitor: Controls all visible input/output since they show the graphics that computers develop.
- Printer: Makes paper printouts of electronic papers.
- Speakers: Provide sound output signals for the users to hear sound and music.
- Projector: Conveys better visuals on a large screen or on any other surface, which is commonly used in presentations.

Computer software

Computer software can be described as a set of instructions, data, and computer programs that control the operation of the computer system for a certain purpose. It is a core element of any computer system, offering its usability and enabling the operations needed to communicate with the hardware components.

Definition: Computer software consists of computer programs that are sets of instructions that guide a computer. These programs are templates of desired solutions in programming languages and can be run by the CPU. Software also consists of data to be processed and results that are created or utilised by programs at runtime.

Types of Computer Software:

1. System Software: Operating systems cover all the programs utilised to manage and supervise computer hardware. This involves the operating system, system drivers, system utilities, and other software that allows the user to interface with the hardware.

The operating system enables applications to run and controls the computer's resources.

2. Application Software: Historically, application software is users' programs carrying out a specific purpose or job on a computer or an IT system. This category consists of such programs as word processing, spreadsheets, graphic and web designing tools, browsers, mail clients, media players, and database management systems. Application software is developed to fulfil different needs and expectations, offering the possibility to solve certain problems from the user's side.

3. Programming Software: Programming software is composed of applications used in writing, testing, and even debugging computer programs. Some examples are the text editor, integrated development environment, compiler, debugger, and libraries. System software supports programmers' general activities and helps them develop and alter application software.

1.9 Operating System Basics

Operating systems are the most important central software, commonly known as the middleman between the user and processors. They regulate and supervise the internal processes of the computer hardware and also handle the interaction with the user. The operating system has another important duty: acting as an intermediary between the user and the hardware. This user interface can effectively utilise hardware resources.

Functions of the operating system:

- Operating systems acquire rights to use computer hardware facilities.
- Users may communicate with the operating system by typing operating system commands.
- The program generally performs calls to the operating system, which in turn provides the desired services.
- Another role is that the operating system can be best described as an interface between the user and the computer hardware.
- It performs the role of resource control of the operating system.
- The main goal of the operating system is to make processing resources, for example, the hardware or users of computers to be more productive.

Definition of the operating system:

- "An operating system is software that interacts with hardware & manages all resources and processes."

- "It is an organised group of software extensions of hardware comprising of Control routines for operating a computer and for supplying an environment for the execution of programme activities of the operating system."

A computer system is made up of various hardware and software parts that work together to produce an efficient computing tool.

Hardware, often known as the internal architecture of the computer or physical computing equipment, is a broad term for the electrical, mechanical, and electronic components that make up the computer.

- **Knowledge Check 2**

  Fill in the Blanks

  1. ALU stands for _____. (Arithmetic Logic Unit)
  2. _____ are output devices that display the computer's output on a larger screen or surface. (Projectors)
  3. _____ Provide sound output signals for the users to hear sound and music (Speaker)

- **Outcome-Based Activity 2**

  Create a presentation on input devices and output devices on computers.

1.10 Summary

- The use of computers is critical in the contemporary world. Their definition of electronic devices that can process and store information tends to be a basic comprehension of what the gadgets are designed to do.
- Computerisation's influence is clearly seen at the general system level, improving production and the general society's function, as well as on the individual level, changing the pattern of working, playing, and socialising. Indeed, due to advancements in technology, the definition of computers will advance as well, and this will create room for new development in society.
- Among the storage units found in computers, there are two key models of storage: primary storage and secondary storage. Primary storage, which includes RAM and cache memories, enables the CPU to retrieve data that it is processing at the

moment frequently. This one fluctuates more and costs considerably more but is more efficient.

- Secondary storage comprises such components as hard disk drives, solid state disks, and optical disks for storing larger content for extended use. It is non-volatile and inexpensive and allows data to be stored for future use.
- Central processing unit/processing unit – it stands for Central Processing Utility or, in short, it is known as CPU, which is the brain of any computer. This is made up of the ALU, the control unit, and registers and is responsible for the computation of data as well as coordination of operations.
- Typically, the CPU's clock speed and the number of cores it has affects the processing capacity of the CPU. Knowledge of the processing unit functions and characteristics is vital to gain insight into the internal operations of regulating computer systems.
- Input and output devices are important elements that define the communication process between users and computers. They allow the user to feed information or commands/instructions into the computer and receive visual, audio, or touch feedback. The proper input and output devices must be chosen depending on the user's needs and the functions they are to fulfil.
- The impact of the software includes boosting production, providing a means of communication, promoting innovation, increasing efficiency and speed and creating a friendly interface. Undoubtedly, it has gained tremendous significance in today's society because it drives technology and supports numerous processes and activities.

1.11 Keywords

- **Storage units:** Storage units in a computer refer to devices or components used for storing and retrieving data or instructions.
- **Cache Memory:** Cache memory is a very fast memory used to store data or instructions that are frequently accessed so that access time can be kept to a minimum.
- **Volatile memory:** As the name suggests, volatile memory is the type of computer memory that is only functional when it is connected to a power source and loses its content as soon as the power is cut off.

1.12 Self-Assessment Questions

1. How would you distinguish a computer from other electronic devices?
2. What are the key characteristics of computers?
3. Describe the major milestones in the evolution of computers.
4. Explain the functions of the CPU (Central Processing Unit) in a computer.
5. Discuss the primary differences between supercomputers and microcomputers.

1.13 References / Reference Reading

- Fundamental of Computers by Rajaraman
- Computes Today by B. Sandra

Unit 2: Basics of HTML

Learning Outcomes:

- Students will be able to define basic HTML text formatting tags.
- Students will be able to demonstrate the use of bold, italic, underline, strikethrough, and overline.
- Students will be able to create marquees and add images to a webpage.
- Students will be able to construct hyperlinks and interactive elements like textboxes and buttons.

Structure:

2.1 Applying Text Formatting

2.1.1 Bold, Italic, Underline, Strikethrough, Overline

2.2 Creating Marquees and Adding Images

2.3 Hyperlinks

- Knowledge Check 1
- Outcome-Based Activity 1

2.4 Textboxes and Buttons

2.4.1 Checkboxes, Radio Buttons

2.5 Creating Lists

2.5.1 Ordered and Unordered Lists

2.6 Creating Tables

2.7 Using FRAMESET and LEGEND Tags

2.8 Forms and Form Handling

- Knowledge Check 2
- Outcome-Based Activity 2

2.9 Summary

2.10 Keywords

2.11 Self-Assessment Questions

2.12 References / Reference Reading

2.1 Applying Text Formatting

2.1.1 Bold, Italic, Underline, Strikethrough

Applying text formatting in HTML involves using various HTML tags to alter the appearance of text. Here's a guide on some of the most common text formatting tags and how to use them:

1. Bold Text (`)

- `<b>`: This tag makes text bold without conveying any extra importance.

syntax

This text is bold

2. Italic Text (`)

- `<i>`: This tag makes text italic without adding any extra emphasis.

syntax

This text is italicised

3. Underlined Text (`<u>)

- `<u>`: This tag underlines text.

syntax

<u>This text is underlined </u>

4. Strikethrough Text (`<s>)

- `<s>`: This tag strikes through text.

syntax

<s>This text is struck through</s>

2.2 Creating Marquees and Adding Images

HTML provides ways to create moving text (marquees) and to add images to your web pages. Here's how you can do both:

Creating Marquees

The `<marquee>` tag is a deprecated HTML tag that was used to create scrolling text or images. While it still works in some browsers, it is not recommended for modern web development. Instead, it would help if you used CSS for better control and compatibility.

Using the `<marquee>` Tag (Deprecated)

syntax

<marquee behavior="scroll" direction="left">This is a scrolling text using the marquee tag.</marquee>

Attributes:

- `behaviour`: Determines the scrolling (auto, manual, reverse, alternate), sliding or any other movements of the text.
- `direction`: Indicates the direction that the sprite should go; the direction could be left, right, up or down.

Adding Images in HTML

For adding images in an HTML document, the tag used is the `<img>` tag. This is an XHTML self-closing tag, and it has several parameters working as attributes to show the image correctly:

Basic Syntax

The basic syntax for the `<img>` tag includes the `src` and `alt` attributes: The basic syntax for the `<img>` tag includes the `src` and `alt` attributes:

syntax

<img src="image.jpg" alt="Description of the image">

- `src`: This attribute defines the URL of the image file path.
- `alt`: This attribute supplies a text description for the image as an aid to disabled persons and when the image can not be loaded.

Detailed Example

Here's a comprehensive guide on how to use the `<img>` tag in different scenarios:

1. Local Images

If the image is stored in a subdirectory: If the image is stored in a subdirectory:

syntax

<img src="image.jpg" alt="A description of the image">

If the image is stored in a subdirectory:

syntax

<img src="image/myimage.jpg" alt="A description of the image">

2. Remote Images

To use an image hosted on another website: To use an image hosted on another website:

syntax

<img src="https:[URL link for the image] [Alt= ‘A description of the remote image ’]

2.3 Hyperlinks

Links or hyperlinks are the basis of the World Wide Web and all the sites on it. It permits entry from one webpage to the next because it does not support other navigation forms. Input references in HTML can be created with the help of <a> (anchor) tag.

Basic Syntax

The basic structure of a hyperlink is: The basic structure of a hyperlink is:

syntax

Link Text

- `href`: This attribute defines the URL of the link where the Web page is to be found.
- `Link Text`: This is the option of the link which the user will see.

Examples

1. Linking to Another Website

syntax

Visit Example.com

This creates a link that, when clicked, takes the user to "https://www.example.com".

2. Linking to a Specific Section of Another Page

You can link to a specific section of a webpage using an ID:

syntax

 Go to Section 1 on Example.com

The `#section1` part refers to an element on the destination page with `id="section1"`.

- **Knowledge Check 1**

Fill in the blanks

1. _____ tag underlines text. (<u>)
2. The basic syntax for the `<img>` tag includes the _____ and _____ attributes. (src, alt)
3. _____ tag strikes through text. (<s>)
4. The `<marquee>` tag is a _____ HTML tag. (deprecated)

- **Outcome-Based Activity 1**

  Create a hyperlink form with HTML code.

2.4 Textboxes and Buttons

Textboxes allow users to input text. They are created using the `<input>` tag with the `type` attribute set to `text`.

Example of a Textbox

syntax

```
<form>
   <label for="name">Name:</label>
   <input type="text" id="name" name="name" placeholder="Enter your name">
</form>
```

- `type="text"`: Specifies that the input is a textbox.
- `id` and `name`: Submitting a form using JavaScript, and some of the attributes used were learnt.
- `Placeholder`: Displays a hint to the user about what to enter in the textbox.

Buttons

Forms can be submitted, or some action can be initiated with the help of buttons.

Example of a Submit Button

syntax

```
<form>
   <button type="submit">Submit</button>
</form>
```

- `type="submit"`: Specifies that the button will submit the form.

2.4.1 Checkboxes, Radio Buttons

The checkboxes enable the users to tick one or many choices from the available options. These are developed with the <input> tag, and the type attribute is set to the checkbox.

Example of Checkboxes

syntax

```
<form>
   <label><input type="checkbox" name="option1" value="Option 1"> Option 1</label>
   <label><input type="checkbox" name="option2" value="Option 2"> Option 2</label>
   <label><input type="checkbox" name="option3" value="Option 3"> Option 3</label>
</form>
```

- `type="checkbox"`: Specifies that the input is a checkbox.
- name: Separates checkboxes because the contents of the checkboxes are usually set as the data for the form submission.
- value: The value to be submitted if the checkbox is ticked.

Radio Buttons

Radio buttons are buttons that let the user choose a single option out of the available options. These are made by the <input> tag with the attribute type set to radio.

Example of Radio Buttons

syntax

```
<form>
   <label><input type="radio" name="choice" value="Choice 1"> Choice 1</label>
   <label><input type="radio" name="choice" value="Choice 2"> Choice 2</label>
   <label><input type="radio" name="choice" value="Choice 3"> Choice 3</label>
</form>
```

- `type="radio"`: Specifies that the input is a radio button.
- `name`: Groups radio buttons together so only one can be selected at a time.
- `value`: The value that will be submitted if the radio button is selected.

2.5 Creating Lists

HTML provides two main types of lists: ordered lists and unordered lists. These lists organise content in a structured and readable way.

2.5.1 Ordered and Unordered Lists

Ordered lists are used when the order of the items is important. They are created using the `<ol>` tag, with each list item enclosed in an `<li>` tag.

Basic Syntax of an Ordered List

syntax

```
<ol>
   <li>First item</li>
   <li>Second item</li>
   <li>Third item</li>
</ol>
```

Unordered Lists

Unordered lists are used when the order of the items does not matter. They are created using the `<ul>` tag, with each list item enclosed in an `<li>` tag.

Basic Syntax of an Unordered List

syntax

```
<ul>
   <li>Item one</li>
   <li>Item two</li>
   <li>Item three</li>
</ul>
```

Example of an Unordered List

Syntax

```
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <title>Unordered List Example</title>
</head>
<body>
    <h2>Grocery List</h2>
    <ul>
        <li>Rice</li>
        <li>Dal</li>
        <li>Eggs</li>
    </ul>
</body>
</html>
```

2.6 Creating Tables

HTML tables allow you to organise data into rows and columns. Tables are created using the `<table>` tag along with `<tr>` for table rows, `<th>` for table headers, and `<td>` for table data cells.

Basic Structure of a Table

Here's the basic structure of a table in HTML:

syntax

```
<table>
    <tr>
        <th>Header 1</th>
        <th>Header 2</th>
    </tr>
    <tr>
        <td>Row 1, Cell 1</td>
        <td>Row 1, Cell 2</td>
    </tr>
```

```
    <tr>
        <td>Row 2, Cell 1</td>
        <td>Row 2, Cell 2</td>
    </tr>
</table>
```

2.7 Using FRAMESET and LEGEND Tags

`<frameset>`

The `<frameset>` tag was used to replace the `<body>` tag when you wanted to divide the browser window into multiple frames. Each frame could display a different HTML document.

Example of `<frameset>`

syntax

```
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <title>Frameset Example</title>
</head>
<frameset rows="50%,50%">
    <frame src="top.html">
    <frame src="bottom.html">
</frameset>
</html>
```

- `rows="50%, 50%"`: Divides the window into two horizontal frames, each taking up 50% of the screen.
- `<frame src="top.html">`: Specifies the HTML document to be displayed in the first frame.
- `<frame src="bottom.html">`: Specifies the HTML document to be displayed in the second frame.

`<legend>`

The `<legend>` tag is used to provide a caption for the `<fieldset>` element. The `<fieldset>` element is used to group related elements within a form, and the `<legend>` provides a caption for this group.

Example of `<fieldset>` and `<legend>`

syntax

```
<!DOCTYPE html>
<html lang="en">
<head>
   <meta charset="UTF-8">
   <meta name="viewport" content="width=device-width, initial-scale=1.0">
   <title>Fieldset and Legend Example</title>
</head>
<body>
   <h2>Registration Form</h2>
   <form action="/submit" method="post">
      <fieldset>
         <legend>Personal Information</legend>
         <label for="first name">First Name:</label>
         <input type="text" id=" first name " name=" first name "><br><br>
         <label for="last name">Last Name:</label>
         <input type="text" id=" last name " name=" last name "><br><br>
         <label for="email">Email:</label>
         <input type="email" id="email" name="email"><br><br>
      </fieldset>
      <br>
      <fieldset>
         <legend>Account Details</legend>
         <label for="username">Username:</label>
         <input type="text" id="username" name="username"><br><br>
         <label for="password">Password:</label>
         <input type="password" id="password" name="password"><br><br>
```

```
        </fieldset>
        <br>
        <button type="submit">Register</button>
    </form>
</body>
</html>
```

2.8 Forms and Form Handling

Forms in HTML are used to collect user input. They typically contain various input elements like text fields, checkboxes, radio buttons, and buttons. Here's a basic example of an HTML form:

```HTML
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <title>Simple Form</title>
</head>
<body>
    <form action="/submit" method="post">
        <label for="name">Name:</label>
        <input type="text" id="name" name="name"><br><br>

        <label for="email">Email:</label>
        <input type="email" id="email" name="email"><br><br>

        <input type="submit" value="Submit">
    </form>
</body>
</html>
```

Explanation of the Form Elements

1. `<form>` Tag: This tag envelops all the input elements and defines the where (action) and how (GET/POST) of form submission.

- `action="/submit"`: The destination to which the form data will be submitted is the URL.
- `method=" post"`: The HTTP method to use when submitting encoded form data.

2. Input Elements:

- `<label>`: Helps to define the label for an input element, enhancing accessibility.
- `<input type="text" id="name" name=" name">`: An input of text type designed to contain the user's name.
- `<input type="email" id="email" name="email">`: An email input field of the form.
- `<input type="submit" value="Submit">`: A submit button to submit the form data.

Form Handling

Form handling involves processing the data submitted by the user. This is typically done on the server side. Here's a simple example using Python with the Flask framework to handle form data:

- **Knowledge Check 2**

  Fill in the blanks

  1. _____ allow users to input text. They are created using the `<input>` tag. (Text fields)
  2. _____ allow users to select exactly one option from a set. (Radio buttons)
  3. _____ are created using the `<ul>` tag. (Unordered lists)
  4. The _____ tag was used to replace the `<body>` tag. (<main>)

- **Outcome-Based Activity 2**

  Create an HTML Code with the help of `<fieldset>` and `<legend>` tags.

2.9 Summary

- Basic Concepts of HTML:
  - HTML (HyperText Markup Language): The foundational language used to create and structure content on the web. HTML documents are made up of elements represented by tags.
  - HTML Document Structure: Every HTML document starts with `<!DOCTYPE html>`, followed by `<html>`, which contains `<head>` (for meta-information, title, and linked resources) and `<body>` (for the visible content).
- Applying Text Formatting:
  - Bold: Use `<b>` or `<strong>` to make the text bold.
  - Italic: Use `<i>` or `<em>` to italicize text.
  - Underline: Use the `<u>` tag to underline the text.
  - Strikethrough: Use `<s>` or `<strike>` to strike through text.
- Marquees: Use the `<marquee>` tag for scrolling text or images, although this tag is deprecated in HTML5.Adding Images: Use the `<img>` tag with `src` (source of the image) and `alt` (alternative text) attributes to display pictures.
- Hyperlinks: Use the `<a>` tag with the `href` attribute to create links to other web pages, sections within the same page, or email addresses.
- Textboxes: Use the `<input type="text">` tag to create single-line text input fields.
- Buttons: Use the `<button>` tag or `<input type="button">` to create clickable buttons.
- Checkboxes: Use the `<input type="checkbox">` tag to create checkboxes for multiple selections.
- Radio Buttons: Use the `<input type="radio">` tag to create radio buttons for a single selection within a group.
- Creating Lists:
  - Ordered Lists: Use the `<ol>` tag for numbered lists, with each item wrapped in `<li>`.
  - Unordered Lists: Use the `<ul>` tag for bulleted lists, with each item wrapped in `<li>`.
- Tables: Use the `<table>` tag to create a table, `<tr>` for table rows, `<th>` for header cells, and `<td>` for standard cells. Additional attributes can control the table's appearance.

- Using FRAMESET and LEGEND Tags:
  - FRAMESET: The `<frameset>` tag was used to define a collection of frames, which is deprecated in HTML5 in favour of `<iframe>`.
  - LEGEND: Use the `<legend>` tag to provide a caption for the content within a `<fieldset>` element.

2.10 Keywords

- **Strikethrough**—A strikethrough is a text decoration that draws a horizontal line through the centre of the text, indicating that the text is no longer valid or is meant to be ignored.
- **Hyperlink**: A hyperlink, or simply a link, is a reference in a hypertext document that leads to another document or a specific section within the same document. It enables users to navigate between different web pages or different sections of the same page.
- **Marquee**: A marquee is a scrolling piece of text or image that moves horizontally or vertically across a webpage. It is used to create a scrolling effect for content.

2.11 Self-Assessment Questions

1. Discuss the importance of the `DOCTYPE` declaration in an HTML document. How does it affect the rendering of a webpage?
2. Explain the difference between inline and block-level elements in HTML.
3. Describe the process and benefits of using CSS to apply text decorations such as bold, italic, underline, strikethrough, and overline instead of using HTML tags.
4. How would you create an accessible image gallery on a webpage?

2.12 References / Reference Reading

- Fundamental of Computers by Rajaraman
- Computes Today by B. Sandra

Unit 3: Operating Systems

Learning Outcomes:

- Students will be able to define an operating system.
- Students will be able to describe the functions of operating systems.
- Students will be able to demonstrate basic DOS commands.
- Students will be able to explain the elementary concepts of modern operating systems.

Structure:

3.1 Definition and Functions of Operating Systems

3.2 Disk Operating System (DOS)

3.2.1 Basic Commands

- Knowledge Check 1
- Outcome-Based Activity 1

3.3 Elementary Concepts of Modern Operating Systems

3.4 Introduction to Windows and Linux

- Knowledge Check 2
- Outcome-Based Activity 2

3.5 Summary

3.6 Keywords

3.7 Self-Assessment Questions

3.8 References / Reference Reading

3.1 Definition and Functions of Operating Systems

An operating system is the main software that enables the user to interact directly with computer hardware. It regulates the internal processes of computer hardware and offers an interface for the user. It's very important to understand that one of the fundamental functions of an operating system is to help act as a mediator between the user and the hardware. This interface also allows a user to optimise the full usage of hardware resources.

Functions of the operating system:

- An operating system acquires control over a computer system's hardware and software resources.
- User May communicate with the operating system with the help of operating system commands.
- The program commonly activates the operating system services using the operating system calls.
- The operating system actually helps the user to interact with the hardware and can defined as an interface.
- It performs the role of the manager of resources of the operating system.
- The main goal of the operating system is to enhance the efficiency of processing resources, such as hardware or computer system users.

Definition of the operating system:

- "An operating system can be defined as a type of software that allows it to interact with the hardware and control all the resources as well as processes."
- This is an organised group of software extensions of the hardware composed of Control routines for managing a computer and an environment that provides for the performance of program activities in the operating system.

A computer system involves several parts of the hardware and software, which, when combined, result in an efficient computing system.

Hardware or internal architecture of the computer or physical computing equipment is a general term used for the electrical, mechanical and electronic parts of the computer.

The operating system performs the following functions:

1. Booting

Booting is the process of turning on and using the computer's operating system. After being examined, the computer is prepared for use.

2. Memory Control

It is also an essential component of the operating system. Without an operating system, managing the RAM is difficult. Programs and data operate concurrently in memory, and interaction between the programs might occur. Without an operating system, the system will not function properly.

3. Execution and Loading

A program has to be loaded into memory before it can be run. The operating system facilitates the speedy loading of programs into memory and their subsequent execution.

4. Data protection

Data is a crucial component of a computer system. The operating system guards against unauthorised access, modification, and destruction of the data kept on the computer.

5. Process Administration

A CPU can complete one task at once. The operating system chooses which task should use the CPU if there are many ones.

3.2 Disk Operating System (DOS)

A disk operating system (DOS) is an operating system that controls access to disk storage devices for storing and retrieving data. It is intended to support the running of applications and communication with physical computers.

In the first few years of the personal computers, DOS was one of the most used operating systems on IBM-compatible machines. The most famous among DOS versions is MS-DOS, or Microsoft Disk Operating System, developed by Microsoft Corporation. DOS is built on a command prompt interface, and users have to enter a command to execute a specific operation.

The main role of a DOS is effective disk management, which means organising the disk operations, such as writing and reading the data from or to the disk storage. It also has the capability of a file system, which means that it divides information into directories and files to enable its efficient storage. In DOS, you can have text files, files with execution extensions, and data files, among others.

DOS also supports simple file and directory operations such as creating, renaming, copying, moving, and deleting them. It provides commands for formatting disks, as well as disk checking and partitioning. Also, DOS has facilities for customising

system options, such as determining the systematic time, managing the memory, and installing system devices.

The first of these is the simplicity and efficiency of the DOS. It is a lean operating system that doesn't consume many system resources and can be used on low-end computers. This made it popular in the earlier days of personal computing when system resources were more limited.

Although DOS is no longer used today due to the numerous modern graphical operating systems, its use and impact can still be noted. DOS formed the base of many operating systems, and even today, DOS-compatible command prompts exist in systems such as Windows and Unix-like systems.

A disk operating system or DOS is an operating system that deals with disk space and offers a foundation on which applications can run. It divides the data into files and folders and provides basic functionalities for files as well as utilities for disks. DOS can be remotely considered as a historic aspect of the evolution of personal computers despite the fact that it is no longer in use.

3.2.1 Basic Commands

Managing files and directories || Linux mkdir

Now, let's look at how to use the command prompt to build your directory.

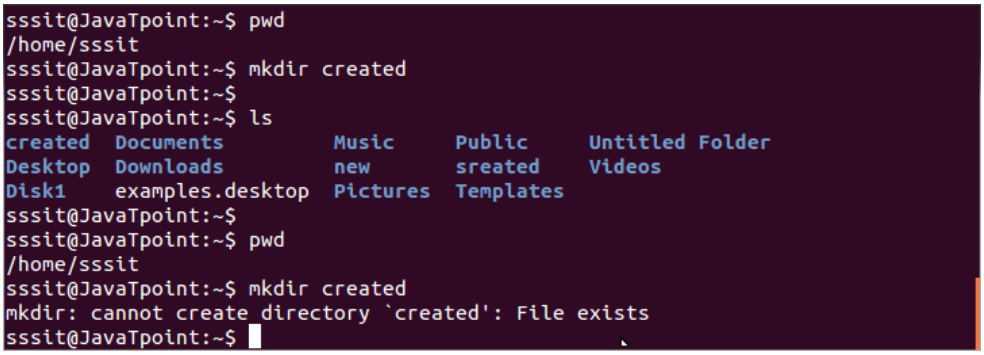
The command mkdir means 'make directory.' You can construct a new directory anywhere in your system by using the mkdir command. Type "mkdir dir name>" (instead of dir name>, type the name of the new directory you want to create) and hit enter.

Syntax:

1. mkdir <dirname>

Example:

1. mkdir created



We are in the /home/sssit directory in the example above. I used the command "mkdir created" to create the directory "created." Now, if we try to build a new file with the same name as an existing file named 'made,' we'll get an error message.

Linux rmdir Command

This command is used to delete a directory. However, you won't be able to erase a directory that includes a subdirectory. It implies that in order to be removed, a directory must be empty.

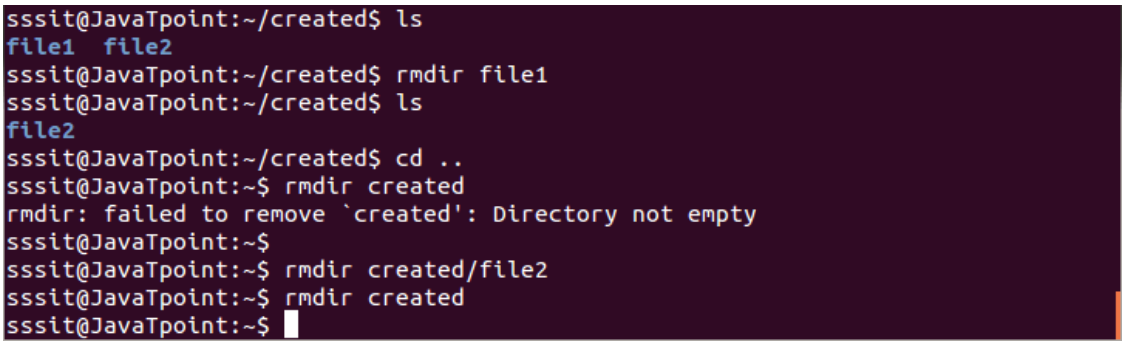
Syntax:

1. rmdir **<dirname>**

Example:

1. rmdir created

For example, we successfully deleted the directory 'file1' from 'envelope' in the image below. We now want to get rid of the 'made' directory. However, it displays an error because it contains the word file2'. It is impossible to delete the ‘made’ directory unless ‘file2’ is deleted first. We will be able to delete the ‘generated’ directory after that.



Linux cd Command

Linux has a command called cd that is used to change the current working directory, or, in other words, where the current Linux user is currently operating. The command ‘change directory’ has the letter ‘cd’. The command is frequently used in Linux terminals.

Syntax:

1. cd **<dirname>**

It is one of the fundamental and most commonly used commands in the Linux system, and you can use it many times. Hence, it will be possible to change through the

directories of the system applying this order. We may go to the previous directory, the next directory, or any directory of our choice or select at random.

Because we are accustomed to Linux directories, the following cd operations will be performed on them.

1) Change from the current directory to a new directory

It also means that we can change the working directory from the current one to a different directory. Execute the following order to see the latest working directory

- **pwd**

If you wish to change the current or working directory, use the below command

- cd **< current** directory> **<specified** directory>

Below is the output:

```
sssit@JavaTpoint:~$ pwd
/home/sssit
sssit@JavaTpoint:~$ cd /home/sssit/Desktop
sssit@JavaTpoint:~/Desktop$
```

From the above output, we got the current directory by using the pwd command, which shows that the current directory we used is "/home/sssit." Next, we typed the 'cd' command to change our working directory to a new one and entered the path as /home/sssit/Desktop. We can see in the next picture that we are now in the Desktop folder. The working directory has been changed to Desktop.

2) Use an absolute path to change the directory

Using an absolute path requires us to specify the entire path, beginning at the root, in order to alter the directory. Take a look at the example below:

```
sssit@JavaTpoint:/run/cups$ cd /run/cups/certs
sssit@JavaTpoint:/run/cups/certs$
```

From the above output, we are changing our directory to 'certs' from 'cups'. Beginning at the root (/), we have supplied the entire path "/run/cups/certs". We refer to this as an absolute route.

3) Go back to the Home directory

To navigate the directory to the entire system's root directory from the current working directory, execute the command as follows:

cd /

Consider the below output:

```
javatpoint@javatpoint-Inspiron-3542:~/Downloads$ cd /
javatpoint@javatpoint-Inspiron-3542:/$
```

As can be seen from the above output, the current working directory has shifted to the system's root directory.

Linux pwd Command

The pwd (print working directory) command in Linux shows the current working directory. It will return the entire path, beginning at the root and ending at the directory.

Syntax:

- pwd

Example:

Let's take a look at an example of the pwd order.

Type pwd into your terminal and hit the enter key. You can see the route to your directory. My current location is sssit, and my route is /home/sssit.

It's worth noting that the location will be shown either from the root or from the filesystem.

Linux ls command

The list command in Linux is ls. It will show all the contents or the list of your directory. Click the enter key after typing ls. The entire material will be displayed.

Example:

- ls

After running the ls command, we got the entire content list of the /home/sssit directory.

```
sssit@JavaTpoint:~$ pwd
/home/sssit
sssit@JavaTpoint:~$ ls
Desktop    Downloads         Music     Public     Videos
Documents  examples.desktop  Pictures  Templates
sssit@JavaTpoint:~$
```

- **Knowledge Check 1**

  Fill in the Blanks:

  1. The operating system can be described as a compilation of several _____. (programs)
  2. UNIX is a _____operating system.(multi-user)
  3. An _____ is the first program that is run in the computer when the computer is switched on. (operating system)

- **Outcome-Based Activity 1**

  Find out different operating systems used in computer systems.

3.4 Elementary Concepts of Modern Operating Systems

Because an operating system is a very large and complex system, it can only be developed by dividing it into manageable portions. These parts of the system should have clearly defined inputs, outputs, and functions for these components. While Mac, Unix, Linux, Windows, and other operating systems have different organisational structures, most of them share the same OS system.

Elements, such as a file, process, memory, and I/O device management**.**

1) Handling files

A file is a set of linked data that needs to be defined by its creator. It usually employs sources and objects to depict programs and information. Both numeric and alphanumeric data can be used in the formation of data files.

Management of files' functions.

- File and directory creation and deletion
- Useful for editing files and directories.
- It is used for transferring files to other locations that may be out of the reach of the computer.
- It is important to keep the files on a secure server; only store a backup copy of the file on the server.

2) Process Management:

The process management component of the operating system can be used to manage the many processes that run concurrently. It is a package fact that every running software application program is linked or associated with one or more processes.

For example, the process for a browser program like Google Chrome is operating when you are using it. Furthermore, several methods are currently being executed within the OS's environment that carry out different tasks.

These should all be under process management because it ensures that processes run efficiently. It can also activate and shut down the memory given to them.

Process management functions

- It means adding and removing procedures or steps for a particular system.
- The resumption of football after a stoppage in play, whether intentionally or as a result of a stoppage.
- Synchronisation procedure
- Conversational flow

3) I/O Device Management:

Another role of an operating system is to assist in the camouflage of a specific type of hardware. The OS's I/O management features include: The OS's I/O management features include:

- A system for the buffer cache Organised systems of the buffer cache.
- It determines a simple device driver program.
- In addition to this, it serves as a drivers for specific hardware devices.
- I/O gives you the possibility to study the peculiarities of specific devices.

4) Network Management:

The operation of computer networks is carried out through a procedure known as network management and control. This includes monitoring the quality of service delivery, network provisioning, fault analysis, and performance. Management and fault analysis. A scattered system is a connection of computers or processors that are not located in the same area. Time is considered to be sacred, and it must never be shared with a memory or a clock. In this type of system, every CPU has its local memory as opposed to a shared central memory. They all talk to each other across different networks, which could be fibre optic or phone lines. The computers in the network are connected with the help of a communication network, which may be established in a number of diverse ways. Using network management, the network can be wholly or partly controlled in order to optimise the use of the available resources. Somewhat related so that they can create design routing and connection strategies as the solution connection and security issues.

5) Security Management:

These processes have to be protected from one another at the level of the operating system. To achieve this, several strategies can be employed while ensuring that processes that require more time to write files, memory, CPUs, and other resources are used with the proper operating system authorisation. For individual components of the software, such as Sing memory addressing hardware, you may ascertain that a process can exist within its own memory space. In doing so, it is still for the timer that no method is capable of keeping the CPU control it requires to proceed if it is not for regaining it. For this reason, no process is executed that may impair the integrity of the numerous peripheral devices. Do its I/O, which means that it should be able to read from an input device as well as write to an output device.

6) Main Memory Management:

The main memory is comprised of bytes that have an address that forms a large number of bytes. Memory management refers to accessing data in the memory through a sequence of reads or writes from or to designated memory addresses. Before a program may be called, it is linked and has to be loaded into memory and relocated to absolute addresses. A lot of factors, such as class, instance, and stack, are three memory management methods that can be affected by a particular situation. However, the hardware layout of the device is a fairly good one for such a low-cost netbook, but it lacks the finesse and solidity of the more expensive Asus 1201n.

The system is quite important. Both algorithms are not computationally independent; they need hardware support. Main Memory, which the

It is fast and allows the CPU to access it right away; it provides storage. However, this also means that it will be more expensive, and the additional storage space is limited.

As a result, however, to be executed, a program must reside in the main memory.

Functions of Memory Management:

1. Working memory is one of the areas that benefit from the support of the tool.
2. Establish which ones are being utilised and by whom which ones aren't.
3. The OS decides which process to allocate Memory to and how much memory this process should take in a system with numerous programs.
4. In the RAM model, memory is allocated when a process requires it.
5. Moreover, it frees up memory when a task is done or when the task no longer needs it.

Introduction to Windows and Linux

Windows is a widely used operating system developed by Microsoft Corporation. It provides a graphical user interface (GUI) that allows users to interact with their computer hardware and software applications. Here's an introduction to Windows, along with an overview of its utilities:

Introduction to Windows

1. Graphical User Interface (GUI): Windows features a user-friendly interface with icons, windows, menus, and pointers (cursor) that enable users to interact with the computer system visually.
2. Multitasking: Windows supports multitasking, allowing users to run multiple programs simultaneously and switch between them seamlessly.
3. File Management: The file management system in Windows is a program that enables the organisation of files and folders on the computer storage media. Files can be created, copied, moved, and deleted, and they can also be searched with the File Explorer application.
4. Networking: Networking features in Windows enable the connection of a computer to LANs and the internet. The efficiency in resource sharing through networking is that users can share files, printers, and other resources.
5. Security: Some of the security features that come with Windows are user account control, Windows Defender antivirus, Firewall, and encryption tools, which help prevent the system from being infected by malware or accessed by unauthorised persons or programs.

Overview and Utilities of Windows:

1. Start Menu: The Start menu gives the users a list of programs that are commonly used, as well as configurations, documents, and system tools. From the start menu, users can start applications, search document folders and access other system commands.
2. Taskbar: The Taskbar is the thin strip at the bottom of the screen. It contains icons for the applications currently running, shortcuts, and pop-up notifications. It also comprises a start button, a system tray, and a notification area.
3. Control Panel: The control Panel is where you can adjust all the operating system settings and configurations regarding hardware devices, user accounts, network connections, and security.

4. File Explorer: File Explorer is a computer program that enables a user to manipulate files and folders located in the storage devices of a computer. It is an interface for carrying out file operations like copying, moving files, renaming files and deletion of files.

Linux:

The Linux Operating System

Linux operating system is an independent development of the UNIX operating system, which is one of the most widely implemented—developed to offer a free or very low-cost operating system for personal computers. It is known due to its ability to work quickly and get the job done. Linux, on the other hand, is a complete operating system that comes with a GUI layer. UNIX Operating System, C shell, Bourne Again SHell (BASH), Fundamentals of UNIX, Graphical User Interface (GUI), Transmission Control Protocol and Internet Protocol (TCP/IP), Emacs Editor, X Window System and so on. It is a family of distributors of the free and open source operating systems that run under the Linux kernel first sawn the light on September 17, 1991, by Linus Torvalds. Linux is usually distributed with a Linux distribution or distro, that is, a Linux kernel with related system software and applications.

Libraries, of which many are products developed by the GNU Project. Linux distributions can be used for different tasks, such as using it as a desktop and a server.

Applications. Some of the well-known Linux distributions are Debian, Fedora, and Ubuntu. Commercial distributions include Red Hat Enterprise Linux and SUSE Linux Enterprise Server and Desktop. There are several flavours of Linux, and those come with a windowing system like X11 or Wayland and a desktop environment such as GNOME or KDE Plasma. It is possible that distributions initially aimed at servers do not include graphics at all and instead provide a solution stack like LAMP.

Linux initially rose to prominence in personal computers that use the Intel x86 microprocessor. Still, it has since been migrated to more platforms than any operating system has been in the past. It is the foremost operating system on servers and other big iron systems like mainframe computers, and it is the only operating system applied to the TOP 500 supercomputers (since November 2017, when it phased out the use of all competitors). At the same time, only 2 people use Linux. While only 3% of desktop computers use Linux, it is implemented in embedded devices like routers, automation controls, televisions, digital video recorders, video game consoles, and

smartwatches. Most of the popular comic smartphones and tablet computers are on Android and other platforms. Linux derivatives make Linux the operating system that is installed most on the world's computers, which are general-purpose operating systems.

- **Knowledge Check 2**

  Fill in the blanks

  1. command for making subdirectories of a directory using the_____ command. (mkdir)
  2. _____ command is used to delete a directory. (rmdir)
  3. To change the directory to the parent directory of the current working directory, then _____. (cd ..)
  4. This command is used to print a list as coloured _____. (ls –color)

- **Outcome-Based Activity 2**

  Students need to perform lab activity on their PC by implementing all ls command

3.5 Summary

- An Operating System is the Main software that acts as an intermediary between the user and computer hardware.
- It controls the internal activities of computer hardware and provides a user interface.
- A computer system is made up of a variety of hardware and software parts that work together to produce an efficient computing tool.
- one of the primary jobs of an operating system is to work as an interface between the user and the hardware.
- This interface enables a user to utilise hardware resources very efficiently.
- It is only possible to develop an operating system by partitioning it into manageable chunks because it is a very huge and sophisticated system.
- These components ought to be a well-defined part of the system, with inputs, outputs, and functions that are properly specified.

- Both users and programmes can receive services from an operating system. Following are a few common services provided by an operating system:
    i. Program execution
    ii. I/O operations
    iii. File System Manipulation
    iv. Protection
    v. Resource Allocation
    vi. Communication
    vii. Error Detection
- In this topic, we have gone over file and directory management in Unix in depth. A directory is a file whose sole purpose is to store the file names and information associated with them. Directories hold all files, whether they are regular, unique, or directory files.
- The command mkdir means ‘make directory.' You can construct a new directory anywhere in your system by using the mkdir command. Type "mkdir dir name>" (instead of dir name>, type the name of the new directory you want to create) and hit enter.
- *The rmdir* command is used to delete a directory. However, you won't be able to erase a directory that includes a subdirectory. It implies that in order to be removed, a directory must be empty.
- To modify the current working directory in Linux, use the cd command (i.e., in which the current user is working). 'Change directory' is represented by the letter "cd." In the Linux terminal, it's one of the most commonly used commands.
- The list command in Linux is ls. It will show all the contents or the list of your directory. Click the enter key after typing ls.

3.6 Keywords

- **Software—The term "software" describes the collection of programs** created to offer services to the system.
- **Hardware -** Hardware refers to the computer's tangible components or delivery systems that store and run the written instructions provided by the software.

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

3.7 Self-Assessment Questions

1. List out the commands used for managing the files and directories and explain their functionality.
2. Differentiate between less and more commands in Linux.
3. What is an Operating System? Explain the Functions of the operating system.
4. Define Operating System. Explain the components of the Operating System.
5. Explain the services of the Operating System.

3.8 References / Reference Reading

- Fundamental of Computers by Rajaraman.
- Computes Today by B. Sandra.

Unit 4: Introduction to Boolean Algebra

Learning Outcomes:

- Students will be able to define basic logic gates (AND, OR, NOT, NAND).
- Students will be able to explain the functions of half-adder and full-adder circuits.
- Students will be able to construct Karnaugh maps.
- Students will be able to apply simplification techniques in Boolean algebra.

Structure:

4.1 Basic Logic Gates

4.1.1 AND, OR, NOT, NAND Gates

- Knowledge Check 1
- Outcome-Based Activity 1

4.2 Half-Adder and Full-Adder Circuits

4.3 Karnaugh Maps

4.4 Simplification Techniques

4.5 Applications of Boolean Algebra

- Knowledge Check 2
- Outcome-Based Activity 2

4.6 Summary

4.7 Keywords

4.8 Self-Assessment Questions

4.9 References / Reference Reading

4.1 Basic Logic Gates

Logic gates are fundamental components of digital circuits. Typically, most logic gates have two inputs and one output. Each terminal operates in one of two binary states at any given time: low (0) or high (1), which correspond to specific voltage levels. Logic gates are essential for building digital systems and include types such as AND, OR, NOT, NAND, NOR, EXOR, and EXNOR gates. The basic functions of these gates are often illustrated using truth tables.

Boolean Algebra

Boolean algebra is a type of logical algebra where symbols represent logic levels. In this system, the numbers 1 and 0 correspond to the logic states; in electrical circuits, logic 1 denotes a closed switch, high voltage, or an "on" state, while logic 0 signifies an open switch, low voltage, or an "off" state.

A digital device will always be in one of these two states. For instance, consider a light bulb to understand how a logic gate works: applying logic 0 to the switch keeps it off and the bulb unlit, while applying logic 1 turns the switch on, lighting the bulb. Logic gates are widely used in integrated circuits (ICs).

Truth Table: A truth table displays the output for all possible input combinations for a logic gate or circuit. Inputs are usually represented as 1 (True) or 0 (False), detailing the resulting output for each possible input scenario.

Types of Logic Gates

The logic gates are the digital devices used in the transmission of data, and they depend on logical operations. They determine when to switch on a signal by using particular formalised reasoning procedures to regulate the communication processing. The commonly used logic gates include:

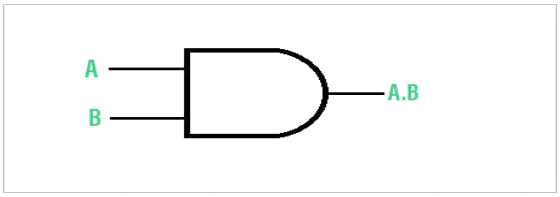
- AND
- OR
- NOT
- NOR
-NAND
-XOR
-XNOR

- **AND, OR, NOT, NAND Gates**

AND Gate

An AND gate is a type of logic gate that possesses one output, and two or more inputs are connected to it. The gate output is 1 only when all the inputs are 1. For instance, let the inputs be A and B, then the Boolean expression of the AND gate is (Y= A. B). The symbol and truth table for an AND gate are shown below:

Input		Output
A	B	A AND B
0	0	0
0	1	0
1	0	0
1	1	1



Symbol of AND gate

The gate produces a high output whenever the inputs are high.

OR Gate

An OR gate includes two or more inputs and one output. It is apparent from the logic that if one or more of the input variables is 1, then the output will also be 1. For instance, for input A and B, the Boolean expression for the OR gate is (Y = A + B).

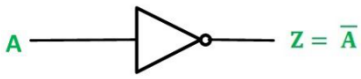
Symbol of OR gate

Input		Output
A	B	A OR B
0	0	0
0	1	1
1	0	1
1	1	1

As a result, when any of the inputs is high, the output of the OR gate is high.

NOT Gate

A NOT gate is a simple logic gate with one input and one output. It inverts the input: if the input is 1, the output is 0, and if the input is 0, the output is 1. Due to this behaviour, it is also called an inverter. For an input (A), the output can be expressed with the Boolean equation Y=A'.



Symbol of NOT gate

Input	Output
A	Not A
0	1
1	0

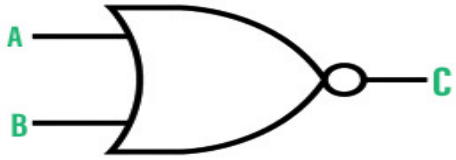
The truth table of a NOT gate demonstrates that it reverses the incoming signal.

Universal Logic Gates

NOR Gate

A NOR gate, also known as a "NOT-OR" gate, is constructed by combining an OR gate with a NOT gate.

This gate produces an output of 1 only when all of its inputs are 0. Conversely, if any of the inputs are high, the output is low. For a NOR gate with two inputs, A and B, the Boolean expression is Y=(A+B).



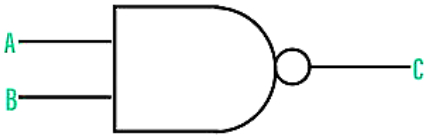
Symbol of NOR gate

Input		Output
A	B	A NOR B
0	0	1
0	1	0
1	0	0
1	1	0

By comparing the truth tables, it's evident that the outputs of a NOR gate are the exact inverse of those of an OR gate. Since a NOR gate can be used to create OR, AND, and NOT gates, it is often called a universal gate.

NAND Gate

A NAND gate, also known as a "NOT-AND" gate, is made by combining a NOT gate and an AND gate. This gate outputs a 1 only when none of its inputs are 1. When all inputs are low, the output is high. For a NAND gate with two inputs, A and B, the Boolean expression is Y=(A.B)'.



Symbol of NAND gate

Input		Output
A	B	A NAND B
0	0	1
0	1	1
1	0	1
1	1	0

By comparing their truth tables, we can see that their outputs are the polar opposite of an AND gate. The NAND gate is sometimes described as a universal gate since it can implement the AND, OR, and NOT gates.

- **Knowledge Check 1**

  State True/False.

  1. When the inputs are distinct, the output of an exclusive-OR (XOR) gate is 1. (T)
  2. A NAND gate's output is the same as the reversed output of an AND gate. (T)
  3. Predictable gate functions in logic gate circuits open their outputs. (F)
  4. The gate must be an AND gate if both inputs must be ON for the output to be ON. ((T)

- **Outcome-Based Activity 1**

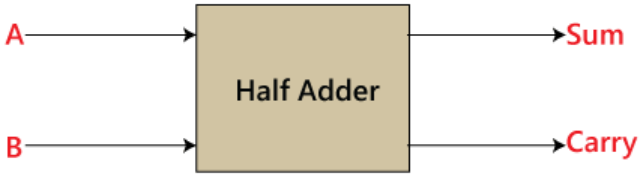
  Prepare a list of applications where Logic Gates Can be used.

4.2 Half-Adder and Full-Adder Circuits

Half Adder

A Half Adder is a basic circuit that adds two binary numbers, producing two outputs: sum and carry. It takes two single-bit binary inputs and uses the OR operation for addition. The inputs are termed augend and addend, while the outputs are sum and carry.

Block diagram



Truth Table

Inputs		Outputs	
A	B	Sum	Carry
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

In the truth table:

- The inputs are denoted as A and B.
- The outputs are sum and carry.
- If both inputs are 0, the carry is 0.
- The 'sum' bit represents the least significant bit of the result.

The sum and carry have the following SOP form:

x'y+xy' = sum

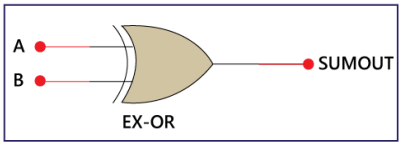
xy = carry

Construction of Half Adder Circuit:

The Half Adder circuit has two inputs (augend and addend) and two outputs (sum and carry). It is constructed using the following

2-input Exclusive-OR Gate or Ex-OR Gate

The **Sum** bit is generated with the help of the **Exclusive-OR** or **Ex-OR** Gate.



The symbol above represents the EX-OR gate. In the figure above, 'A' and 'B' are the inputs, while 'SUMOUT' is the result of the XOR operation of both values.

The EX-OR gate's truth table is as follows:

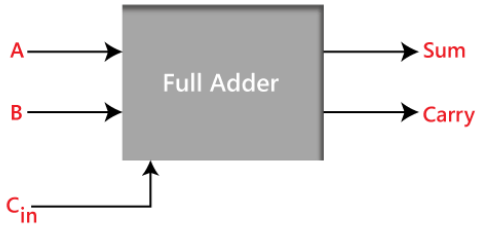
Input		Output
A	B	SUMOUT
0	0	0
0	1	1
1	0	1
1	1	0

The following table shows that when both inputs are different, the XOR gate produces a value of 1. When both inputs are the same, the outcome of the XOR is 0.

Full Adder

The half-adder is used to add two digits alone. To address this issue, the full adder was created. It is utilised to add three 1-bit binary values, A, B, and C. The full adder contains three input states, sum and carry, and two output states.

Block diagram



Truth Table

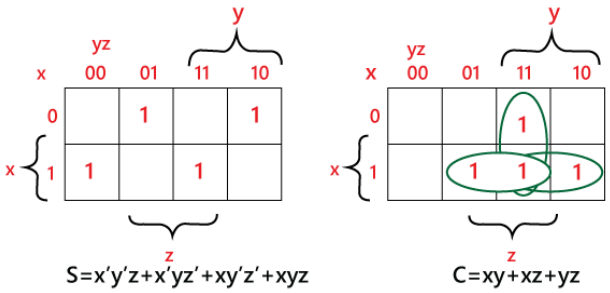
Inputs			Outputs	
A	B	C_{in}	Sum	Carry
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

In the following table,

1. The input variables are 'A' and 'B.' These variables reflect the two significant bits to be added.

2. The third input, 'C_{in},' denotes the carry. The carry bit is retrieved from the preceding considerably lower position.
3. The output variables 'Sum' and 'Carry' determine the output values.
4. The eight rows under the input variable represent all potential 0 and 1 combinations that can occur in these variables.

The SOP form may be produced using K-map as follows:



Sum = x' y' z+x' yz+xy' z'+xyz

Carry = xy+xz+yz

4.3 Karnaugh Maps

The K-map approach may be used to simplify boolean equations methodically. We might use the K-map approach to determine the simplest POS and SOP expression, often known as the minimal expression. An approach to simplifying is the K-map.

A K-map keeps track of every conceivable pairing of input variable values and matching output values, much like a truth table does. In contrast, K-map values are maintained in array cells. Each cell has a binary value for each input variable.

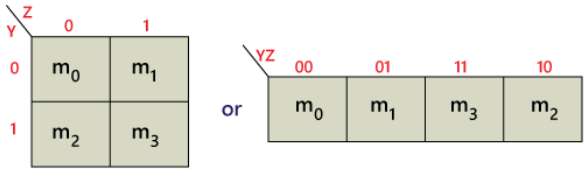
For phrases with 2, 3, 4, and 5 variables, the K-map method is applied. Quine-McClusky approach is another method for simplifying a higher number of variables. The entire number of variable input combinations is equal to the number of cells in a K-map. For instance, if there are three variables, there are 23=8 cells, and if there are four variables, there are 24 cells. There are two forms for the K-map: SOP and POS. There are 0s and 1s in the K-map grid. Group formation is the solution to the K-map. The expressions are solved using K-map in the manner described below:

1. First, we calculate the K-map based on the number of variables.
2. Determine the maximum and minimum terms in the given phrase.
3. Fill the cells of the K-map for SOP with 1s corresponding to the minterms.
4. Fill the cells in the POS block with 0 in relation to the maxterm.

5. Next, we make rectangular groups with total words in the power of two, such as 2, 4, 8,..., and aim to encompass as many components as possible in one group.
6. Using these groupings, we locate the product phrases and summarise them into the SOP form.

Karnaugh Map with Two Variables

A 2-variable K-map has a total of 4 variables. The 2-variable K-map has two variables. The construction of the 2-variable K-map is depicted in the image below:



There is only one way to arrange four neighbouring minterms in the graphic above.

The potential groupings of two adjacent minterms are (m0, m1), (m2, m3), (m0, m2), and (m1, m3).

4.4 Simplification Techniques

Boolean Laws

Boolean Laws are classified into six categories.

Commutative law

Commutative operations are any binary operations that satisfy the following expression.

(i) $A.B = B.A$ (ii) $A + B = B + A$

According to commutative law, altering the order of variables does not influence the output of a logic circuit.

Associative law

According to this law, the sequence in which logic operations are done is unimportant because their impact is the same.

(i) $(A.B).C = A.(B.C)$ (ii) $(A + B) + C = A + (B + C)$

Distributive law

The following requirement is stated by distributive law.

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

AND law

These laws use the AND operation, so they are referred to as AND laws.

(i) $A.0 = 0$ (ii) $A.1 = A$

(iii) $A.A = A$ (iv) $A.\overline{A} = 0$

OR law

The OR operation is used in these laws. As a result, they are known as OR laws.

(i) $A + 0 = A$ (ii) $A + 1 = 1$

(iii) $A + A = A$ (iv) $A + \overline{A} = 1$

INVERSION law

The NOT operation is used in this legislation. According to the inversion law, double inversion of a variable results in the original variable itself.

$\overline{\overline{A}} = A$

Important Boolean Theorems

- Boolean Functions
- De Morgan's Theorems

Boolean Expression/Function

Boolean algebra deals with logic operations and binary variables. An algebraic expression known as a Boolean expression, which includes binary variables, the constants 0 and 1, and symbols for logic operations, defines a Boolean function. Think about the following situation.

$F(A, B, C, D)$	=	$A + \overline{BC} + ADC$	Equation No. 1
Boolean Function		Boolean Expression	

In this case, the left side of the equation reflects the output Y, so equation 1 may be stated. $Y = A + \overline{BC} + ADC$

De-Morgan's Theorem

The two most important theorems of boolean algebra were created by renowned mathematician De-Morgan. The equivalence of the negative-OR and NAND gates, as well as the NOR and negative-AND gates, is demonstrated by the De-Morgan theorems. These theorems can be applied to the solution of many Boolean algebraic equations. The table below lists the logical operation for every possible combination of the input variables.

Input variables		Output Condition			
A	B	AND	NAND	OR	NOR
0	0	0	1	0	1
0	1	0	1	1	0
1	0	0	1	1	0
1	1	1	0	1	0

De-theorem Two input variables (x and y) plus Boolean formulas for OR, AND, and NOT are used to create Morgan's rules. De-morgan's first theorem states that, as opposed to using the OR operation on the variable's complement, the same outcome can be achieved by carrying out the AND operation on two input variables and then NOT the result. According to De-Morgan's second theorem, the result of an AND operation on the variable's complement is the same as that of an OR operation on two input variables followed by a NOT operation on the output.

4.5 Applications of Boolean Algebra

Boolean algebra is a branch of mathematics that deals with variables that have two distinct values: binary, that is, 0 and 1 or true and false. This field of algebra includes the following applications, particularly in computer science, electrical engineering, and mathematics. Here are some key applications of Boolean algebra:

1. Digital Logic Design

Boolean algebra is an essential basic building block in the construction of digital circuits. It describes the functionality of logic gates and circuits in the simplest and most organised manner possible.

- Logic Gates: AND, OR, NOT, NAND, NOR, XOR and XNOR gates are simple gates and are expounded by Boolean equations.
- Simplification: Boolean algebra can be used to analyse and optimise large and complex logic circuits, resulting in efficient and cheaper circuits.

2. Computer Algorithms

Boolean algebra is essential in the creation of algorithms, as well as the operations performed within computers.

- Conditional Statements: These are typically found in programming and are employed in decision-making (e.g., in if-else statements) and directing the sequence of code execution.

- Search Algorithms: These are used in developing good search procedures such as hash tables, among others.
- Bitwise Operations are crucial for operations on binary data, such as encryption, data compression, and error detection and correction.

3. Computer Architecture

In computer architecture, Boolean algebra is used to model and enhance the functioning of the hardware.

- Arithmetic Logic Unit (ALU): The arithmetic and logic unit, or ALU, is the component used to perform arithmetic and logic operations using Boolean functions.
- Control Units: Boolean expressions control the execution of instructions in CPUs, and their control units are also designed.

- **Knowledge Check 2**

  Fill in the blanks

  1. In the boolean algebra A + A equals to _____.(A)
  2. The basic Laws of Boolean Algebra that relate to the _____ allowing a change in position for addition and multiplication. (commutative property)
  3. In the Boolean algebra: A+0=___. (A)

- **Outcome-Based Activity 2**

  Simplify F(A, B, C, D)=π(3,5,7,8,10,11,12,13) with the help of a K-map in a group of 2.

4.6 Summary

- A logic gate is an idealised or physical device that performs a Boolean function, which is a logical operation on one or more binary inputs that results in a single binary output.
- A kind of logical algebra in which symbols represent logic levels is known as Boolean algebra.
- A truth table lists the outputs for all possible combinations of inputs that may be applied to a logic gate or circuit.
- Logic gates are used in microprocessors, microcontrollers, embedded system applications, and in electronic and electrical project circuits.

- Boolean laws are classified into six categories: Communicative law, associative law, distributive law, AND law, OR law, and INVERSION law.
- The K-map is a method for methodically simplifying Boolean equations. We may use the K-map approach to determine the simplest POS and SOP expression, often known as the minimal expression.
- The De-Morgan theorems are used to prove the equivalence of the NOR and negative-AND gates, as well as the negative-OR and NAND gates.
- Combinational logic circuits are those that contain various types of logic gates.
- Adder, Subtractor, Decoder, Encoder, Multiplexer, and De-multiplexer are examples of combinational logic circuits.

4.7 Keywords

1. **Logic Gate:** A logic gate is an idealised or physical device that performs a Boolean function, which is a logical operation on one or more binary inputs that results in a single binary output.
2. **K-Map:** The K-map is a method for methodically simplifying Boolean equations. We may use the K-map approach to determine the simplest POS and SOP expression, often known as the minimal expression.
3. **Sum of Product (SOP):** The sum of the product form of representation. The product number is logical and operates on the different input variables, where the variables could be in the true form or the complemented form.

4.8 Self-Assessment Questions

1. Simplify expression Y=A'B'C' D'+A' B' CD'+A' BCD'+A' BCD+AB' C' D'+ABCD'+ABC.
2. Explain different logic types with the truth Table.
3. Explain De-Morgan's Theorem.
4. Describe the Construction of FULL Adder Circuit.
5. Differentiate between SOP and POS.

4.9 References / Reference Reading

- Fundamental of Computers by Rajaraman.
- Computes Today by B. Sandra.

Unit 5: Introduction to Computer Networks

Learning Outcomes:

- Students will be able to define the concepts of networking.
- Students will be able to describe the advantages of networking.
- Students will be able to classify networks into LAN, MAN, WAN, and VWAN.
- Students will be able to explain the uses of Usenet and Telnet.
- Students will be able to illustrate various network topologies.

Structure:

5.1 Concepts of Networking

5.2 Advantages of Networking

5.3 Classification of Networks

5.3.1 LAN, MAN, WAN, VWAN

- Knowledge Check 1
- Outcome-Based Activity 1

5.4 Usenet and Telnet

5.5 Network Topologies

- Knowledge Check 2
- Outcome-Based Activity 2

5.6 Summary

5.7 Keywords

5.8 Self-Assessment Questions

5.9 References / Reference Reading

5.1 Concepts of Networking

Data Communication Definition

Data communication can be defined as the exchange of data or information from one device to another through a channel or a network. It comprises the sending, receiving, and understanding of data by both the sending and receiving devices. The objective of data communication is to transfer data like text, files, images, videos, and so on from one device to another so that users can interact with and share data.

In data communication, data is converted into a form of signal that can be transmitted over some communication channel, such as a wire or through the air. The process typically involves the following components:

1. **Sender:** The sender is the device or application that starts sending data when the data communication process is initiated. It transforms the data into a form suitable for transmission and sends it through a transmission medium.
2. **Communication Channel:** The communication channel is the medium by which data is passed from one place to the other, either physically or virtually. It can be copper wires, fibre-optic cables, radio waves, wireless networks, and the like.
3. **Receiver:** This is the device or application that receives the transmitted data. It demodulates the received signals and reconverts them back into useful form for the recipient.
4. **Protocols:** Data communication depends on protocols-virtually; a protocol is the format and procedures used to carry out the data communication. Protocols make it possible for the sender and the receiver devices to be in a position to decode the data.
5. **Error Detection and Correction:** In data communication systems, error detection and correction techniques are sometimes used to check and verify the information being sent. These mechanisms correct errors that may occur during the message's transmitting process.

Data communication can occur in LANs, WANs, or the Internet. It makes possible many programs and facilities that depend on data exchange, including Messaging, the World Wide Web, File Transfer, Video and voice conferencing, and many others.

Data communication is the transfer of data from one device to another through a channel of communication. It incorporates transmitting and receiving data by

converting it to signals and then decoding that information. It has a significant function in the interaction and information exchange processes between devices and networks.

5.2 Advantages of Networking

Some of the main advantages of Computer Networking are discussed below:

1. Centralised Data Storage: Files are generally stored on a specific node known as the file server so that they can be shared with users in an organisation.
2. Connectivity: To join a modern computer network, nothing is needed; knowledge is easily available, and children are able to search for it.
3. Faster Problem-Solving: By distributing the tasks, specific problems can be solved more effectively in the context of integrating connected devices.
4. Reliability: This type of data reliability is backed up to maintain operations even when the hardware has issues.
5. Flexibility: Computer networking provides such freedom to the user that they can try and experiment with software and other resources which are not a hindrance to their utility.
6. Security through Authorisation: Data integrity is preserved by granting users permission to view particular files or run specific applications.

5.3 Classification of Networks

5.3.1 LAN, MAN, WAN, VWAN

- **LAN:**

A Local Area Network (LAN) is a type of network that is restricted geographically to a small area like a home, office, or school compound. It links the devices within this localised region, ensuring they can communicate and access resources. LANs are employed in homes, small offices, schools, and large-scale enterprises, among other places.

The first defining factor of a LAN is usually the geographical limit in which it is set up, and most LANs are found in a localised area. LANs employ different communication media, such as Ethernet or wireless media, to link commodities like computers, printers, servers, and network switches. These devices are connected with network cables or any wireless connection, which creates a network of the devices.

A main benefit of a LAN is its high transfer rates and low transmission delays. This allows devices within the network to communicate quickly and effectively in activities such as file transfer, printing, and others. LANs also enable the management and control of resources in the network, such as user accounts, security, and network configuration.

- **MAN:**

MAN is a network that is limited geographically compared to WAN but larger than a LAN. Many LANs are connected by MANs in a city or a college. Because of their communication and sharing of resources capabilities, MANs support the efficient sharing of information and data across several locations.

MANs are widely adopted in organisations, universities, and government facilities with several locations within a particular metropolitan region. Employing the concept, they support direct connectivity and interaction with other branches or departments and permit the usage of resources such as files, databases, and applications.

The first attribute of a MAN is geographical since it interconnects several LANs but is limited to a metropolitan area. To create networking, MANs use several technologies, such as fibre-optic cables, wireless connections, and leased lines to connect different LANs.

Another benefit of applying a MAN is that it offers efficient data communication with high speed and minimal delay in the targeted region. This enables organisations to establish efficient communication channels for tasks such as video conferencing, data sharing, and centralised access to shared SAN: This allows organisations to develop efficient communication channels for functions such as video conferencing, data sharing and centralised access to shared SAN:

A Storage Area Network (SAN), on the other hand, is a more narrow network that exists exclusively for data storage. SANs are normally used in large-scale environments such as enterprises and data centres, where data storage and sharing are paramount. 4 (DCN, Behrouz A Forouzan)

The main purpose of a SAN is to facilitate efficient access to storage entities such as disk arrays, tapes, or SSDs. It allows several servers or computing systems to access the storage devices through a separate network different from the organisation's local area network (LAN) for regular data transmission.

• **WAN:**

A WAN is a network that is usually used to connect several LANs or computers that are located in different geographical areas. WANs are used in organisations to ensure that computers in different locations communicate, bearing in mind that they can connect computers that are in other offices, campuses or even different countries. 5(DCN, Behrouz A Forouzan)

The main feature of a WAN, is that it is a wide-area network that operates over large geographical regions such as cities, states, or even continents. WANs use communication media such as leased lines, satellite links, and public and private networks to connect geographically separated locations.

WANs give organisations the flexibility to create and implement effective communication systems that can link distant locations. They facilitate the exchange of information, materials, and services within various sites and allow workers to work collectively and access assets from a central location despite their geographical locations.

Another advantage of WANs is the fact that they can cover large distances while at the same time ensuring that the data being transmitted is secured. They use intensive network standards like MPLS (Multiprotocol Label Switching) or IPsec (Internet Protocol Security) for secure data communication. WANs also contain special attributes such as quality of service (QoS) that help give preference to important traffic and make the applications that demand real-time communication, like video conferencing or VoIP, have lower latency.

WANs can be established in different topologies based on their needs and the amount of resources to be used. Some of the WAN configurations include point-to-point, which involves the connection of two stations, and hub-and-spoke, in which several stations connect to a central station.

Internet-based WANs, also known as Virtual Private Networks (VPNs), use a public network like the Internet to link remote sites. VPNs use encryption and tunnelling to maintain the confidentiality and integrity of information and control access to a network.

• **VWAN**

Virtual WAN is a networking solution that amalgamates various networking, security, and routing aspects into a single operational view. Key features include:

- Connection of the branches through Virtual WAN Partner devices such as SD-WAN or VPN CPE.
- Site-to-site VPN connectivity.
- Connectivity to remote users using Point to Site VPN.
- ExpressRoute in private connections.
- Connect on the same cloud for transit connectivity to the virtual networks.
- VPN ExpressRoute inter-connectivity.
- Routing, Azure Firewall, and encryption for a private connection.

None of these features must be used to begin using Virtual WAN. It is flexible in the sense that you can start with one use case and build your network slowly.

The design of Virtual WAN is a hub-and-spoke model with branches and VPN/SD-WAN devices, users and Azure VPN/OpenVPN/IKEv2 clients, ExpressRoute circuits, and virtual networks. This architecture provides structures through which a global transit network can be set up so that there can be transitive connectivity between endpoints that may be located at various types of spokes.

- **Knowledge Check 1**

  Fill in the Blanks

  1. Abbreviation for TCP is _____. (Transmission Control Protocol)
  2. Abbreviation of WAN is_____. (Wide Area Network)
  3. A _____ is a specialised type of network architecture designed for the centralised storage and retrieval of data. (Storage Area Network)

- **Outcome-Based Activity 1**

  A multinational company with offices in different countries needs to establish a network infrastructure to connect all its offices and enable efficient communication and resource sharing.

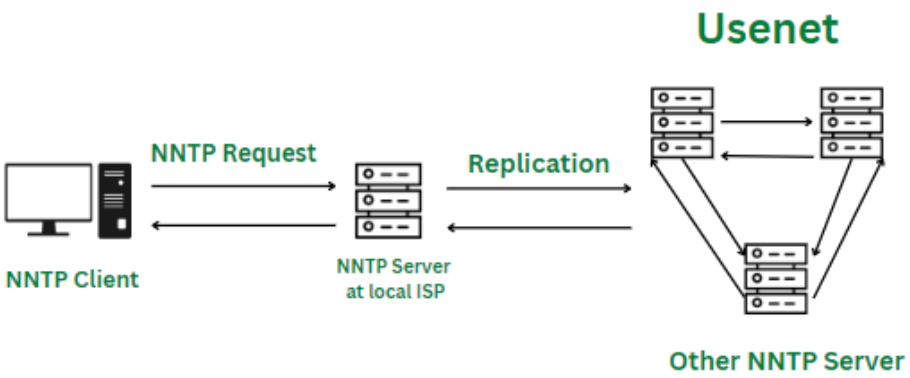
  Make a group of 4 to discuss and determine which type of network (LAN, MAN, or WAN) would be most suitable for the given scenario. They should consider factors such as geographical distance, number of users, and network requirements.

5.4 Usenet and Telnet

Usenet

Usenet, short for User Network, operates similarly to a Bulletin Board System, allowing users to post articles or messages on various topics.

Usenet newsgroups are organised hierarchically, similar to the Domain Name System (DNS). Each Usenet comprises user-submitted articles or posts on diverse topics disseminated across servers on the global network.



Working of Usenet

Usenet operates on the Network News Transfer Protocol (NNTP), defined in Request for Comments (RFC) 977. It consists of two main components:

1. Client/Server Portion: This portion enables users to interact with news servers using client software like Google Chrome. Users can download a list of available Usenet newsgroups, read existing messages, reply to messages, or post new ones.

2. Server/Server Portion: Allows news servers to communicate with each other to replicate messages from newsgroups. For instance, Microsoft Exchange Server fully supports NNTP.

TELNET

TELNET, derived from Teletype Network, is a protocol that facilitates one computer to connect to another remotely. It functions as a standard TCP/IP protocol for virtual terminal service as per ISO standards.

During TELNET operation, actions performed on the remote computer are displayed on the local computer. TELNET operates on a client/server principle, with the local computer employing a telnet client program and the remote computer using a telnet server program.

5.5 Network Topologies

LANs can be further classified based on their topologies, which determine how devices are interconnected within the network. Common LAN topologies include:

- **Bus Topology:** Devices in a bus topology are linked to a single communication line known as a bus. Data is sent along the bus, and devices get the data that is meant for them.

Bus

- **Star Topology:** Devices in a star topology are connected directly with a central device, such as a switch or a hub. All communication in the organisation is channelled through the central device.

Star

- **Ring Topology:** A ring topology provides circular connectivity of the devices, which forms a closed loop. Information is transmitted in the ring fashion from one device to the next until it reaches its desired destination.

Ring

- **Mesh Topology:** In a mesh network, the devices are connected with many interconnections, so there are many routes for data transmission. This makes the communication system robust and fail-safe by enabling it to carry out communication even if some of the devices fail.

Mesh

- **Knowledge Check 2**

  Fill in the blanks

  1. TELNET stands for _____. (Terminal Network)
  2. USENET stands for _____. (User Network)
  3. The acronym of DNS is _____. (Domain Name System)

- **Outcome-Based Activity 2**

  Usenet and DNS are similar. Justify.

5.6 Summary

- Data communication can be defined as the process of transferring digital data from one device or system to another using a communication network.
- It is a process that involves sending data in the form of bits and bytes through the application of communication standards and products.
- A network is a collection of equipment like computers, servers, and peripherals that are connected to enable them to share resources and or exchange information.
- Depending on the geographical extent, the types of networks are Local Area Networks (LAN), Metropolitan Area Networks (MAN), Storage Area Networks (SAN), and Wide Area Networks (WAN).
- A LAN (Local area Network) is a network that links devices and spans a limited area, often a campus or a building.
- A MAN (Metropolitan Area Network) is a LAN of many LANs spread over a larger region of a city.
- A WAN is a network made of different networks operating at a large geographic distance, such as between cities or countries.

- Usenet is the contraction of the User Network. It looks like just a Bulletin Board System where the users can upload articles or posts on different topics.
- Of, TELNET means Teletype Network. It is a protocol that facilitates direct communication between one computer and the local computer. It is employed as a standard TCP/IP protocol for virtual terminal service offered by ISO. The computer that initiates the connection is referred to as the local computer.

5.7 Keywords

- **TCP/IP**: TCP/IP (Transmission Control Protocol/Internet Protocol) is an assortment of networking protocols that oversees data exchange and communication between devices connected to the Internet or any IP-based network.
- **Data**: Data refers to information in the form of digital bits and bytes that is processed, stored, and transmitted within computer systems and networks. It represents various types of information, such as text, images, audio, and video.
- **Topology**: Topology in computer networks refers to the physical or logical arrangement of devices, connections, and communication paths, determining the structure and layout of the network. It can be represented in various forms, such as bus, star, ring, mesh, or hybrid configurations.

5.8 Self-Assessment Questions

1. What is the definition of data communication?
2. How would you define a network?
3. What are the different types of networks, and what are their characteristics?
4. What is Usenet?
5. Explain TELNET with the help of an example.

5.9 References / Reference Reading

- Fundamental of Computers by Rajaraman.
- Computes Today by B. Sandra.

Unit 6: Advanced Networking Concepts

Learning Outcomes:

- Students will be able to define the concept of a Green P.C.
- Students will be able to explain the importance of screen savers.
- Students will be able to describe ergonomics in computing.
- Students will be able to identify basic principles of network security.

Structure:

6.1 Concept of Green P.C.

6.2 Screen Savers

- Knowledge Check 1
- Outcome-Based Activity 1

6.3 Ergonomics in Computing

6.4 Network Security Basics

- Knowledge Check 2
- Outcome-Based Activity 2

6.5 Summary

6.6 Keywords

6.7 Self-Assessment Questions

6.78 References / Reference Reading

6.1 Concept of Green P.C.

The term Green PC (Green Personal Computer) can be defined as the creation of computers that are friendly to the environment in terms of their fabrication, application, and even disposal. It focuses on low energy consumption, low CO2 emissions, and low environmental impact from the device's production to its disposal.

Key Components of a Green PC

1. Energy Efficiency:

Energy-Efficient Components: Employing the low-power-based hardware system components, including low-power microprocessors, efficient power supplies and the LED display.

Energy Star Certification: Most green PCs meet the Energy Star program, which is a designation of energy specifications for appliances.

2. Sustainable Manufacturing:

Eco-Friendly Materials: The choice of materials for the components and the packaging, more specifically, the use of items that can be recycled and items that decompose naturally.

Reduced Hazardous Substances: Reducing or eliminating toxic substances such as lead, mercury, and cadmium in the manufacturing process.

3. Lifecycle Management:

Extended Lifespan: Designing PCs that will last longer to cut on the number of replacements and, hence, the e-waste.

Upgradability: Making it possible to replace, upgrade, or repair PCs without having to replace the entire system.

4. Recycling and Disposal:

Take-Back Programs: Enacting programs through which the consumer can return old PCs to be recycled and disposed of properly.

E-Waste Management: Ensuring that the environment is not endangered when disposing of electronic waste by following set rules and regulations in addition to the universally accepted standards.

5. Software Optimisation:

Energy-Saving Settings: Consumer devices with settings that allow for less power usage, such as a power saver mode and other power-related options.

Benefits of Green PCs

1. Environmental Benefits:

Reduced Carbon Footprint: Reduced energy also means lowering greenhouse emissions.

Less Electronic Waste: The longer lifespan and the recyclability of solar panels also reduce the amount of electronic waste.

2. Economic Benefits:

Lower Energy Costs: The PC has energy-efficient features, which means it consumes less electricity, which over time translates to savings on bills.

Cost Savings on Upgrades: Portable PCs are more cost-effective because they are not disposed of as often as other PCs; hence, the upgrade is more economical.

3. Health Benefits:

Reduced Exposure to Toxins: When measured in terms of health, using fewer hazardous substances in production benefits the workers and users.

Challenges and Considerations

1. Initial Cost: The green PCs may be more expensive to manufacture because of the various special materials and technologies used.
2. Performance Trade-offs: The energy-efficient components do not adversely affect the performance needed for some applications.
3. Consumer Awareness: Informing consumers about the benefits and availability of green PCs will encourage them to go green.

Green PC initiatives and their examples

1. Dell: Sustainability is another key aspect of Dell, as is its product recycling program and energy-efficient products.
2. Apple: Apple products are energy-friendly, and the company is driven to incorporate recycled materials and reduce carbon emissions.
3. HP: Currently, HP has developed a series of energy-saving and environmental protection PCs and has set up take-back and recycling projects.

The idea of a Green PC is an important part of sustainable computing. They incorporate energy efficiency, sustainability in production, life cycle considerations, and the correct disposal of the end products, hence reducing the effect of computers

on the environment. With the advancement in technology, the market for green PCs is expected to grow as a result of client pull and government push.

6.2 Screen Savers

In advanced networking, the concept of screen savers does not have any direct link with the networking protocols and network infrastructures. However, there is still room for screen savers, primarily in networked environments, which are widely used in the sphere of enterprise.

Definition of Screen Savers

A screen saver is a program usually in the computer that displays information moving on the monitor screen when the computer is idle for some time. The main function of screen savers is to avoid screen burn-in, a state in which the specific areas of the monitor become permanently stained or damaged as a result of static pictures displayed on the screen for a long time.

Screen Savers in Advanced Networking Environment

1. Security: Screen savers can also be set to come on automatically after some time of inactivity, especially within an enterprise network, so as to prevent access to some confidential data. Some screen savers force the user to key in their login details to get back to the desktop, which enhances the security of systems that are networked.
2. Network Management: Screensavers are easy to distribute in a network of computers since they can be easily configured and copied through network management systems. This enables the administrators to centrally manage screen saver policies that include the minimum amount of time of inactivity that triggers the screen saver to come on and also the level of authentication that is required to turn it off on any of the connected devices.
3. Resource Conservation: Some screen savers, such as dimming the display or turning off the entire monitor after a while, are also effective in a large networked environment. In particular, there is a potential for dramatic energy savings during periods of inactivity, thereby saving money on electrical bills and decreasing organisations' impact on the environment.
4. Branding and Messaging: Today, corporate marketing and communication messages can also be placed in screen savers as part of corporate identification. Many corporations can program screen savers to have their company logos,

messages, or advertisements to enhance the imprinting of company identity and pass on information to employees.

5. Remote Management: In the new age of work-from-home, screen savers can still be controlled and set for all remote devices through the management tools. This enables the administrators to continue ensuring that security and energy-saving policies are well set for the distributed networks of the remote devices.

Guidelines concerning the implementation of screen savers

- Policy Implementation: Develop and implement coherent screen-saver policies with regard to the security and energy-saving goals and apply them uniformly across the network.
- User Education: Inform users why screen savers are useful for security and conserving energy and help them set up their screen savers according to the organisation's standards.
- Regular Monitoring: Check on the screen savers at least once a week to ensure that they are functioning as expected and to review the compliance with policies that have been put in place.
- Integration with Endpoint Security: The last recommendation is to enhance the endpoint security solutions to oversee screen savers and check that they meet the necessary security standards and do not pose threats within the network.

Screen savers could be considered a minor element. However, in a sophisticated network environment, they can prove useful for security, energy, and communication goals. The following key is presented as a conclusion, with the observation that when it comes to managing screen saver policies and taking advantage of effective tools and management to control centralised systems, organisations can successfully achieve the optimum efficiency of screen savers and avoid side effects.

- **Knowledge Check 1**

  Fill in the blanks

  1. The fundamental components of a green PC can be outlined as follows: _____ & _____.(energy-efficient hardware, power management features)
  2. Following are the Benefits of Green PCs: _____. (Reduced energy consumption)

3. The main function of the screen savers is to minimise _____. (screen burn-in)
4. The advantages of screen savers are _____ (Preserving monitor lifespan)

- **Outcome-Based Activity 1**

  Create a presentation on all the varieties of screensavers that are available on your computer.

6.3 Ergonomics in Computing

Computing ergonomics is the manner in which computer workstations and peripherals are positioned and arranged to enhance users' comfort, productivity, and safety. This involves evaluating body position and movement patterns and eyes to reduce the chances of developing MSDs or other health complications due to excessive computer usage.

The Ergonomics principles that apply to Computing are;

1. Proper Posture: Ask the users to sit with their back straight and spine erect, shoulders relaxed, and wrists in a straight position, especially when typing or using a mouse.
2. Adjustable Furniture: Users should be given adjustable desks, chairs, and monitor stands to cater to tall and tiny-framed individuals and enable them to have the correct positioning of the keyboard, mouse, and monitor.
3. Monitor Placement: Align the monitor at eye level and maintain a distance of one arm's length away from the user to avoid neck strain and minimise the effect of glare arising from either overhead lighting or the presence of windows.
4. Keyboard and Mouse: Special keyboards and mice are employed, which are padded with wrist rests and shaped to minimise stress on the wrist and hand. Users are advised to position the keyboard and mouse so that they do not have to stretch their arms, bend, or tilt their wrists.
5. Foot Support: We suggest footrests or foot stools for feet and circulation, particularly for those who cannot put their feet on the floor.
6. Breaks and Stretching: To prevent RSI and eye strain, suggest that users take a break from the keyboard and mouse and close their eyes for a while.

7. Task Lighting: Provide sufficient lighting for the task with sufficient control for eye strain and glare that comes with monitor lighting. This can be in the form of desk lamps or lighting that does not reflect off screens.
8. Cable Management: Managing cables and wires to avoid tripping on them, maintaining the tidiness of the working environment, and using trays or clips to manage cables away from the working area.
9. Software Settings: Change features like brightness, contrast, and font size in a way that is most comfortable for the eyes. Functionalities such as night mode or blue light filters help reduce the effects of blue light and are best used at night.
10. Training and Awareness: Offering instruction to employees on how to use computers correctly and how effectively the workstation must be set up relative to ergonomic positions.

Advantages of implementing Ergonomics in the use of Computers

1. Improved Comfort: Correct ergonomic design minimises the risks of experiencing body pain and tiredness linked to long hours of computer use, improving a user's general health.
2. Increased Productivity: A well-designed and properly equipped workstation enhances concentration, reducing the time taken to complete tasks.
3. Reduced Risk of Injury: This factor reduces the possibility of developing Musculoskeletal disorders, Repetitive strain injuries, and other ailments which are a result of poor posture and reproductions of certain movements.
4. Enhanced User Satisfaction: Investing in comfortable work chairs and desks has a positive impact on the organisation. It shows that the employer is concerned with the employee's health, and morale will be high.
5. Cost Savings: Ergonomic design can help increase organisational return because the cost savings recoup the cost of proper ergonomic design in time off, medical expenses and worker’s compensation from ergonomic-related injuries.

Cohesion in ergonomics in computing is crucial in enhancing health and safety and increasing performance efficiency. By using ergonomic principles in the design and location of computer workplaces, it is possible to improve personnel working conditions and productivity and minimise the frequency of injuries and their impact on the organisation's financial situation.

6.4 Network Security Basics

The protection of data, resources, and communication is crucial in any organisation or personal network. Here's an overview of the fundamental concepts and practices involved in network security:

 # 1. What is Network Security?

Network security refers to the collection of processes employed to safeguard the data and resources available on a network. It comprises a broad field of technologies, devices, and methods intended to protect against threats of unauthorised use, abuse, or destruction.

 # 2. Key concepts in security in computer networks

Confidentiality: Ensure that the information can only be viewed by those with the right permission.

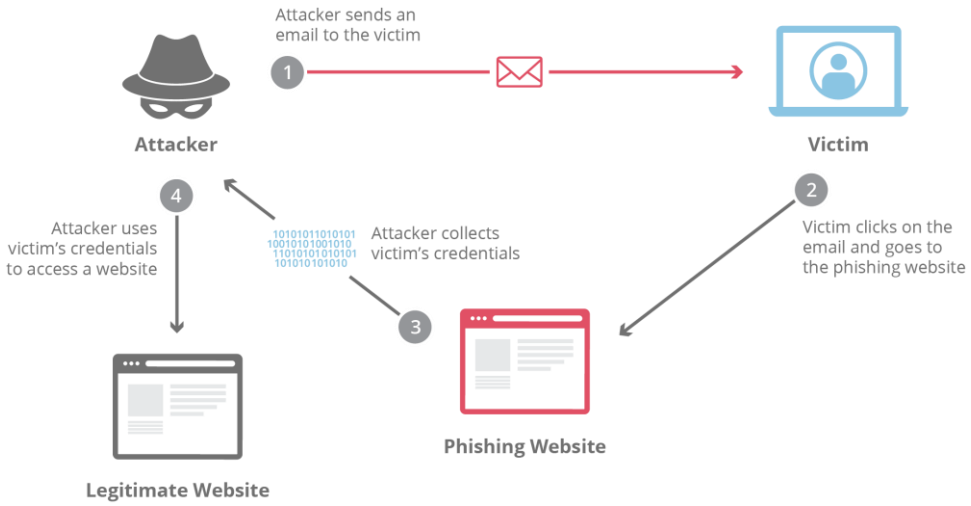
- Integrity: Preventing data from being changed or modified by other people who are not authorised to do so.

- Availability: The role of making sure that data and resources are made available to only the users who are authorised to use them when the need arises.

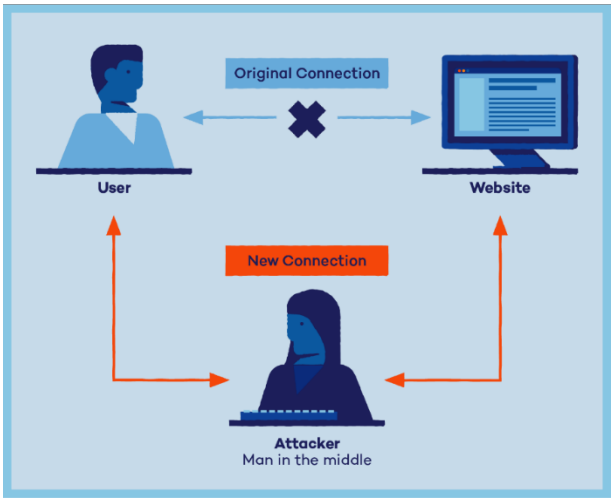
 # 3. There are many threats to network security that are frequently encountered on the internet today. These include;

- Malware: Malware consists of programs like viruses, worms, and Trojan horses that are intended to harm a network.

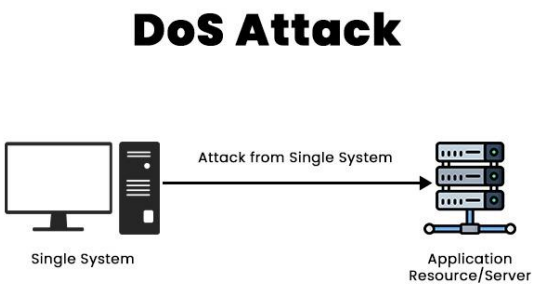
Phishing is an approach in which the attacker takes the identity of a legitimate entity in an attempt to deceive the target into yielding valuable information.



Man-in-the-Middle Attacks: In these attacks, the attacker's motive is to intercept and possibly modify the communication between two parties without their consent.



Denial of Service (DoS) Attacks are efforts to deny a network or service to its legitimate users by sending a large number of unwanted requests to the network or service.



 # 4. Essential Security Measures

- Firewalls: These serve as filters between a secure network and an unsafe network where it scans and regulates traffic flow within such networks in compliance with the set security policies.

Intrusion Detection Systems (IDS) and Intrusion Prevention Systems (IPS): These systems help detect suspicious activities on the network and can stop them as and when they are noticed.

- Encryption: This involves placing a code to the data in a way that only allows people to decipher the information, with protection during transfer.

Access Control: Limiting users' access to available network resources through authentication and authorisation, which will enable only authorised users to have access to certain information or specific systems.

 # 5. Recommendations on Network Security

Regular Updates and Patch Management: Update all the software and systems being used to ensure they have the relevant security patch to avoid hackers exploiting known vulnerabilities.

Strong Password Policies: Enact measures such as policies that demand the use of strong passwords and frequent password re-entries to minimise the cases of unauthorised access.

User Education and Awareness: This includes security awareness, how to distinguish between a phishing attack, and how to handle personal and confidential information.

- Regular Security Audits: Performance of periodical check-ups/audits of the network for threat and vulnerability analysis.

 # 6. Trends in Network Security

Artificial Intelligence (AI) and Machine Learning are more commonly used to forecast and detect threats by observing patterns and activities on the network.

Zero Trust Security Model: This is an approach to security in which no one is trusted and where everyone must prove that they are authorised to use the network's resources, be they internal or external.

- **Knowledge Check 2**

  Fill in the blanks

  1. _____ in computing refers to the design and arrangement of computer workstations. (Ergonomics)
  2. A _____ is a computer program that displays a moving image or animation on the screen of a computer monitor (screensaver)
  3. _____ in computing is essential for promoting health, safety, and efficiency in the workplace. (Ergonomics)
  4. _____ can be configured to activate after a specified period of inactivity to protect sensitive information from unauthorised access. (Screensavers)

- **Outcome-Based Activity 2**

  Make a list of Ergonomics activities in Computing.

6.5 Summary

- The concept of a Green PC (Green Personal Computer) refers to designing, manufacturing, using, and disposing of computers in an environmentally friendly manner.
- Energy Efficiency, Lifecycle Management, Recycling and Disposal are a few Key Components of a Green PC.
- Benefits of Green PCs are reduced carbon footprint, lower energy costs, reduced exposure to toxic substances, etc.
- In advanced networking, the concept of screen savers is not directly related to the core functionalities of networking protocols or infrastructure.
- A screen saver is a computer program that displays a moving image or animation on the screen of a computer monitor when it is not in use for a certain period.
- The primary purpose of screen savers is to prevent screen burn-in. In this phenomenon, certain areas of a monitor display become permanently discoloured or damaged due to static images being displayed for extended periods.
- Best Practices for Screen Saver Deployment are Policy Implementation, User Education, Regular Monitoring, etc.
- Ergonomics in computing refers to the design and arrangement of computer workstations and peripherals to optimise comfort, efficiency, and safety for users.
- Key Principles of Ergonomics in Computing are Proper Posture, Monitor Placement, Cable Management, etc.
- Benefits of Ergonomics in Computing are Reduced Risk of Injury, Improved Comfort, Increased Productivity, etc.

6.6 Keywords

- **Green PC:** The concept of a Green PC (Green Personal Computer) refers to designing, manufacturing, using, and disposing of computers in an environmentally friendly manner.
- **Screen Savers:** A screen saver is a computer program that displays a moving image or animation on the screen of a computer monitor when it is not in use for a certain period.

- **Ergonomics:** Ergonomics in computing refers to the design and arrangement of computer workstations and peripherals to optimise users' comfort, efficiency, and safety.

6.7 Self-Assessment Questions

1. What are Green PC?
2. What are screensavers?
3. What is meant by Ergonomics?
4. What are the benefits of Ergonomics?
5. What are the Best Practices for Screen Saver Deployment?

6.8 References / Reference Reading

- Fundamental of Computers by Rajaraman.
- Computes Today by B. Sandra.

Unit 7: Structured Design Techniques

Learning Outcomes:

- Students will be able to define Nassi-Shneiderman diagrams.
- Students will be able to explain Warnier-Orr diagrams.
- Students will be able to describe decision trees and decision tables.
- Students will be able to create HIPO, VROC, IPO diagrams, and data dictionaries.

Structure:

7.1 Nassi Shneiderman Diagram

7.2 Warnier-Orr Diagrams

- Knowledge Check 1
- Outcome-Based Activity 1

7.3 Decision Trees and Decision Tables

7.4 HIPO, VROC, IPO, and Data Dictionary

- Knowledge Check 2
- Outcome-Based Activity 2

7.5 Summary

7.6 Keywords

7.7 Self-Assessment Questions

7.8 References / Reference Reading

7.1 Nassi Shneiderman Diagram

A Nassi-Shneiderman Diagram (NSD), also known as a structogram, is a graphical representation used to design and visualise structured programming constructs. Developed by Isaac Nassi and Ben Shneiderman in the early 1970s, NSDs provide a visual method to depict the logical flow of a program, making it easier to understand and analyse the structure and sequence of code.

Key Features and Structure

1. Block Structure:

It is necessary to note that NSDs focus on the concept of blockification of a program, where each block is designed for the execution of a specific function. These blocks are nested with each other to demonstrate the hierarchy and flow of the controls and give the best depiction of control structures.

2. Control Structures:

Sequential Execution: It is illustrated as a set of horizontal or vertical blocks indicating the process's sequence.

Branches (Decisions): These are used as separate branches, where each branch refers to the possibility of a condition’s result.

Loops: These are shown by blocks with repetition signs that symbolise the cycle of the control flow.

3. No GOTO Statements:

NSDs do not employ GOTO statements as they encourage structured programming, which enhances the quality of the code.

The Elements of a Nassi-Shneiderman Diagram

1. Process Block: This stands for an individual statement or a series of statements to be executed. It is described as a rectangle.
2. Decision Block: This block is used for conditional statements that are if-else statements. It is indicated by a rectangle that is split into one or more sections, with the different options indicated below.
3. Loop Block: This block stands for a ‘for’, ‘while', or ‘do-while’ statement that can be used to repeatedly execute a sequence of instructions. It has a control part that defines the number of repetitions and a body part where the repeated statements are made.

4. Subroutine Block: Applicable to methods or procedures, suggesting a precondition of a function that can be launched from other places in the program.

Advantages of Nassi-Shneiderman Diagrams

- Clarity: They also make the program's structure easily understandable, and even when you want to debug it, it is very easy to do so, as the NSDs outline the program well.
- Structured Design: They promote good programming practices by enforcing a good structure for the program's control flow.
- Documentation: It is useful as records of programs with intricate structures, and it helps the developers exchange information.

Example

Here's a simple example of an NSD for finding the maximum of two numbers: Here's a simple example of an NSD for finding the maximum of two numbers:

1. Start: Begin the process.
2. Input: Take two inputs, which are two numbers; let's call them A and B.
3. Decision: If A is greater than B, tick the box.
   - True Path: Output A.
   - False Path: The output of this type of case will be:
4. End: End the process.

Use in Modern Development

Though the concept of NSDs is not as popular today as it was in the past, the principles of NSDs are embedded in today's programming tools and approaches. They are most relevant in educational settings to explain flow control and in scenarios where it is important to see the program's organisation.

The Nassi-Shneiderman Diagrams are quite useful for representing and designing structural programs. Due to their capability of presenting control structures in a systematised manner, they assist programmers in coming up with well-structured and easily manageable code. Though the instances of NSDs may not be very common in current development, the principles on which they are established are still useful in dissecting and explaining the logic of programming.

7.2 Warnier-Orr Diagrams

Key Characteristics

1. Hierarchical Structure:

Warmier Orr diagrams are based on the idea of using a tree structure of a hierarchical nature to model the program. Each level of the tree describes the program into more sub-divisions depending on the level of the tree, starting from the system level to the operation level.

2. Data-Centric:

While flowcharts, or Nassi-Shneiderman Diagrams, show the control flow, the Warnier-Orr Diagrams are aimed at showing the structure and manipulation of data. They demonstrate how information is stored and managed at different tiers.

3. Top-Down Design:

These diagrams are suitable for applications of the top-down approach in program design. This approach introduces the general outline of the program and details it to progressively smaller components. It helps to get an overall outlook on what is going on before drilling down to the details.

Components of a Warnier-Orr Diagram

1. Root Node: On the system level, it stands for the whole system or principal module. It is the most developed level of the hierarchy.
2. Branches and Sub-nodes: Every circle, in this case, is a process or data container. Branches link the nodes to demonstrate the breakdown from the more general process to the more specific one.
3. Annotations: Include more details regarding the processes or data fields, such as conditions, iterations, and operations performed on data.

Building a Warnier-Orr Diagram

1. Identify Major Processes: These are the system's major activities or operations, as seen in the first tier.
2. Decompose Processes: Further decompose each of the major processes into sub-processes and list the operations and data structures that are to be used.
3. Detail Data Structures: Explain the organisation of data, input, and output at each level of the hierarchical structure.
4. Annotate: Make the necessary annotations to explain the logic and conditions linked with each process or data element and iterations.

Advantages of Warnier-Orr Diagrams

- Clarity in Data Processing: Because they concentrate on data structure and processing, these diagrams offer a nice perspective on how data moves within the system.
- Structured Design facilitates program planning and implementation, enhances efficiency, and makes the program easier to comprehend and modify.
- Documentation: This proves useful during the design phase and whenever the product is to be maintained later.

Example

Here's a simplified example of a Warnier-Orr Diagram for processing a list of student grades:

1. System (Process Grades):

- Input Data (Student List): Student's name and their grade.
- Process (Calculate Averages):
- Loop (For Each Student):- Loop (For Each Student):
- Sum Grades: Add the grades for each student to obtain the total.
- Calculate Average: Now, take the total of the sum and divide it by the number of grades.
- Store Result: Store the average computed in the student record.
- Output Data (Averages List): The table shows the list of students with their average scores calculated in the table below.

Usage in Modern Development

Even though Warnier-Orr Diagrams are not used as often as in the past, their focus on data structures and logical processes' arrangement is still useful. They are most effective in data processing applications and systems where the data flow pattern has to be ascertained.

- **Knowledge Check 1**

  Fill in the blanks

  1. A Nassi-Shneiderman Diagram (NSD), also known as a _____. (structured flowchart)
  2. Nassi-Shneiderman Diagram (NSD) is developed by _____. (Isaac Nassi and Ben Shneiderman)

3. _____ offers a great opportunity to visualise and design such programs which are focused on data organisation and manipulation. (Data flow diagrams)
4. _____ is the Advantages of Warnier-Orr Diagrams. (Modularity)

- **Outcome-Based Activity 1**

  Make a group of 4 and discuss Warnier-Orr Diagrams & Nassi-Shneiderman Diagrams in class.

7.3 Decision Trees and Decision Tables

Decision Trees

Decision Trees are a widely used and very effective supervised learning algorithm used in classification and regression. They are a general method that can be employed when working with both quantitative and qualitative variables. Decision Trees are applied in different sectors, such as finance, Healthcare, and Marketing.

Structure of Decision Trees:

- Nodes: In Decision Trees, the nodes are elements of the dataset, also known as features of a certain data set.
- Edges: The connection between nodes or the edges is the decision path based on the values of the attribute.
- Leaves: The terminal nodes are the final decision or the result of the decision-making process.

How Decision Trees Work:

1. **Splitting Criteria:** The decision tree selects one of the attributes to divide the data at a node and then builds the tree based on the lowest entropy. The splitting criteria are designed in such a way that they try to segregate the population in the most efficient manner, where the different sub-populations that are formed are as homogeneous or as 'pure' as possible.
2. **Recursive Splitting:** The data is divided into subsets recursively in accordance with the chosen attribute until some condition is met. This could have been the maximum depth of the tree, the minimum number of instances in a node, or a minimum gain in purity.
3. **Decision Making:** After the tree is constructed, the new data instances are evaluated, starting from the root node and reaching the leaf node based on the attribute values. The last outcome or decision about an instance is based on the

most frequent class (in the case of classification) or the mean of the values (in the case of regression) of the instances in the node.

Advantages of Decision Trees:

1. Interpretability: Decision Trees are simple to construct, use and interpret; the decision process can be explained to other people easily.
2. Versatility: They are able to work with numerical and nominal data and multiple target outputs, making them suitable for different kinds of problems.
3. Non-Parametric: Decision Trees do not make assumptions about the distribution of the given data, which is why they do not affect the end output by including outliers or features that are not probable.
4. Feature Importance: Decision Trees could help understand the feature importance of the data set and determine which attributes are most informative.

Limitations of Decision Trees:

- Overfitting: Decision Trees tend to overfit the model, especially when the tree depth is not well regulated. Some approaches, like pruning and specifying the maximum depth of the tree, can address this problem.
- Instability: Because small variations within the data lead to the development of different trees, Decision Trees are regarded as unstable in contrast to the majority of algorithms.
- Bias Towards Features with Many Levels: One weakness of this method is that Decision Trees tend to prefer features with many levels or categories, which results in bias in the split.

Decision Tables:

Decision tables are a part of the decision modelling technique that involves listing several different conditions and correlating actions to be taken. They are especially helpful when combined with the description of business rules for checks and balances that determine whether the information is complete in its given context and whether any areas of the model are logically inconsistent. Here's an overview of decision tables:

Subsections of a Decision Table

1. Conditions: These are the criteria or inputs that define the decision. Conditions are usually statements, propositions, or dichotomies (either or).

2. Actions: These are the scenarios that must be realised or the actions that must be taken depending on the conditions. Conducts are the things which are done as a result of the conditions or the evaluation of the conditions.

3. Rules: These are the concrete relations between the conditions and the respective actions. The row of rules in the table specifies what actions should be taken when fulfilling some conditions.

This chapter focuses on the structure of a Decision Table.

A typical decision table is organised into four quadrants: A typical decision table is organised into four quadrants:

- Top Left: States the conditions.
- Top Right: Gives the list of possible values that each of the conditions can take.
- Bottom Left: Enumerates the actions.
- Bottom Right: This links each condition value combination (rule) to the actions to be taken or performed.
- Clarity and Simplicity: They give a very efficient and straightforward method of expressing decision rationale.
- Completeness: Decision tables enable the evaluation of potential conditions and combinations so as not to miss anything.
- Consistency: This way, rules can be stated clearly, enabling the application of consistent decisions.
- Error Detection: They make it easier to see where decision rules are missing, where there are duplications or where changes are needed.

Creating Decision Tables

1. Identify Conditions: Identify the factors that are related to the decision.
2. List Possible Values: For each condition, enumerate the values or states that are possible or can occur.
3. Define Actions: Concisely decide on the steps to be made depending on the conditions.
4. Populate the Table: Insert the rules in the table below that maps conditions to actions.
5. Validate: Make sure that you consider all the possibilities and that the rules that you are setting make some sense.

Decision tables are a business rules management technique that can be used to express decision logic for decision-making in business environments.

- Business Rule Management: Drawing business policies and procedures.
- Software Testing: Creating test cases for different input scenarios.
- Workflow Automation: Enabling decision-making automation in the case of interactions and a lot of other cases.
- Compliance: The process of making sure that a decision made is legal and meets the set regulations and standards.

Importance of Decision Table

Decision tables are useful in test design techniques.

1. Clarity and Simplicity

Visual Representation: Decision tables are easy to read and provide a clear representation of the flow of decision-making, making them easily understandable and communicable.

Structured Format: This way, the decision criteria and actions are also clearly enumerated and do not leave any room for ambiguity due to following a structured format.

2. Completeness and Accuracy

Comprehensive Coverage: They assist in preventing the exclusion of some conditions or their possible interaction with other factors.

Error Detection: Decision tables help to discover missing, overlapping, and conflicting decision options by using conditions and outcome arrangements.

3. Consistency

Standardisation: Decision tables are a systematic way of recording the decision rules in a table, making it easy to have a standard format across different users or teams.

Reproducibility: They help in decision making as this gives a guarantee that similar circumstances will lead to similar actions.

4. Efficiency

Simplified Decision-Making: When decision rules are established, then decision-making is made easier and less complicated.

Reduced Complexity: They reduce the complexity of decision-making since it is made up of sub-processes.

Advantages of Decision Table

- Easy conversion of business flow to test case: This technique works well for any complex business flow, allowing for easy creation of test scenarios and test cases based on it.
- Works iteratively: Decision tables are used iteratively, which implies that the table produced in the first iteration is used as input in the following tables. The iteration is performed only if the initial table does not meet a satisfactory level.

7.4 HIPO, VROC, IPO, and Data Dictionary

HIPO (Hierarchical Input Process Output)

HIPO is a hierarchical technique employed in SADT for documenting a system's modules and processes. It shows the relations between the modules, the processes they contain, and the inputs and outputs in a given system.

Hierarchical Structure: HIPO diagrams normally have a structure in which the main process is the top level, followed by sub-processes and modules at lower levels.

Components:

Hierarchy Chart: Illustrates where the main and sub-processes of the system fall within the big picture.

Input-Process-Output (IPO) Diagrams: IPO diagrams for each module or process, whereby the IPO stands for the inputs, processes, and outputs of the given module.

Benefits: HIPO is a useful tool for presenting the sequencing of information and activities in a system, making it easier to comprehend and model complex systems.

VROC (Volume, Variety, Velocity, Veracity)

VROC is the model that is adopted to assess the characteristics of big data. It consists of four key dimensions: It consists of four key dimensions:

Volume: Counts the number of records an organisation produces or possesses. Big data is defined as a vast amount of data that cannot be processed with the help of regular database management systems.

Variety: Lists the variety of data and their origin. Big data refers to a large amount of data originating from many sources and being structured, unstructured, or semi-structured in nature, such as Social media messages, sensor data, and text documents.

Velocity is the rate at which data is created, collected, and transformed. Real-time or near real-time demands are common in big data applications because data processing involves streaming data.

Veracity is a measure of the quality, correctness, and credibility of the information being collected. Since big data is crowdsourced and sometimes even unstructured, it can be raw data with many errors, inconsistencies, and noise, so it is almost impossible to analyse it without dedicated data quality management.

VROC assists organisations in gaining insight into the nature and issues concerning big data and possible ways of harnessing it for decision-making and value addition.

IPO (Input, Process, Output)

IPO is a fundamental concept in systems analysis and design, representing the three basic components of a system:

- Input: means the information which is input or fed to the system in order to process it. An input can be from a user, a sensor, a database, or even another system.
- Process: This means the processes, functions, or calculations that the system carries out on the actual data to arrive at the result. Operations work on the input data to produce the output based on some preprogrammed algorithms.
- Output: This stands for the output generated by the system in its endeavor to solve the input data problem. An output can be a report, display, alert, or action.

IPO diagrams are often applied in systems analysis and design to depict the ways of data and process distribution across the system and the ways of the required system's comprehension by the stakeholders.

Data Dictionary

A data dictionary is a comprehensive reference source that contains data definitions and descriptions of the data components used in an organisation's databases or information systems. In essence, it contains all the necessary information regarding data constructs, characteristics, associations, and limitations for data administration, processing, and regulation.

- Components:

Data Elements: Detail descriptions of the data item's name, definition, data type, length, and format.

- Data Structures: Meaning and explanation of tables, fields, records, and files and their characteristics, interconnection and dependency.

Data Constraints: The rules, validations, and constraints of data elements and structures, including uniqueness, referential integrity, and data range.

Metadata: Further details about the data elements, such as ownership, usage, source, and characteristics, including quality.

Data dictionaries are very important as they help maintain the consistency, integrity, and usability of data within an organisation. They enable the standardisation, documentation, and exchange of data for all data activities, such as database development, data merging, data management, and analysis.

- **Knowledge Check 2**

  Fill in the Blanks

  1. _____ are a popular and powerful machine learning algorithm used for both classification and regression tasks. (Decision Trees)
  2. Decision Trees consist of _____ that represent attributes of the dataset. (nodes)
  3. A _____ is a good way to settle different combination inputs with their corresponding outputs. (lookup table)
  4. _____ is also called a cause-effect table. (Truth table)

- **Outcome-Based Activity 2**

  Create a group of 4 and discuss the topic HIPO, VROC, IPO.

7.5 Summary

- A NSD (Nassi-Shneiderman Diagram) or structogram is a graphic model to design and describe the structured programming constructs.
- NSDs help in presenting how a logical flow of a program can be drawn to enable an easy approach to developing a structure and analysing the sequence of a code.
- Although the role of NSDs has decreased in the modern development approach, the underlying ideas remain important for the explanation of the programming logic.
- Warnier-Orr Diagrams represent a highly effective means of capturing a program's structure and focusing on data and its processing.
- These are decision trees which are one of the most used and effective techniques which are used in classification and regression.

- Structure of Decision Trees:
  - Nodes: The Decision Trees consists of nodes such that in each node attributes (features) of the dataset are available.
  - Edges: The lines or the edges connecting the nodes are decision paths or decision branches in accordance with the attribute value.
  - Leaves: The final decision or outcome is depicted at the last level of the tree diagram, these are the leaf nodes.
- Decision Trees are easy to understand, easy to interpret, and very flexible, which is why they are widely used in different scenarios.
- A decision table is suitable for resolving different combination inputs with their respective outputs and is known as a cause-to-effect table.
- HIPO is a hierarchical method that is used in structured systems analysis and design to show the modules and processes of a system. It demonstrates the subordinate of the modules, processes, inputs, and outputs in a system.
- VROC is the classification of organisation big data characteristics and is used in big data analysis.
- A data dictionary is a comprehensive reference source that declares metadata and descriptions of data components that are utilised in a company's databases or information systems. It is an extensive list of definitions and characteristics of data, structuring and organising the data resources and their dependencies and limitations for their usage.

7.6 Keywords

- **Decision Trees:** Decision Trees are a popular and powerful machine learning algorithm used for both classification and regression tasks.
- **Decision table:** A decision table is a good way to settle different combination inputs with their corresponding outputs and is also called a cause-effect table.
- **HIPO:** HIPO is a hierarchical method used in structured systems analysis and design to represent the modules and processes of a system.

7.7 Self-Assessment Questions

1. Explain Nassi-Shneiderman Diagram.
2. What do you mean by Warnier-Orr Diagrams.

3. What are Decision Trees?
4. What are Decision table?
5. Expain HIPO

7.8 References / Reference Reading

- Fundamental of Computers by Rajaraman.
- Computes Today by B. Sandra.

Unit 8: Menu Design and Management Information Systems (MIS)

Learning Outcomes:

- Students will be able to define principles of menu design.
- Students will be able to explain Anthony's classification in MIS.
- Students will be able to describe Decision Support Systems (DSS).
- Students will be able to demonstrate the process of software documentation.
- Students will be able to apply user interface design principles in creating menus.

Structure:

8.1 Principles of Menu Design

8.2 MIS and Anthony's Classification

- Knowledge Check 1
- Outcome-Based Activity 1

8.3 Decision Support Systems (DSS)

8.4 Software Documentation

8.5 User Interface Design Principles

- Knowledge Check 2
- Outcome-Based Activity 2

8.6 Summary

8.7 Keywords

8.8 Self-Assessment Questions

8.9 References / Reference Reading

8.1 Principles of Menu Design

Menu design is one of the important elements of UI and UX design since they are the main tools through which users can interact with a system or an application. Good menu design improves the accessibility of the user interface so that the user can conveniently locate a link or execute a command to get the information they require. Here are the key principles of menu design:

1. Clarity

Clear Labels: The labels for menus need to be short, unambiguous, and descriptive in their nature or in terms of what they point to. Do not use abbreviations, and always refer to clear terms and concepts.

Consistency: Minimise the use of abbreviations and acronyms and ensure consistent designs across the menus to enable users to correctly guess the menu options.

2. Hierarchy and Structure

Logical Grouping: Cluster related items in a sensible manner either by the aspects of their use or the level of their usage. This makes it easier for the users to locate what they are looking for.

Hierarchy Levels: Some strategies that should be employed when designing the menus are as follows: Main categories can be further subdivided to accommodate users' oversensitivity to a large number of options.

Order of Items: Position the items that are most often or most crucially used at the top or those that will easily be noticed when opening the menu.

3. Ease of Navigation

Easy Access: Menus should be visible from anywhere in the application, and the user should be able to find them easily. Features that are always visible, such as a fixed menu bar, are beneficial to users with disabilities.

Shortcuts and Accelerators: Supply keyboard access to menu items through a shortcut or accelerator for frequent users who do not like to navigate several submenus.

Search Functionality: Add the search bar to these menus so that users can easily type in a specific term and be directed to the corresponding page if complex functionality is added to the app.

4. Feedback and Visibility

Highlighting: Make the item of the current page stand out so that the user is aware of his position in the menu.

Visibility of Options: Make certain that any option on the menu is either easily visible or easily accessible. Do not bury important choices in subcategories or behind any difficult-to-find controls.

5. Accessibility

Keyboard Navigation: Make sure that the set menus can be accessed and navigated using only the keyboard and do not require a mouse; this way, users with some sort of disability will be able to access the menus.

Screen Reader Support: It is also important to design the applications so that they are easily understandable by screen readers and other assistive technologies. This can be easily achieved by defining the correct ARIA roles and properties for menus.

6. Simplicity

Minimalism: Do not confuse the consumers with numerous choices; it is better to focus on specifics available on the menu. Emphasis should be made on the primary tasks, and it is recommended to place less important options in secondary menus or set them up as subpages.

Progressive Disclosure: Make the information disclosed gradual and provide elaborated options only when required. This decreases the number of options presented to users at one time, minimising the workload on their memory and decision-making abilities.

7. User-Centered Design

User Testing: Make sure to do usability testing with actual users so that the problems and issues that are being encountered may be seen and noted down. How the users navigate through the implemented menu should also be observed to identify their experiences in its usage so as to improve the design.

Customisation: Users should be able to modify the menu or adjust the position of related items according to their choice and frequency of use.

8. Aesthetic and Visual Design

Consistency with Overall Design: The menu's appearance should comply with the application's overall look and feel, including colours, fonts, and icons.

Responsive Design: Design menus that are friendly to people who use handheld devices, computers, and other types of gadgets.

8.2 MIS and Anthony's Classification

MIS refers to the process or the system of collecting, processing, storing, and distributing information in an organisation with the aim of helping with decision-making, coordination, control, analysis, and visualisation. MIS is the utilisation of technology, people, and procedures to develop and deliver relevant information to the managers and other users in an organisation.

Anthony's Classification of Management Information Systems is a framework developed by Robert N. Anthony that categorises information systems in relation to the management levels and decision-making style. It assists in explaining how different system categories provide for the dissimilar information requirements of the several management tiers.

Anthony's Classification

Anthony's Classification divides information systems into three main categories, each aligned with a specific level of management: Anthony's Classification divides information systems into three main categories, each aligned with a particular level of management:

1. Strategic Planning Systems
2. Management Control Systems
3. Operational Control Systems

1. Strategic Planning Systems

Purpose: Facilitate strategic management and policy formulation by the senior management. These systems are largely strategic in that they are oriented towards the accomplishment of organisational long-term aims and objectives.

- Users: Managers and other authority figureheads in institutions.
- Focus: Organisation-environmental scans, long-term dynamics, competitive strategy, and key resource deployment choices.
- Characteristics: Operate in a context with unstructured and semi-structured decisions, are highly uncertain, and need data from outside the company.
- Examples: EIS, DSS, and SPS or Strategic Planning System.

2. Management Control Systems

Purpose: Facilitate the assessment of the organisation's performance and identify any deviations from the planned activity. These systems assist middle management in guaranteeing that the organisational resources are applied optimally to the achievement of the intended goals of an organisation.

- Users: The target population of this research will, be middle managers and department heads.
- Focus: Performance measurement for the short term, control of resources, control of finances, and general control.
Characteristics: Semi-structured decisions are characterised by the need to use both internal and external data, with an emphasis on performance reports and exception analysis.
- Examples: MIS stands for Management Information Systems, while the other two are Budgeting Systems and Performance Measurement Systems.

3. Operational Control Systems

Purpose: To help run day-to-day activities and undertakings; these systems aim to ensure the reliable and effective performance of particular tasks according to the set procedures and guidelines.
- Users: The lower level of management, such as officials and employees at the operational level.
- Focus: Daily transactions, monitoring of processes, and guaranteeing process optimisation.
Characteristics: Work with structured decisions, high turnover of transactions, need detailed internal information, emphasis on automation and transactions.
- Examples: The three main categories of management information systems are Transaction Processing Systems (TPS), Inventory Control Systems, and Payroll Systems.

The following is the integration of MIS and Anthony's Classification:

By integrating MIS with Anthony's classification, organisations can develop a comprehensive information system that addresses the needs of all management levels:
By integrating MIS with Anthony's classification, organisations can develop a comprehensive information system that addresses the needs of all management levels:
- Strategic Level: Technologies for market intelligence competitive benchmarking and future trend information.
- Management Control Level: Middle management should be supported by systems that provide reports, measurement and budget information.
- Operational Level: Introduce processes through which daily business transactions could be handled automatically, as well as procedures that would facilitate control of

the numerous activities within the organisation to ensure that operational processes are precise and quick.

- **Knowledge Check 1**

  Fill in the Blanks

  1. UI Stands for _____. (User Interface)
  2. This means that the abbreviation of UX is _____. (User Experience)
  3. _____ are information systems that are used in an organisation to ensure that proper information is available for decision-making. (Management Information Systems)
  4. Anthony's Classification of Management Information Systems is a framework put forward by _____. (Robert Anthony)

- **Outcome-Based Activity 1**

  Create a Presentation on the principles of menu design.

8.3 Decision Support Systems (DSS)

Decision Support Systems (DSS) are information systems that facilitate the decision-making activities within business organisations. A DSS is a computerised system that assists the user in gathering relevant information from raw data, documents, knowledge base, or business models in an organisation for the purpose of solving some problems and making decisions.

Key Characteristics of Decision Support Systems:

1. Interactive Interface: DSS has an interface where users can interact with the system, obtain their desired data, and analyse it.
2. Support for Semi-Structured and Unstructured Decisions: This is most useful for semi-structured or unstructured problems since other approaches to decision-making may not suffice.
3. Integration of Various Data Sources: DSS can assemble data from internal databases, external databases, and real-time feeds.
4. Model-Driven and Data-Driven: There are two types of DSS: model-based, which incorporates various analytical models to analyse different situations, and data-oriented, which emphasises the data analysis and data-querying functions.

5. Flexibility and Adaptability: DSS can accommodate changes in user requirements and the various settings of the decision-making environment.

Components of Decision Support Systems:

1. Database Management System (DBMS): Controls the information which is incorporated into the decisions. It is the data collected within a company (e.g., sales records) and that collected from the outside world (e.g., trends in the market, trends in the economy).
2. Model Management System: It offers control and acquisition of mathematical and analytical models within the program that are beneficial for data evaluation for decision-making processes. Optimisation models, forecasting models and simulation models are some of the common models used in operations management.
3. User Interface: This is the element of the DSS that users use. It lets them type in data, compute models, and print out reports.
4. Knowledge Management Component: Some DSSs include a knowledge management system, which offers the expertise and information required to solve a certain problem.

Types of Decision Support Systems:

1. Data-Driven DSS: It concerns itself with the search and use of large amounts of data. Some examples are data warehouses, OLAP (Online Analytical Processing), and data mining systems.
2. Model-driven DSS stresses the availability and manageability of a specific set of analytical models, such as financial, statistical, and optimisation models.
3. Knowledge-Driven DSS: Serves as a source of specialised problem-solving knowledge that is encoded as facts, rules, procedures or other such formations. Samples are expert systems and recommendation systems.
4. Document-driven DSS Coordinates, accesses, and processes a mass of data in digital documents of different forms. Some of the applications are document management and content management applications.
5. Communication-Driven and Group DSS: These help establish team cooperation on decision-making processes for efficient team performance. Some examples include groupware, collaborative tools, and conferencing systems.

Applications of Decision Support Systems:

1. Business and Management: These are planning, control, financial decisions, marketing analysis and control, and operational control.
2. Healthcare: Aids in the identification of the disorder, formulating the care, and handling of the patient.
3. Supply Chain Management: It involves the right inventory storage and control, product distribution, and demand prediction.
4. Energy Sector: The software is helpful in resource management, demand forecasting, and optimisation of energy production.
5. Government: Helps in policy formulation, city planning, and crisis management.

Benefits of Decision Support Systems:

1. Improved Efficiency: It reduces the time taken to make decisions since it offers the necessary information and analytical resources.
2. Enhanced Accuracy: Eliminates bias and prejudice by offering information-based prescriptions and analysis for the clients.
3. Better Collaboration: This allows every team member to share information and communicate effectively, thereby increasing the team's informed decisions.
4. Increased Productivity: It eliminates some of the tiresome decision-making activities and frees up the managers' time for other crucial activities.
5. Scalability: It can process a lot of data and work with complex models, which is good for all sizes of organisations and fields.

Challenges and Considerations:

1. Data Quality: A DSS functions based on the data it uses; hence, the quality and accuracy of the data determine its effectiveness.
2. User Training: This means that the users of the DSS need to be trained properly so as to be able to communicate and use the facilities in the DSS properly.
3. System Integration: One problem that can be encountered when implementing DSS is its integration with existing systems and the issue of proper data flow interoperability.
4. Cost: The costs associated with the development and maintenance of a DSS may be very high due to the costs of technology and expertise.
5. Security and Privacy: The security and privacy of sensitive information are paramount, especially in operating areas such as health and business.

8.4 Software Documentation

Software documentation can be described as the textual information that is provided with a software product or system. It becomes a go-to reference manual for users, developers, and other stakeholders whereby key information regarding the software's operation, structure, design, deployment, setup, and application are provided. Here are the key components and types of software documentation:

Components of Software Documentation:

1. User Documentation:

User Manuals: These provide specific procedures for installing, setting up, and applying the software. Some of the integral structures can encompass tutorials, frequently asked questions, tips for solving problems, and general guidelines for efficient use.

Online Help: Help systems that coexist with the tool as a built-in component in the form of help menus that can be invoked on the fly or search-based help that tries to identify what type of help the user wants based on the context in which the help request is made.

- Quick Start Guides: Short tutorials that provide users with a general idea of what the software is and how it should be used; orientation.

2. Technical Documentation:

- API Documentation: The documentation that is usually associated with API for functions, classes, methods, parameters, and return values. It enables the developers to learn how to apply the API and where to incorporate it into undertakings in software engineering.

Developer Guides are specific documentation in the form of technical manuals and lessons intended for software developers. They contain information on the software system's design and implementation, code standards, and recommendations.

Code Comments: Comments that are written on the hard code and are in the same line as the code that is being coded are known as inline comments. They explain to the reader what the segment of code being coded is used for, how it works, and how it should be used. They enhance the code's quality and increase developers' understanding and efficiency.

Architecture and Design Documents: These include block diagrams, the component structure, the modules, the interfaces, and the software's interactions. They give direction on how to comprehend and sustain the software system.

- Data Dictionary: A record of the conceptual, logical, and physical data flows that are utilised in the software in question, such as a database and its structures, tables, fields, and constraints.

3. Administrative Documentation:

Installation Guides: This guide covers the installation and configuration of software on different operating systems and other IT environments, the system requirements, necessary conditions, and recommendations for solving possible problems.

Configuration Guides provide details about adjusting settings to suit an organisation's or an individual's characteristics or needs, interfacing with other applications, and handling user information.

Maintenance Manuals: These contain procedures for patching and backing up software and all the procedures that should be followed regarding software licenses.

Importance of Software Documentation:

1. Facilitates Understanding: Documentation is useful to users and developers to minimise confusion about the software's function, characteristics, and how to use it.
2. Supports Training and Onboarding: Documentation is also useful when training new users and developers to use and develop the software since they are able to read and understand how the software should be used.
3. Aids Troubleshooting and Problem Solving: Complete documentation contains tips, messages, and solutions to many problems and helps users solve those problems themselves.
4. Ensures Consistency and Quality: While documenting software, better standards of coding and design are used, and compliance with the highest standards of practice is also ensured; hence, the code is quality and easier to maintain.
5. Facilitates Collaboration: Documentation facilitates collaboration on the team because it ensures that all the members have a common understanding of the software's design, decisions made during the development process, and the manner in which the software is designed.

Best Practices for Software Documentation:

1. Keep it Updated: Revisit and modify the documentation to incorporate any new software changes, such as changes in features, functions, or even architecture.
2. Use Clear and Concise Language: When writing documentation, avoid using terms that could be easily understood by non-professionals or those who are not

very familiar with the information being documented. Employ diagrams, screenshots, and examples to explain the various concepts.

3. Organize Information Effectively: Organize the structure of documentation reasonably by using headings, bullet points, tables, and hyperlinks.
4. Provide Contextual Information: Use background information, applications, and examples to create awareness and help users appreciate the need for the software.
5. Solicit Feedback: Coax people who work on applications and customers into contributing to the documentation by pointing out what could be improved or added or what is incorrect, in addition to sharing general feedback.

8.5 User Interface Design Principles

User Interface (UI) design is the process of designing the look and feel of the software or computer devices that people use. The intention is to produce interfaces that are palatable to the users and efficient in using them. Here are some key principles that guide effective UI design:

 # 1. Clarity

Definition: The User Interface should be intelligible. A proper plan involves making all elements meaningful and ensuring that the user clearly understands what he can do on the interface.

- Implementation: Easy-to-read labels, simple and intuitive navigation and do not overwhelm the user. In this regard, each component should be simple enough to explain on its own.

 # 2. Consistency

Definition: In the case of UI, consistency prevents users from reinventing how to perform a certain function every time they encounter it in the interface. This aids in mastering the interface and usage, hence the ability to utilise it proficiently.

Implementation: The buttons, icons, and colours should maintain similar aesthetics, as should the actions and responses for the interface.

 # 3. Feedback

Definition: Players have to know what they are doing either instantly or at least without much delay and in a very straightforward manner. This helps them comprehend the impact of their communications.

Implementation: Apply highlights or animations, sounds, and messages to confirm actions, signal an error, or provide information.

 # 4. Simplicity

- Definition: A simple UI is uncomplex which means that it is easy to master and to navigate. It should not flood the user with useless information or choices.
- Implementation: Cater to core tasks and give the simplest means of accomplishing a particular task. Eliminate things that do not add significant value to the product and focus on core functionalities.

 # 5. Visibility

- Definition: Main components should be quickly found and seen without having to be looked for for a long time.
- Implementation: Conveys important elements and information to major areas of the screen so that the user is aware of their existence.

 # 6. Accessibility

- Definition: Accessibility: UI design should suit disabled persons as they endeavour to use the interface.
- Implementation: Image descriptions, focus on accessibility for keyboard control, enough contrast for texts and content readability for screen readers.

 # 7. Flexibility

Definition: There should be several approaches or options for performing tasks to address the users' requirements and preferred styles.

Implementation: For power users, provide shortcuts that they can use while ensuring that basic options are well articulated. Use responsive design to make your website friendly for viewing on different gadgets and screen resolutions.

- **Knowledge Check 2**

  Fill in the Blanks

  1. DSS in computer science stands for _____. (Decision Support System)
  2. The _____ of a DSS depends on the quality and correctness of the data being used in it. (effectiveness)
  3. _____ is an abbreviation of the term documentation that relates to the written and printed literature that is availed along with a software product or system. (User Manua)
  4. The documentation of software is significant in ensuring the reliability, _____, and sustaining the software products and systems. (usability)

- **Outcome-Based Activity 2**

  Discuss the topic Importance of Software Documentation in the classroom.

8.6 Summary

- Menu design is an essential part of UI and UX design since it is the primary channel through which a user interacts with a system or application. Menu design can make it easier for the user to find what they are looking for and improve the system's usability by allowing users to perform commands and access information quickly and efficiently.
- Menu design plays a crucial role in the development of easy-to-understand and use interfaces. Using these principles, designers can develop menus that would benefit navigation, increase usability and finally make a positive impact on the user's experience.
- Management Information Systems (MIS) are systems specifically used to help routine information usage in an organisation to meet key objectives such as decision-making, coordination, control, analysis, and visualisation.
- Anthony's Classification of Management Information Systems, developed by Robert N. Anthony, categorises information systems according to their level of management and decision type.
- Decision Support Systems (DSS) refer to computerised systems that aid businesses or organisations in carrying out their decision processes.
- Decision Support Systems are vital components of today's organisation since they improve decision-making by the use of data, models, and graphical user interfaces.
- Software documentation is the texts provided with the software product or system. It is the complete manual for the target software, which contains information for the user, developer, and other interested parties regarding the software's operational features, structure, design, and deployment, as well as instructions on how to set up and use the software.
- Documentation is a fundamental component of any software product or system, as it facilitates its use and maintenance.

8.7 Keywords

- **Menu design:** Menu design is part of the user interface (UI) and user experience (UX) design processes since menus are the primary tools for interacting with a system or an application.
- **Management Information Systems:** Management Information Systems (MIS) are systems that enable an organisation to collect, process, store, and distribute information to support its planning, decision-making, communication, control, analysis, or visualisation needs.
- **Software documentation:** This is the textual information provided with the software product or system. It contains all the details about how the software works, how it is built, how it looks, how it is set up, and how it should be used by clients, developers, and anyone else interested in using that software.

8.8 Self-Assessment Questions

1. What are the Best Practices for Software Documentation?
2. Describe the Components of Software Documentation.
3. What are the Decision Support Systems?
4. Explain Management Information Systems.
5. What are the Principles of Menu Design?

8.9 References / Reference Reading

- Fundamental of Computers by Rajaraman.
- Computes Today by B. Sandra.

Unit 9: Introduction to Windows

Learning Outcomes:

- Students will be able to identify key features of the Windows operating system.
- Students will be able to explain shortcuts and basic operations in Windows.
- Students will be able to demonstrate the use of WordPad and MS Paint.
- Students will be able to apply file management techniques in Windows.
- Students will be able to evaluate the utilities and tools available in Windows.

Structure:

9.1 Overview and Utilities of Windows

9.2 Shortcuts and Basic Operations

- Knowledge Check 1
- Outcome-Based Activity 1

9.3 Working with WordPad and MS Paint

9.4 File Management in Windows

- Knowledge Check 2
- Outcome-Based Activity 2

9.5 Summary

9.6 Keywords

9.7 Self-Assessment Questions

9.8 References / Reference Reading

9.1 Overview and Utilities of Windows

Windows is one of the most popular operating systems in the market and is owned by Microsoft Corporation. It provides a graphical user interface where users can interface with computer hardware and software applications. Here's an introduction to Windows, along with an overview of its utilities:

Introduction to Windows:

1. Graphical User Interface (GUI): The graphical user interface of Windows involves the use of icons, windows, menus, and pointers, which are also known as the cursor and enable users to interact via the use of the computer system.

2. Multitasking: The Windows operating system has several abilities: multitasking means that several programs can be run at the same time, and one can switch between them easily.

3. File Management: Files and folders on the computer's storage devices are managed by Windows' built-in file organising system. The operating system's application, File Explorer, allows users to create, make copies, move, delete, and search files.

4. Networking: Windows features that enable users to connect their computers to LANs and the Internet are included in the product. This makes it possible to distribute files, printers, and other resources to the other connected apparatuses.

5. Security: Windows comes equipped with features such as user account control, Windows Defender as an antivirus, Windows firewall, and encryption tools to protect the computer system from viruses, hackers, and other security risks.

6. Software Compatibility: Windows supports a multitude of software programs, including office suites, players, browsers, and games. Power users can download such applications from different places on the Internet and run them on the system.

Overview and Utilities of Windows:

1. Start Menu: The Start menu enables users to access the most commonly used applications, control panels, documents, and other utilities. The start menu is a feature

that allows for application, file, and system function searches as well as the launching of applications.

2. Taskbar: It is a horizontal bar placed at the bottom of the operation's window. It shows the running application, quick links, and pop-up messages. It also encompasses the Start button and the system tray or notification area.

3. Control Panel: The Control Panel is a utility that provides access to system and hardware properties, accounts and settings, connections, and security.

4. File Explorer: File Explorer is an application that runs on your computer and enables you to locate, sort, and work on files and folders stored on your computer's storage media. It offers a graphical user interface for file operations like copying, moving, renaming, and deletion.

5. Windows Update: Windows Update is a program that updates the OS and the installed application with patches and fixes. It assists in keeping the system current and safe.

6. Task Manager: In general, the Task Manager is a component of the operating system that provides information about the processes currently running, operation parameters, and the utilisation of hardware resources. With the help of the Task Manager, users can control applications, processes, and services and solve problems related to performance.

7. Windows Defender: Windows Defender is a system proactive program that deals with viruses, malware, spyware and any other risky parasite that may want to harm the system. It offers anti-virus protection, on-demand virus scan as well as virus detection and elimination options.

8. Microsoft Store: Microsoft Store is an online store where customers can purchase and download various applications, games, and other materials. According to users, it provides free and paid applications, application updates, and even application suggestions.

The operating system recognised as Windows is multifaceted and easy to use. It provides diverse characteristics, tools, and programs to satisfy the requirements of ordinary users, companies, and other organisations. Starting from the interface and multiple working windows to the security and compatibility with software, Windows is an efficient computing operating system. Considering the constant updates of its versions and the continuous improvements, Windows has become relevant to the modern demands on computing.

9.2 Shortcuts and Basic Operations

Some commonly used shortcuts and basic operations in Windows:

Keyboard Shortcuts:

1. Ctrl + C: Select the item(s) you want to copy and press the Copy button or right-click and choose Copy.
2. Ctrl + X: Delete specific item/s (delete and paste to clipboard).
3. Ctrl + V: Copy/Paste the item(s) you have copied/cut into clipboard.
4. Ctrl + Z: Undo the last action.
5. Ctrl + A: Select all items in a window or document.
6. Ctrl + Shift + Esc: Open Task Manager directly.
7. Windows Key + D: Show or hide the desktop.
8. Windows Key + E: Open File Explorer.
9. Windows Key + L: Lock the computer or switch accounts.
10. Alt + Tab: Switch between open applications.
11. Windows Key + Left Arrow: Snap the current window to the left side of the screen.
12. Windows Key + Right Arrow: Snap the current window to the right side of the screen.
13. Windows Key + Up Arrow: Maximize current window.
14. Windows Key + Down Arrow: Minimize or restore the current window.
15. Alt + F4: Close the active window or exit the program.

Basic Operations:

1. File Management: Use File Explorer to navigate, create, copy, move, rename, and delete files and folders on your computer.
2. Application Management: Install, uninstall, and launch applications from the Start menu or Taskbar.
3. Window Management: You can resize, minimise, maximise, and close windows using the buttons in the title bar or keyboard shortcuts.
5. Taskbar Operations: Pin frequently used applications to the Taskbar for quick access. Right-click on Taskbar icons for additional options.
6. System Settings: Access system settings and control panel options to customise your computer's appearance, behaviour, and functionality.

7. Search: Use the Windows Search feature to quickly find files, folders, applications, and settings on your computer.
8. Task Manager: It supervises and controls the currently running programs, their efficiency, and the system resources that are utilised in Task Manager.
9. Desktop Customisation: The desktop, background, screen saver, icon, and themes can also be changed to suit the user's preferences.
10. Network and Connectivity: The Network and Internet settings allow a user to connect to Wi-Fi networks, adjust network settings, and resolve network problems.
11. System Updates: Perform general maintenance by periodically updating the system with new Windows updates and patches.

The following are the shortcuts and basic operations that can enable one to maximise the use of Windows. By mastering the above techniques, you can improve your productivity and efficiency in performing your operations using a computer. It is advisable that readers extend their discovery of further features and choices under Windows that meet their requirements.

- **Knowledge Check 1**

  Fill in the Blanks

  1. GUI stands for _____. (Graphical User Interface)
  2. Windows is one of the commonly used operating systems that was designed by _____. (Microsoft)
  3. The _____ is a strip that appears at the base of the screen and shows applications, shortcuts, and system messages. (taskbar)
  4. Windows Key + D is the shortcut for _____ . (showing the desktop)

- **Outcome-Based Activity 1**

  List of the versions of Microsoft Windows launched to date.

9.3 Working with WordPad and MS Paint

WordPad is mainly a text editor for Windows that is simple to use and is bundled with Windows itself. However, it does not have as many characteristics as Microsoft Word

but can perform basic document creation and editing. Here's how to work with WordPad in Windows:

Opening WordPad:

1. Start Menu: Press the Windows button on the keyboard, type WordPad in the Start search bar, and press the Enter key to start WordPad.
2. Run Command: Click on the Windows key on the keyboard and then hold it down before pressing the R key on the keyboard. You will see a box open with the words Run in it. Then, type the phrase wordpad in the box and press enter.
3. Shortcut: If you have added WordPad to the Taskbar or start menu, you can double-click its icon to open it.

Creating a New Document:

1. Open WordPad: Follow one of the methods mentioned above to open WordPad.
2. Start Typing: Once WordPad is open, you can start typing your document directly onto the blank page.
3. Save Document: Click on File > Save or press Ctrl + S to save your document. Choose a location, enter a file name, and click Save.

The Logo of WordPad

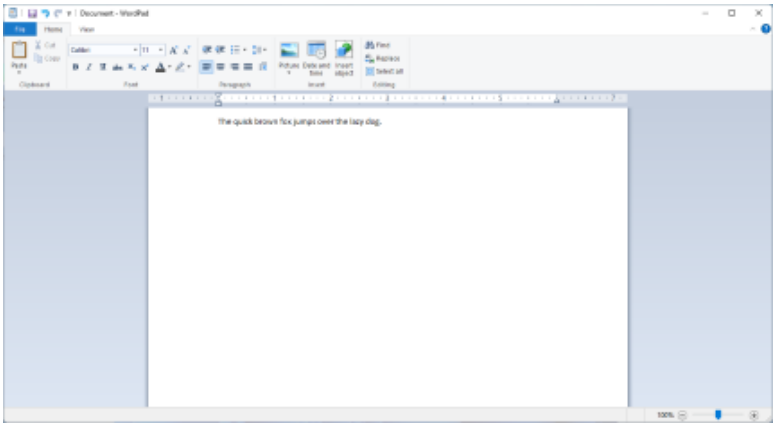
Editing Text:

1. Selecting Text: Click and drag to select text. You can also use the Shift key in combination with arrow keys for more precise selection.

2. Cut, Copy, Paste: Use Ctrl + X to cut selected text, Ctrl + C to copy it, and Ctrl + V to paste it.

3. Formatting: WordPad supports basic text formatting options such as bold, italic, underline, font size, and font colour. To apply formatting, use the formatting toolbar or keyboard shortcuts (e.g., Ctrl + B for bold).

4. Undo and Redo: Use Ctrl + Z to undo your last action and Ctrl + Y to redo it.



WordPad

Inserting Objects:

1. Pictures: Click on Insert > Picture to insert an image from your computer into the document.

2. Paint Drawings: Click on Insert > Paint Drawing to open the built-in Paint program, where you can draw or create simple graphics.

3. Date and Time: Click on Insert > Date and Time to insert the current date and time into the document.

Viewing and Printing:

1. Page Layout: To switch between page views, go to the toolbar and click on 'View', then 'Page Layout'. Here, you will find various options, such as 'Print Layout', 'Draft', etc.

2. Print Preview: File, go to 'Print Preview', and you will see how your document will be when it is printed out.

3. Printing: To print your document, use File, then choose Print or use the shortcut by pressing Ctrl + P. Select your printer and use options if you need to change your print settings.

Saving and Closing:

1. Save: Always use Ctrl + S or initially click on File at the top left corner of the screen and then select Save.

2. Close: To close WordPad, click the close button in the top right corner, which is an X shape. If changes have not been saved, WordPad will inform you that it intends to close the document.

However, WordPad is also an important operating system application that provides the feature for creating and editing text files in Windows. Of course, it is not as diverse as MS Word, but it is enough to type letters, notes, and even simple reports if necessary.

Try out the various options and functions available in WordPad to get a feel for and become conversant with the program.

Microsoft Paint

Microsoft Paint is a simple and easy-to-use image drawing program that comes preinstalled in Microsoft Windows. It offers users a basic tool set to draw and manipulate pictures across the digital platform. Although it does not provide the complex functions of the specialised painting and editing software, for instance, Adobe Photoshop, MS Paint is adequate for simple operations like drawing, colouring, and even adding text to pictures. Here's an overview of MS Paint and how to use it: Here's an overview of MS Paint and how to use it:

Opening MS Paint:

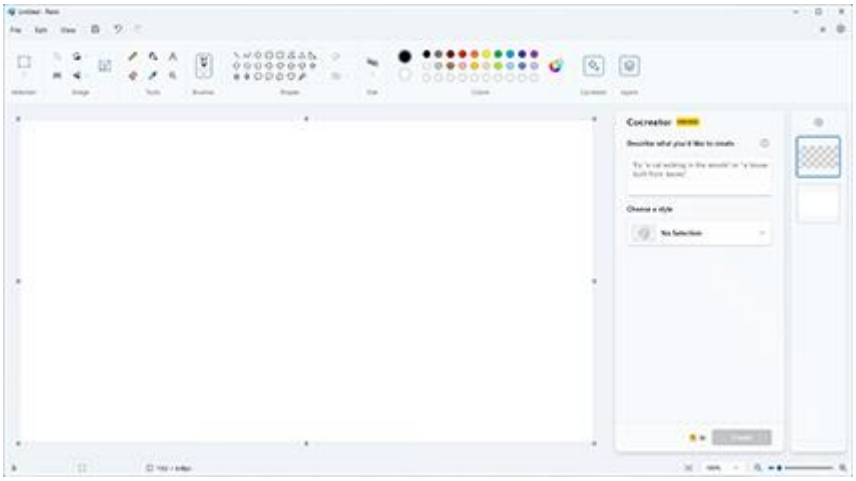
1. Start Menu: Right-click on the Start button and type “Paint” in the Search box, which will appear; then click on Paint to open the program.
2. Run Command: To open a built-in paint, press the Windows key on your keyboard, then type ‘R’ on your keyboard to open the Run dialogue box. Lastly, type ‘mspaint’ and tap the ‘Enter’ button on your keyboard.
3. Shortcut: If you have placed an MS Paint shortcut in the Taskbar or the Start menu, you can double-click on the shortcut icon.

Basic Tools and Features:

1. Canvas: The central section of the MS Paint window where you draw and manipulate images.
2. Tools: MS Paint offers drawing tools such as the Pencil, Brush, Eraser, fill-with-color, and Text tools. To choose a tool, simply hover the mouse over the icon and left-click on it in the toolbar.
3. Color Palette: For drawing and filling shapes, you can select colours using the Color palette. To do so, you can point at a colour and click on the mouse.
4. Resize and Rotate: The Resize and Rotate functions change the size and position of the selected objects or the position of the canvas in general.
5. Undo and Redo: To undo the most recent action, press Ctrl + Z, while Ctrl + Y will redo the most recently undone action.
6. Selection: To select a portion of the image, use the Selection tool. You can then move, resize, or edit the designated area of the map that you want to provide.

7. Zoom: There is a Zoom tool which one may use to zoom in or zoom out the Canvas so as to enable accurate editing.

8. Save and Open: To save an image file, go to File and choose Save. To open an image in the main formats such as BMP, JPEG, PNG, and GIF, choose File>Open.



MS paint

Basic Operations:

1. Drawing: Draw using the Pencil or Brush tool to add textured lines or shapes into the canvas arbitrarily.

2. Filling: This is a tool for filling areas with a particular colour depending on their shape or areas enclosed by a particular line or curve.

3. Erasing: Open the Layers palette and use the Eraser tool to remove unwanted areas of the image.

4. Text: Make sure to utilise the Text tool to write something on the image. Those are the words; when you want to add text, click the canvas at the desired spot, type in your text and then format the font, size or colour as you wish.

5. Shapes: MS Paint also has drawing tools, using which one can make simple shapes, including rectangles, circles, polygons, and others.

6. Cut, Copy, Paste: Pressing the Ctrl key and X at the same time will remove the selected content; Ctrl + C will duplicate the chosen text, while Ctrl + V will paste it.

Advanced Features:

1. Image Effects: Other features of MS Paint include modifying images by blurring, sharpening, or applying artistic effects.

2. Layers: One really big disadvantage is that MS Paint does not support a layering system like sophisticated image editing software; however, it is possible to perform

layering through the Paste From feature, in which you have to copy some parts of the picture and paste them on another layer.

3. Image Cropping: Implement the Select tool to select what one wants to eliminate from the picture, then define the Crop tool to delete the marked portion and retain only the necessary part of the image.

Microsoft Paint is a graphic editor and a painting application that is used to create and modify pictures in Windows OS. Even though it has fewer functions than professional graphics editing software, MS Paint is useful for simple graphic editing. She allows performing basic image manipulations for users who need to make simple graphic changes or create graphs. To gain a good understanding of the products that can be made using MS Paint, one should play around with the many tools and functions available in the program.

9.4 File Management in Windows

File management is an important activity that helps in achieving a well-structured and highly effective computer environment. File management in Windows involves the creation, organisation, and proper utilisation of storage within Windows. Here's a comprehensive guide to file management in Windows:

 # 1. Understanding the File System

- File System Structure: Windows uses the NTFS (New Technology File System) by default on all of its versions. It arranges data in directories (folders) and subdirectories to sort data in a well-structured and easily accessible manner.

Drives and Partitions: Files are in drives (like C: D:) that can actually be hard disks or parts of disk drives.

 # 2. File Explorer

- Accessing File Explorer: It is a software application that allows users to navigate, access, and modify files on the Windows operating system. It can be opened by using the folder I-con on the taskbar at the bottom of the computer screen or by pressing the Windows key and then the key E on the keyboard.

- Navigation Pane: On the left side, it shows drives, folders, and shortcuts for the user to visit on the webpage.

Address Bar: This bar displays what folder you are in at the moment and does not require you to type the entire path to get to a certain location.

 # 3. Basic Operations

Creating Folders: Choose the appropriate location; right-click and click on ‘New,’ then ‘Folder.’ For proper presentation, give the folder an appropriate name.

Renaming Files/Folders: Right-click the item name, then click on another option that says rename, and type the new name.

Deleting Files/Folders: Processes can also be closed by right-clicking on the process name and selecting “delete” or pressing the “Delete” key from the keyboard. Deleted items are moved to the Recycle Bin, where you can recover them or permanently erase them.

- Copying/Moving Files: Take the cursor to the concerned file or folder, then right-click the mouse and choose either “copy” or “cut,” then go to the location you want the file or folder to be at and select “paste.”

 # 4. Advanced Operations

Searching for Files: To search for files, type the name, type, or content of the file into the search box located in the File Explorer tab or in the taskbar of Windows.

Sorting and Filtering: You can sort files by clicking on the column headings (such as Name/ Date modified). When you want to organise your data more complexly, you can use the “Sort by” and “Group by” options.

Viewing Options: You can customise the view mode (large icons, details, list, etc.) by going to the current view tab in the File Explorer.

 # 5. Managing Storage

Disk Cleanup: You should use the Disk Cleanup utility to free disk space by deleting unnecessary files. You can access it through ‘Start’ and look in the search bar for ‘Disk Cleanup.’

Storage Sense: Storage Sense can be toggled on/off in Settings to clean the cache and manage local cloud content independently.

- Check Disk Utility: Run the Command Prompt and perform the Check Disk utility (`chkdsk`) to fix glitches within the file system. It is best to run through the Command Prompt, and you should ensure that you are running it as an administrator.

 # 6. File Security

Permissions: Open the document, right-click on it, and choose properties. In the properties dialog, you can change the security of the item for specific users or groups.

Encryption: Authorised personnel should use BitLocker when encrypting drives or the encrypting file system (EFS).

Backup: Always save documents, photos, and other crucial files through the Windows Backup and Restore tool or similar applications available on the market.

 # 7. Using Libraries

Libraries Overview: Libraries are folders that are combined on the Internet and make accessing files from different places easier.

- Creating Libraries: Click the Libraries tab in File Explorer, then New, Library, with your right mouse button pressed. When you right-click, you may simply type the folder's name as soon as you release the mouse button. Add folders to the library so that you can access them.

 # 8. File History

Setting Up File History: This can be accessed by going to settings, updating and security, and then back up. Click on file history. Select a drive to back up your data on a regular basis.

Restoring Files: To restore previous versions of a file, you can use File History by opening the file location in File Explorer, right-clicking, and selecting 'Restore previous versions'.

Below are useful suggestions on how the staff and students of an institution can effectively manage files.

Use Descriptive Names: When saving files and folders, it is recommended that they be named unambiguously so that their contents are easily recognisable.

- Organize by Category: Organize files into different categories (for instance, Documents, Pictures, and Projects) to enable easy locating of these files.

Regular Maintenance: It is important to go through the files and folders periodically and remove unnecessary files to avoid data clutter and ensure that there is enough space for storing other files.

- **Knowledge Check 2**

  Fill in the Blanks

  1. _____ is one of the simple text editors shipped with the Windows operating system. (Notepad)
  2. Windows and pressing the R key at the same time is used for _____ (Run dialogue box)
  3. Microsoft Paint is commonly known as_____. (Paint)

5. A directory containing image files in different formats may include _____ & _____. (JPEG, PNG)

- **Outcome-Based Activity 2**

  Open Microsoft Paint & draw and use the basic paint function.

9.5 Summary

- Windows is an operating system prevalent in computers, developed by Microsoft Corporation. It offers a graphical user interface through which users communicate with computer hardware and software applications.
- Windows also has a number of elements, including icons, windows, menus, and pointers, or what is commonly known as cursors, that allow users to interact with the computer system visually.
- Windows is a strong player in the domain of computing and work. Through constant updates and enhancements, Windows maintains its form and functions to adapt to today's advancements in computing.
- Some of the more frequently used keyboard shortcuts in Windows include Ctrl + C, which is used to copy; Ctrl + V, which is used for paste; Ctrl + Z for undoing the last action performed; and Windows Key + L for locking the computer.
- WordPad is yet another simple application included in the Windows operating system that is used for creating and editing text documents. It may lack the variety of tools as compared to Microsoft Word, but it is still useful for simple document processing.
- Microsoft Paint is a simple drawing and image-editing tool that has been included in Windows since Windows 1. It is a fair, quick, and basic tool for creating and manipulating images on the digital device's screen.

9.6 Keywords

- **Windows:** Windows is one of the most commonly used operating systems in the world today, currently owned by Microsoft Corporation.
- **WordPad:** This application is closely related to MS Word in that it is a basic word processor for the Windows operating system. Compared to Microsoft Word, it may lack many of its features, but it can be used for basic text processing needs such as writing and editing documents.

- **Microsoft Paint:** Microsoft Paint is a simple drawing program that is part of the Microsoft Windows operating system. It offers users easy-to-use tools to draw and manipulate pictures on computer display surfaces.

9.7 Self-Assessment Questions

1. How multitasking is done in the MS Windows Operating System.
2. What are the fundamental elements of Windows systems?
3. Enumerate Some of the generally known shortcuts in Windows.
4. What is the procedure for performing the Insert Objects in Wordpad?
5. What is new in MS Paint, and what basic tools are available in it?

9.8 References / Reference Reading

- Fundamental of Computers by Rajaraman.
- Computes Today by B. Sandra.

Unit 10: Microsoft Office Applications

Learning Outcomes:

- Students will be able to define basic features of MS Word.
- Students will be able to explain the utilities and tools in MS Word.
- Students will be able to describe the basic features of MS Excel.
- Students will be able to demonstrate basic functions and tools in MS Excel.
- Students will be able to create basic presentations using MS PowerPoint.

Structure:

10.1 MS Word

10.1.1 Basic Features and Utilities

- Knowledge Check 1
- Outcome-Based Activity 1

10.2 MS Excel

10.2.1 Basic Features and Utilities

10.3 MS PowerPoint Basics

- Knowledge Check 2
- Outcome-Based Activity 2

10.4 Summary

10.5 Keywords

10.6 Self-Assessment Questions

10.7 References / Reference Reading

10.1 MS Word

Microsoft Word is a word processor owned by Microsoft Corporation. It is also an application under Microsoft Office that is used to prepare documents, edit them, format them, and share them.

Microsoft Word enables users to create various documents, such as letters, reports, resumes, and essays. It offers a comprehensible design and a plethora of powerful tools that increase efficiency and contribute to the document creation process.

Another important characteristic of Microsoft Word is its rather rich formatting capabilities. They can work with the typefaces and the type sizes freely, and they can also set the space between the paragraphs and use numerous tools to make the documents present a nice appearance. It also contains features for inserting tables, images, and headers/footers to enhance the format of work-related papers.

Microsoft Word, the last in the list of basic features for working with documents, provides for sharing and reviewing. It is useful for teamwork because it enables users to monitor changes made in the document, post comments, and even work simultaneously on the document.

Microsoft Word also has extra features such as spell check, grammar check, and thesaurus to make text free from errors and professional. In particular, it optimises the process of preparing professional-looking documents and allows for the addition of elements such as borders, watermarks, and templates.

Furthermore, it has features involving the generation of indexes, table of contents, and bibliographies, making Word an essential package for research students, researchers, and professional document users.

The software also has the feature of compatibility with other Microsoft Office products. A user can easily insert content from Microsoft Excel spreadsheets, PowerPoint presentations, and Outlook emails right into the Word document.

In general, Microsoft Word can be defined as an all-in-one word tool that targets users of various types and scales. It is easy to learn, has many formatting tools and options, and has convenient options for working with others and integrating with other programs, making it a versatile tool for writing, revising, and sharing documents quickly.

10.1.1 Basic Features and Utilities

Starting Microsoft Word

Starting Microsoft Word can be such a thrill for new users, especially if they are new to the software. Here's a step-by-step guide to help you get started with Microsoft Word and unleash your creativity:

1. Launching Microsoft Word: To begin typing in Word, search for the program icon on the desktop or in the programs list in the Windows Start menu and double-click it. When the program is loaded, the screen you will see is a white sheet, and it is on this that you will type.

2. Exploring the User Interface: Allow some time to get acquainted with the program or application's layout. The main parts or sections are the Ribbon, a set of tabs containing groups of related commands; the Quick Access Toolbar, where you can pin commands you use most often; and the document space, where most of the work will be done.

3. Creating a New Document: If you wish to start a new document, go to the “File” tab in the Ribbon menu and choose “New.” Here, you can either opt for a blank template or choose from a variety of templates available for types such as resumes, letters, reports, etc.

4. Adding and Formatting Text: Type your content beginning in the document area of the page. Formatting the text can easily be done by highlighting it and using the format options from the Ribbon. The ribbon allows you to alter the font type and size, make the text bold/italic, align text, and modify the distance between paragraphs.

5. Inserting Images and Graphics: You may also insert pictures, drawings, or any other graphics into the document to enrich it. To do so, first go to the Ribbon and locate the “Insert” tab, then select the right option. You can include pictures from other applications on your computer or from the World Wide Web or draw simple shapes and diagrams.

Ribbon Menu system

The features found in any MS Office Suite application, including the Ribbon Menu system in MS Word, are one of the most efficient ways to access commands and features. Let's explore the different Ribbon Menu categories in Microsoft Word.:

"Home" Ribbon Menu: The Home tab is where most of the fundamental setting options that you might need for your document are located. As a result, it provides a

large number of commands for changing the font type, size, and colour and for applying the bold, italics, and underline effects to the text. One can also align the text to the left, right, and centre, justify the paragraph, and format the paragraph by indentation and space between the lines while creating a list with bullets or numbers for better organisation. The Styles and Themes options will enable you to format your document in a very short time using formats that are already designed.

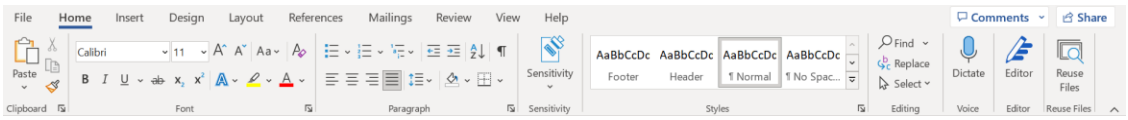


Fig:- "Home" Ribbon Menu

"Insert" Ribbon Menu: The Insert tab is filled with numerous possibilities for inserting numerous things into a document. To spice up your document and make it more visually appealing, you can add pictures/ images from your computer or off the web, as well as shapes and SmartArt graphics. Under the Table command, you have the option to create specific rows and columns with the data you have entered, while the Chart option builds the figures and charts of data entered. You can also add headers and footers and place the page numbers or any symbol that can be useful in structuring the document.

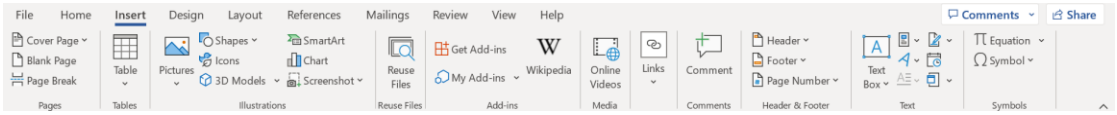


Fig: - "Insert" Ribbon Menu

"Page Layout" Ribbon Menu: The Page Layout tab covers aspects of the appearance and structure of the document. It contains commands to change a number of margins, switch between the portrait and landscape orientation, and choose available paper sizes. It can bring you page borders and colours to help you make your document look more attractive. Further, the Breaks and Columns options enable you to manage the page breaks and perform the multiple-column layouts for newsletters or brochures.

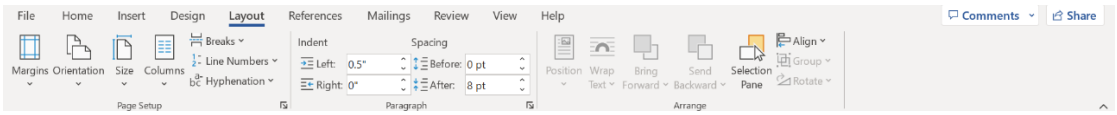


Fig:- "Page Layout" Ribbon Menu

"References" Ribbon Menu: The References tab is used to handle citations and references for the document that is being prepared. It provides features for adding footnotes/ endnotes and citations using formats like APA, MLA, or Chicago. It allows

for the creation of a table of contents for the document structure and indexes for further navigation. The Captions command enables users to caption tables, figures and any other objects that may be in a document.

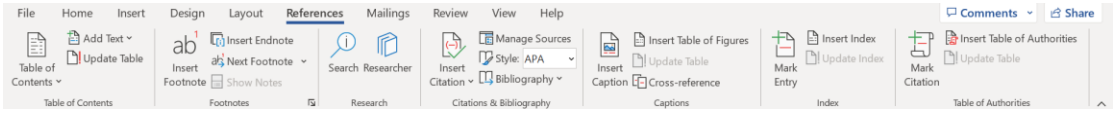


Fig: - "References" Ribbon Menu

"Mailings" Ribbon Menu: The Mailings tab is mainly used for mailing operations, that is, operations related to mail merging. Mail merge enables one to produce documents like letters, envelopes, and labels whereby information from a database or spreadsheet is inserted into the document. There are options to create lists of recipients, use placeholders to insert fields, and view the merged data. To perform a mail merge, Microsoft Word offers a mail merge wizard that guides a user through the process.

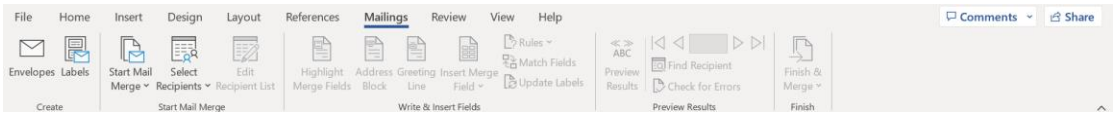


Fig: - "Mailings" Ribbon Menu

"Review" Ribbon Menu: The Review tab is used to navigate to different options for reviewing and editing the document. The Spelling and Grammar checkers assist in locating and correcting any spelling and grammatical mistakes. Comments can be inserted at the required location in the document, including the feature of version history with the changes made by the different users, and one can either accept or reject the changes. Word Count includes the statistics of words, characters, and the number of paragraphs in the document you are working on. Also, Among the Protect Document options, you can try to limit editing, insert digital signatures, or password-protect the document.

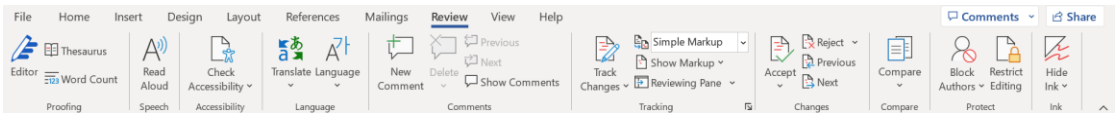


Fig: - "Review" Ribbon Menu

Mail Merge:

Mail merge in MS Word is a versatile tool for generating individual documents, such as letters, envelopes, labels, or even e-mails, with the help of the main document and data source. It is often employed in connection with the sending of numerous e-mails at once or when applying personal data to a number of records.

It involves preparing a master document with fixed content alongside the areas that would be filled by variable content. The recipient data, such as the name, address, or any other field that is to be personalised, are stored in a data source, which may be an Excel or a database.

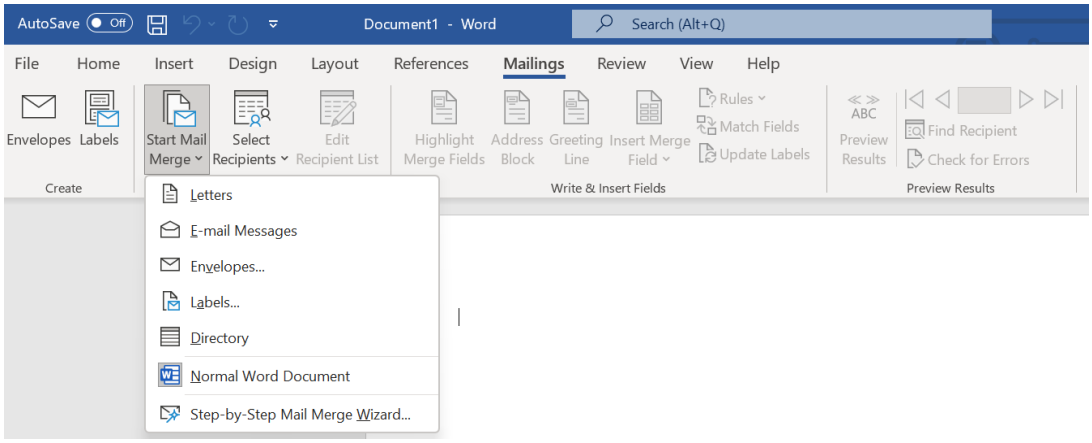


Fig:- Mail Merge

Mail merge is an effective means of creating several documents based on the selected template but adjusted for the recipient. This process connects the main document with the data source and identifies the fields to be inserted. MS Word then inserts the data found in the data source into the placeholder to generate a customised document for each recipient.

Mail merge in MS Word covers quite a number of customisation features, such as choosing recipients, pre-sifting the data, sorting the records, and coding the content to be inserted. This allows users to make very efficient and accurate documents with high customisation in the shortest time possible and without much strain.

- **Knowledge Check 1**

  Fill in the Blanks

  1. _____ is a word processing software developed by Microsoft Corporation.(Microsoft Word)
  2. One of the tools that are availed to users by Microsoft Word is the spelling and _____ checker. (grammar)
  3. The _____ tab relates to the general formatting of the document. (Home)

- **Outcome-Based Activity 1**

  Create a Word document, then copy the Images of your college.

10.2 MS Excel

MS Excel is an efficient tool for processing, analysing, and manipulating data through the organisation of data in tabular form. The first important component that should be discussed here is the Ribbon, a graphical toolbar of Excel. Learning about the Ribbon in MS Excel is important because it will introduce the user to how to use it and where to find the various commands.

The Ribbon in MS Excel is arranged into various tabs, each containing a particular set of commands useful in various operations and calculations. The main category tabs are Home, Insert, Page Layout, Formulas, Data, Review, and View. Every tab is created to hold similar commands and functions, making it easy for the user to find and apply the preferred functions.

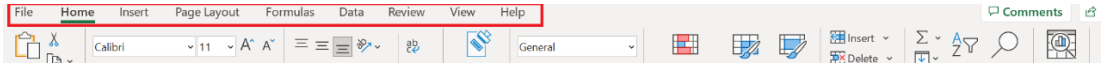


Fig:- Ribbon in MS Excel

The home tab is situated in the Ribbon and contains the most frequently used commands for formatting data. It enables users to change text format, control cell alignment, format numbers, and perform simple analyses of the data, such as sorting and filtering. Also, it gives a convenient way of accessing frequently used operations, such as copy, paste, and undo.

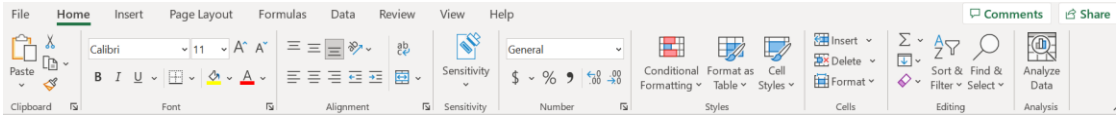


Fig: - Home tab

The Insert tab enables the addition of various items to the spreadsheet. By using insertions, the user can place tables to create subtopics for data, create charts to aid in the identification of trends, and add pictures and shapes for aesthetic value. Other objects that may be included are hyperlinks, headers, and footers.

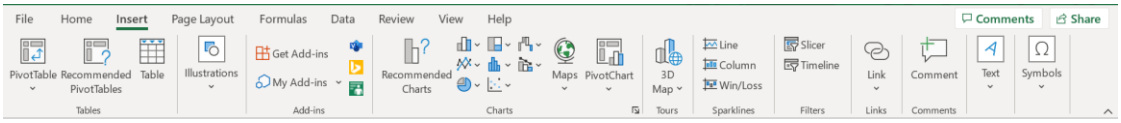


Fig: - Insert tab

The current tab, Page Layout, deals with the design and formatting of the spreadsheet. The layout tools allow for changing margins, orientation (portrait or landscape), Headers, and footers, as well as applying themes to the document to give it a proper

outlook. Users can also adjust the printed materials' appearance, and they can see the format before printing.

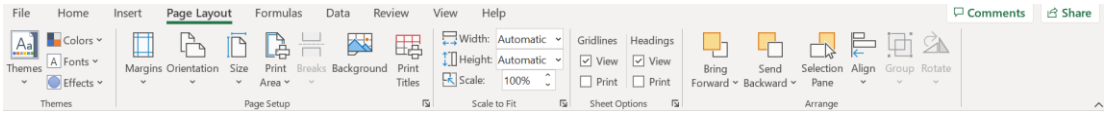


Fig: - Page Layout tab

The Formulas tab is dedicated to the calculation and formula-related tasks in Excel. It contains a basket of pre-specified functions to be applied to the data, including mathematical computation, statistical computation, text manipulation, and logical tests. This tab also offers features for working with and checking the appropriate and efficient formulas when dealing with multiple hierarchical equations.

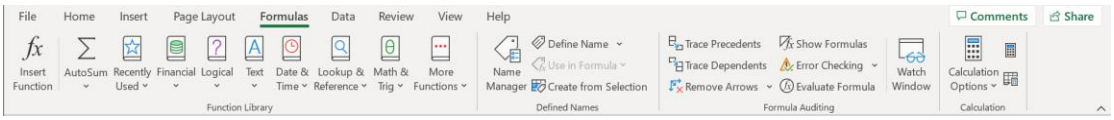


Fig: - Formulas tab

The Data tab is one of the most important tabs when working with Excel as it contains numerous tools to manipulate the data. It provides choices for getting data from other applications and databases, filtering out redundancies, checking the inputs, and handling data operations such as constructing tables and merging data obtained from different sources.

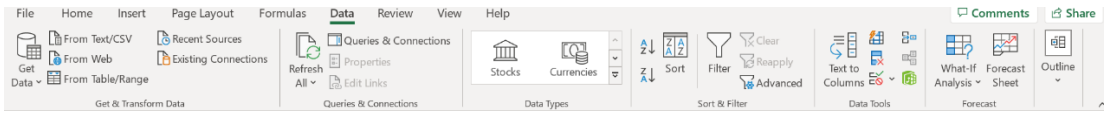


Fig: - Data tab

10.2.1 Basic Features and Utilities

Following the Microsoft Excel environment to its details enables the users to modify it to suit their needs and make work easier. Here are some key aspects of customisation in Microsoft Excel:

1. User Interface Customisation: In Excel, the modifications and changes that the users make can enhance the users' interface to suit their needs. They can move the tabs of the Ribbon and groups around, increase or decrease the command options, and design their tabs. They can also be included in the Quick Access Toolbar, which is the list of commands that are frequently used in the application. Also, users can define various hotkeys for particular commands to optimise their work process.

2. Themes and Styles: Users can also use the many themes and styles that Excel readily offers. These themes include colour coordination, fonts, and effects that provide a professional and uniform appearance to workbooks. Users can also define their own themes and styles, which means that they can maintain the same appearance across different spreadsheets.

3. Workbook Views: Within Excel, one is able to view data in different ways depending on the nature of the work to be done. The Normal view is commonly used for editing and formatting text for general content. A feature on the interface is the Page Layout view, which enables users to see how the output of the spreadsheet will look and, hence, change the margins, headers, footers, and breaks on the printed sheet. This is done through the use of the Page Break Preview view, which assists users in identifying page breaks and making modifications. It is convenient to switch between these views, which are beneficial for each task that needs to be performed.

4. Custom Templates: The user can create custom templates in Excel to contain specific settings and formatting as well as other formulae. Such templates can have specific layouts, headers, footers, and data structures best suited for their purpose. Users can create templates for operations or texts they use regularly so that they do not have to redo the formatting each time.

5. AutoCorrect and AutoFill: AutoCorrect is an Excel tool that performs a spelling check and corrects the most frequently made mistakes. Users can also use AutoCorrect by adding abbreviations, often-used terms, or special characters. AutoFill is another useful tool that allows users to fill cells with a series of data, such as numbers, dates, or custom lists, through the fill handle.

6. Custom Functions and Add-ins: Excel also allows for the development of user-defined functions through Microsoft's Visual Basic for Applications (VBA). Advanced users with knowledge of programming can create their own functions to carry out some calculations or even a number of operations. Also, there are numerous add-ins in Excel that enhance the program's capabilities, as users can incorporate additional programs into Excel.

7. Data Analysis Tools: Excel has many built-in data analysis tools that assist users in analysing and interpreting their results efficiently. Tools like PivotTables data tables and the scenario manager enable users to manipulate the data and summarize it meaningfully. These tools offer the possibility of selecting a specific range of data,

performing complex calculations, formatting the data, and generating useful reports and graphs.

Settings for formulas MS EXCEL

Functions are an integral part of Microsoft Excel, where the users can calculate data, modify it, and establish dependent relationships with the active cells. To enhance the functionality of the formula, Excel offers different options that the user tends to set. These settings improve the formula behaviour, how formulas are checked for errors, and the accuracy of the calculations. Let's explore some of the key settings for formulas in MS Excel:

Formula Calculation Options: There are calculation modes in Excel that determine how the formulas are calculated and processed. The default mode is Automatic, in which the formulas are updated each time changes are made to the worksheet. Users can also select Auto mode, which means calculations are performed automatically, while there is also the Manual mode, where the calculations have to be triggered by the user. This setting is useful in large data input or formula-intensive applications as it enables users to determine when and how often the calculations are made so as to minimise resource consumption and, hence, increase efficiency.

Iterative Calculation: In some cases, formulas can be iterative, in which Excel continues to calculate a cell until a certain value is obtained. The user can change the number of iterations and maximum changes in iterative calculations for the analysis. This setting is especially applicable when working with circular references, meaning when the formula refers to its outcome.

Formulas in MS Excel along with a short description for each: Formulas in MS Excel along with a short description for each:

1. SUM Formula: The SUM formula is also used to sum up a range of cells in Excel. This function helps to sum up the values set in the cells that have been indicated and gives the total value. For example, "=SUM(A1:A10) is an example of how the SUM function works: it sums the values in cells A1 to A10.

2. AVERAGE Formula: The AVERAGE formula is used to find the average of a range of cells in Excel. It sums up the values and then divides the obtained result by the number of cells in the range. For instance, "=AVERAGE(B1:B5)" performs an average function between the values that are contained in the cells B1 to B5.

3. IF Formula: IF unleashes the possibility of conditional computations. It tests a given condition and then returns a given value if the condition is true; otherwise, it provides a different value if the condition is false. For instance, “=IF(A1>10, “Yes”, “No”)” will compare the value in cell A1 with the number 10 to determine if it is greater than or less than 10. If true, it will say “Yes,” and if false, it will say “No”.

4. VLOOKUP Formula: The VLOOKUP is the formula used to look up a value in the first column of arguments and returns a value in any column that you specify. It is commonly applied in data search and data recovery. For instance, "=VLOOKUP(A1, C1:This means that to find the value in cell A1 in the range C1:D10, type in "=D10, 2, FALSE)." If found, it will identify the second column of that range and return its value.

The following formulas are just the tip of the iceberg of the many mathematical, logical, and text functions available in MS Excel. These offer users the ability to make computations, assessments, and decisions based on certain conditions and search for information. If these formulas are grasped and used by the users, then MS Excel can be used to its optimum level, and all data processing-related work can be made easy.

10.3 MS PowerPoint Basics

Microsoft PowerPoint is a computer program for creating presentations included in the Microsoft Office package. It is intended to produce impressive and interesting visuals for various purposes, such as business meetings, educational presentations, sales, and training.

PowerPoint allows users to create appealing slides that include texts, pictures, graphics, animations, and other media objects. It provides users with a vast number of tools and functions that help reveal information and ideas in a graphic and structured way.

- **Key features of Microsoft PowerPoint include:**

1. Slide Creation: The users can develop single slides and then align them properly to present information in the best way possible. The content placed on the slides can be text, graphics, charts, tables, shapes, images, and any other multimedia tools.

2. Slide Design: PowerPoint is endowed with numerous default exciting design templates and themes that enable users to make good designs. It is entirely possible to design the look and feel of the application, from the layout to the colour options, font type, and even the background, to the user’s desire or organisational colours.

3. Animation and Transitions: Animation services and slide transitions can also enhance the movement of the slides and the manner in which the added content is displayed. This can regulate the entry, exit, and manoeuvering of objects on the slides, making the content look more attractive.

4. Multimedia Integration: Multimedia components include graphics, video clips, sound clips, and other formats like animated graphics, which are supported by PowerPoint. For a more engaging presentation, there are options to place objects right into the slides or link to files outside the application.

5. Presenter Tools: Using PowerPoint, the presenter is provided with tools to help during the presentation. These are the presenter's view, the speaker's notes, and on-screen notes. These tools assist the presenters in ensuring that they easily and freely give their presentations.

6. Collaboration and Sharing: One of its features enables users to share documents with other people and work on the PowerPoint presentation online. It is convenient when several people edit the presentation at once, which is possible with this program due to simultaneous access.

7. Slide Show Presentations: PowerPoint also enables the user to present their slideshow in different modes, like a full-screen mode or the presenter's mode. Timing of the slide itself, narration, and slide transitions are other options that can be used by the users.

- **Knowledge Check 2**

  Fill in the blanks

  1. Excel provides _____ features to enable the software to be accessible to people with the relevant disabilities. (accessibility)
  2. Excel has a wide variety of _____ tools that are integrated into the software to assist users in analysing their data properly. (analysis)
  3. Excel has the _____ feature, which helps to correct the most frequently made spelling errors or typos as the user types. (AutoCorrect)

- **Outcome-Based Activity 2**

  Explore Themes and Styles in MS -EXCEL.

10.4 Summary

- Microsoft Word is one of the common word processing software with many tools that can be used to create, edit and format documents. It has simple control and can be used for many activities like completing an essay, creating a report, or creating a professional document.
- On the initial launch of the Microsoft Word application, the user will be presented with a fresh document on which they can start typing or open a document from their computer. All the features and options available in MS Word are grouped into tabs that appear as ribbons across the top of the screen; the available tabs include Home, Insert, Page Layout, References, Mailings, Review and View, among others.
- The basic operations performed in MS Word are to create a new document, open a document, save a document for the first time, save a document, include and manipulate text, set margins, headers, and footers, number the pages, and exit from a document. These tasks are crucial for the generation, revision, and manipulation of documents in any organisation.
- Mail merge and macros are among the tools in MS Word that enhance the user's ability to format documents by automating certain operations. Mail merge is a way of creating form letters or e-mails by inserting data in a main document from a source document.
- MS Excel is an application that provides several aspects for data handling and comes as a powerful spreadsheet.
- The ribbon in MS Excel includes Home, Insert, Page Layout, Formulas, Data, Review, and View, which are the tabs that contain commands and options.
- Microsoft Excel allows the user to personalise the Excel interface through the ribbon, designing new tabs and keyboard shortcuts for commands.
- Microsoft PowerPoint is an application for creating presentations developed by Microsoft and included in the Microsoft Office package. It is intended to produce eye-popping and engaging multimedia content for diverse purposes, such as business and corporate meetings, educational presentations, sales, and training.

10.5 Keywords

- **Microsoft Office suite:** The Microsoft Office suite is a group of applications used in business environments to perform various tasks; these include Word, Excel, and PowerPoint, among others.
- **User Interface (UI):** This is the graphical or combination of graphical and text aspects of the software or application that enable a user to control it.
- **Visual Basic for Applications (VBA):** VBA is an application that is part of the Microsoft Office package and supports the development and efficient management of applications using Visual Basic.

10.6 Self-Assessment Questions

1. What role does the Microsoft Word play when it comes to word processing?
2. What are the steps to take to open Microsoft Word and create a new document?
3. What are the various subcategories of Ribbon Menu in MS Word, and what are they capable of doing?
4. How does Microsoft Word play a role in the functionality of word processing software?
5. What actions can you take to open Microsoft Word and begin creating a new document?

10.7 References / Reference Reading

- Fundamental of Computers by Rajaraman.
- Computes Today by B. Sandra.

Unit 11: Introduction to the Internet

Learning Outcomes:

- Students will be able to define the internet.
- Students will be able to describe the importance of the Internet.
- Students will be able to outline the history of the internet.
- Students will be able to identify necessary equipment for internet connectivity.
- Students will be able to explain key internet protocols.

Structure:

11.1 Definition and Importance of the Internet
    - Knowledge Check 1
    - Outcome-Based Activity 1
11.2 History of the Internet
11.3 Necessary Equipment for Internet Connectivity
11.4 Internet Protocols
    - Knowledge Check 2
    - Outcome-Based Activity 2
11.5 Summary
11.6 Keywords
11.7 Self-Assessment Questions
11.8 References / Reference Reading

11.1 Definition and Importance of the Internet

The Internet is a system of linked computers and other devices located in various countries around the world that employ a specific set of rules for exchanging information. They allow users to connect with a myriad of sites, mail, social media, streaming, shopping, and other services available on the Internet. Here's a brief introduction to the Internet, along with its definition:

Definition of the Internet:

The Internet is a global system of interconnected telecommunications networks that use Internet technology (TCP/IP) to connect systems and devices. It is composed of millions of private and public, academic, business, and government networks connected by wired and wireless technologies, routers, switches, and servers.

Features of the Internet:

1. Global Connectivity: The Internet links many millions of devices globally through the provision of communication and information exchange services irrespective of geographical location.
2. Decentralised Architecture: The Internet is decentralised, which means it does not have a central administrator who manages the whole Internet. However, it is divided among many interconnected networks that belong to different organisations and related bodies.
3. Open Standards: The Internet uses open and standardised communication protocols like TCP/IP, HTTP, and SMTP, which are intended to work at different layers of the communication protocol stack.
4. Information Access: The Internet is a vast collection of sites, information, databases, multimedia, and services located on the World Wide Web and can be accessed through browsers and others.
5. Communication: Some of the communication that happens through the Internet includes e-mail, instant messaging, voice and video conferences, social networks, newsgroups and forums, and collaboration platforms.

Importance of the Internet:

Today, the Internet is an immutable part of people’s lives, and its impact is unarguably significant in contemporary society. It touches all spheres of human activity, affecting people, companies, states, and society as a whole. Here are some key aspects highlighting the importance of the Internet:

1. Access to Information:

- The Internet brings unlimited information with a single click for any topic that man can think of.

- It provides information about existing issues and allows users to search, study, and stay up to date with current events, academics, and people's opinions.

2. Communication and Connectivity:

The Internet enhances communication and connection between people and firms worldwide, with friends, families, colleagues, and other communities.

- They include emails, instant messaging applications, social networks, voice and video communications, and online collaboration applications.

3. Economic Growth and Innovation:

- The Internet has revolutionised commerce and business operations, enabling e-commerce, online banking, digital payments, and global trade.

- It fosters innovation and entrepreneurship by providing a platform for startups, small businesses, and individuals to develop, market, and distribute products and services globally.

4. Education and Learning:

- The Internet has transformed education by providing access to online courses, educational resources, digital libraries, and interactive learning platforms.

- It offers opportunities for distance learning, skill development, and lifelong learning, making education more accessible and inclusive.

5. Social Interaction and Community Building:

- The Internet facilitates social interaction and community building through social networking platforms, online forums, and virtual communities.

- It connects people with shared interests, values, and experiences, fostering collaboration, support networks, and collective action.

6. Access to Services and Resources:

- The Internet provides access to a wide range of services and resources, including government services, healthcare information, entertainment content, and public utilities.

- It enhances convenience and efficiency by offering online banking, booking services, entertainment streaming, and digital content delivery.

7. Empowerment and Participation:

- The Internet empowers individuals to express themselves, share their ideas and opinions, and participate in civic engagement and democratic processes.
- It democratises access to information and amplifies voices that may otherwise be marginalised or underrepresented.

8. Globalisation and Cultural Exchange:

- The Internet transcends geographic boundaries and cultural barriers, facilitating global communication, collaboration, and cultural exchange.
- It promotes cross-cultural understanding, appreciation of diversity, and the sharing of ideas, traditions, and perspectives.

- **Knowledge Check 1**

  Fill in the blanks

  1. _____ enables users to access a vast array of resources and services, including websites, email, social media, online streaming, e-commerce, and more. (Internet)
  2. The _____ is a global network of interconnected computers and other devices that use standardised communication protocols to exchange data and information. (Internet)
  3. _____ & _____ are the Features of the Internet.(Connectivity & Accessibility)
  4. IoT stands for _____. (Internet of Things)

- **Outcome-Based Activity 1**

  Make a ppt on the Evolution of the Internet.

11.2 History of the Internet

The evolution of Internet technology began in the late 1960s and has since then been shaped by progressive advancements in technology, cooperation between the Internet community members and key accomplishments. Here's a brief overview of the key events and milestones in the history of the Internet:

1. Origins:

- 1960s: The forerunner to the Internet – ARPANET (Advanced Research Projects Agency Network) was created by the U. S. Department of Defense's Advanced

Research Projects Agency (ARPA, now called DARPA) at the end of the 1960s. It was to be used to coordinate, communicate, and share information between research institutions and universities.

2. Birth of the Internet Protocol (IP): Birth of the Internet Protocol (IP):

- 1970s: TCP/IP or Transmission Control Protocol/Internet Protocol is credited to computer scientists Vint Cerf and Bob Kahn, who are the pioneers of today's Internet. TCP/IP defined the common communication protocols of networking and data exchange to let different computer networks connect and exchange information with each other.

3. Expansion and Commercialisation:

1980s: In 1986, the National Science Foundation (NSF) provided funding to create a high-speed backbone network known as NSFNET for research and academic institutions in the United States. This expansion provided the foundations for the commercialisation of the Internet.

The 1990s: The WWW was developed by British computer scientist Tim Berners-Lee, who was working at CERN in Switzerland. Web browsers and HTML tools greatly improved how users navigate information on the Internet, causing a surge in use and adoption across the globe.

4. Popularisation and Globalisation:

1990s—2000s: Internet usage and popularity grew rapidly due to technology enhancements, cheap computers, Internet accessibility, and the availability of new Internet-based services and applications.

Mobile Internet: The introduction of smartphones and mobile devices in the 2000s also boosted internet usage, as it became convenient to use the Internet anywhere at any time.

5. Evolution and Innovation:

Web 2. 0: Web 2. 0 technologies appeared at the beginning of the twenty-first century. These developments are mainly evident in social media platforms, user content creation, and newly developed Web 2.0 applications.

Cloud Computing: The advancement of cloud computing technologies since the late 2000s has changed the ways of storing and utilising data and services in a scalable and on-demand manner through the Internet.

6. Internet of Things (IoT) and Beyond: Internet of Things (IoT) and Beyond:

- Internet of Things (IoT): The Internet of Things has materialised as a new trend in the last several years, where billions of smart devices and sensors, including home appliances, industrial equipment, etc.

5G and Beyond Current developments in networking technologies, such as 5G wireless technology and satellite Internet, are expected to boost connectivity, speed, and reliability, which form the future of the Internet.

11.3 Necessary Equipment for Internet Connectivity

The following main equipment and components are required for Internet connection. Here's a list of the necessary equipment for Internet connectivity:

1. Modem: A modem is an acronym for modulator. A demodulator is a device that modulates and demodulates digital signals to facilitate the connection between your computer or network and your ISP. There are different types of modems available in the market, such as cable modems, DSL modems, fibre optic modems, and satellite modems, depending on the Internet connection you are using.

2. Router: A router is a device used to connect various devices in your home or workplace network to the Internet. It works as a router between your Local Area Network (LAN) and the Internet. Some of the common integrated functions of routers are wireless communication, firewall, and Network Address Translation (NAT).

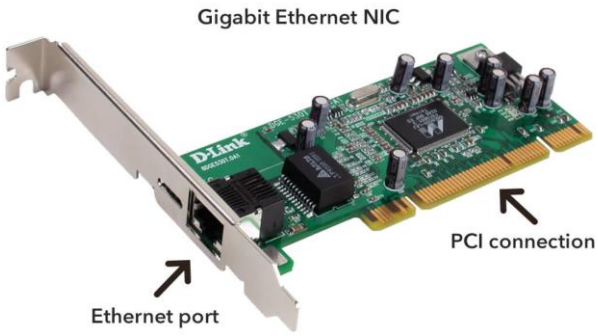
3. Ethernet Cable: An Ethernet cable connects your modem to your router or directly to your computer or other device if you are using a wired (Ethernet) connection. Of course, Ethernet cables vary by category (for example, Cat5e, Cat6) and length and are used to create a wired Internet connection.

Ethernet Cable

4. Wi-Fi Access Point: If you are using a wireless Internet connection, then you will require a Wi-Fi access point or router with Wi-Fi capability. Wireless local area

networks are transmitting stations that send electromagnetic waves into the air, which Wi-Fi-compatible devices like laptops, smartphones, tablets and smart home gadgets can use to connect to the Internet.

5. Network Interface Card (NIC): A Network Interface Card, also referred to as a NIC or Ethernet card, is a computer hardware device that enables a computer to connect to a network. Almost all current computers have built-in Ethernet ports for LAN, while wireless can be built-in hardware or a card installed on the computer through the USB ports or expansion slots.



Network Interface Card

6. Power Supply: This is the product category that supplies electrical power to your modem, router, and other networking equipment. Ensure there are electrical outlets and power strips available in case you need to charge or power some of the gadgets.

7. ISP Equipment: Depending on your ISP and the kind of internet connection, your ISP may offer other equipment like a cable modem, DSL modem, or optical network termination (ONT) for fibre connections. Always check with your ISP to find out if they will provide you with any of the equipment when you subscribe to their Internet services.

8. Computer or Device: Finally, to actually use the Internet, you will require a computer, laptop, tablet, smartphone, or any other Internet-enabled device. Ensure that your device has the network connectivity options needed to connect to your network, namely an Ethernet port or a wireless adapter.

With such basic equipment, you can create an Internet connection and have full access to the numerous resources as well as services on the Internet.

11.4 Internet Protocols

Internet protocols refer to procedures that define how information is to be sent over the Internet and other networks. These protocols help in the proper and effective

transfer of data to enhance the communication between the devices. Here's an overview of some fundamental internet protocols:

 # 1. Internet Protocol (IP)

Purpose: Internet Protocol provides addresses to which packets of data can be referred so that they can be routed to appropriate networks.

- Versions:

IPv4 uses a 32-bit address scheme, which enables the system to have 4. 3 billion unique addresses.

- IPv6: Employed a 128-bit addressing system, which expanded the total addressable extent due to the burgeoning of the internet attachment devices.

- Functionality: IP is also responsible for the delivery of a packet from the source host to the destination host using the IP address. It does not provide any delivery, order or error checking.

 # 2. Transmission Control Protocol (TCP)

- Purpose: TCP offers an application a guaranteed, sequenced, and checked mode of transmitting data chunks.

- Functionality:

- Connection-oriented: This is created before data transfer starts.

- Flow control and congestion control: Controls the flow of data to get transmitted and prevent network traffic.

- Error detection and correction: Oversees that data is not corrupt and resends to fix packets that have been misplaced or destroyed.

 # 3. User Datagram Protocol (UDP)

Purpose: UDP, on the other hand, is much simpler. It is a connectionless protocol used in applications where speed is more important than anything else.

- Functionality:

Connectionless: This type does not require a prior connection, making it faster than the others, yet it cannot promise data delivery, sequence, or error detection.

Use Cases: This is ideal for uses such as video on demand, real-time games, and Voice over Internet Protocol telephony, where delivering information on time is more critical than delivering information with high precision.

 # 4. Hypertext Transfer Protocol (HTTP)

- Purpose: HTTP is applied to transfer web pages through the internet.

- Functionality:

- Request-Response Model: A consumer (typically a Web browser) presents a request to a supplier, and the supplier produces a Web asset in return.

- Versions:

- HTTP/1. 1: Well-known, allows connection reuse, and adds several features over HTTP/1. 0.

- HTTP/2: Enhances performance through multiplexing, header compression as well as server push.

- Secure Version:

HTTPS: HTTP Secure utilizes SSL/TLS to encrypt data, providing secure transmission of data over the Internet.

 # 5. File Transfer Protocol (FTP)

- Purpose: FTP is a method of transferring files from one computer to another on a network, specifically between a client and server.

- Functionality:

Client-Server Model: On the server, clients can upload, download, delete, and even rename files.

- Modes:

- Active Mode: The client creates a communication connection, and the server sends/receives data.

- Passive Mode: The server establishes a channel through which the client downloads information, which is important for passing through firewalls and NAT devices.

- Secure Version:

FTPS: FTP Secure introduces the use of SSL/TLS on transfers to ensure their security.

- SFTP: SFTP, which stands for Secure File Transfer Protocol, operates on SSH and is used for secure file transfer and manipulation.

 # 6. The most commonly used protocol is the Simple Mail Transfer Protocol (SMTP).

- Purpose: SMTP is used to transmit mail or, in other words, send emails.

- Functionality:

Client-Server Model: An email client sends messages to an Email server, which then delivers them to the recipient’s Email server.

Command-Response Model: This model uses commands and responses to send messages from one server to another and from the server to the clients.

 # 7. The two primary protocols that are used to connect to a mail server are Internet Message Access Protocol (IMAP) and Post Office Protocol (POP).

Purpose: IMAP and POP are protocols for viewing emails on a mail server.

- Functionality:

- IMAP:

Server-side management: The messages are saved on the server, so you can access them from any device.

Synchronisation: These updates and modifications are made so that all the devices seem to be coordinated.

- POP:

Client-side management: It is evident that emails are taken off the server and mostly expunged for offline use.

- Single-device access: Often applied whenever one is using a different device to access the emails.

Hence, these are some of the main Internet protocols that are vital in comprehending how data is sent, received, and controlled on the Internet. Each of them serves a purpose, and every element creates the whole picture that is essential for Internet communication. Through such protocols, users and developers can enhance the interaction between applications and services to achieve the best exchange of data.

- **Knowledge Check 2**

  Select True/False

  1. The very first predecessor of what is commonly referred to as the Internet, namely ARPANET. (T)
  2. The TCP/IP (Transmission Control Protocol/Internet Protocol) suite was developed by only one computer scientist, namely Vinton Cerf. (F)
  3. A modem is a device that can modulate and demodulate digital signals, the full form of the word being derived from ‘modulator and demodulator’. (T)
  4. A Network Interface Card, also referred to as a LAN adapter or an Ethernet adapter, is basically a piece of hardware that enables a computer to connect to a network. (T)

- **Outcome-Based Activity 2**

  Try to make out a list of differences between a Modem and a Router.

11.5 Summary

- The Internet is a computer system that connects computers all over the world and makes them work in a standardised way by exchanging data and information.
- The Internet is composed of millions of private and public networks, academic and business networks, and government networks connected through different technologies, such as wired and wireless connections, routers, switches, and servers.
- The Internet of Things is defined as the connection of devices such as sensors and software together with connectivity in order for them to share information.
- The Internet is an essential component of contemporary society and is now included in the list of the most significant human necessities. It is relevant across all spheres of human life and influences people, companies, states, and the global community.
- The Internet is the outgrowth of ARPANET, which was created by the United States Department of Defense's Advanced Research Projects Agency (ARPA, now DARPA) in the late 1960s.
- Computer scientists Vinton Cerf and Robert Kahn invented the TCP/IP (Transmission Control Protocol/Internet Protocol) suite, which later defined the structure of the contemporary Internet.
- The first web was developed by Tim Berners-Lee, a British computer scientist working at CERN in Switzerland.
- Web browsers and HTML (Hypertext Markup Language) emerged, enabling users to access information and navigate the Internet, enhancing its use and adoption worldwide.
- This Web has evolved from Web 1.0, which started in the early 2000s, to Web 2. 0 technologies that include social media sites, the use of content created by the users and interactive web technologies.
- A network interface card, also frequently referred to as a NIC, is a piece of hardware that connects a computer to a network, whether it is a local network or the Internet.

11.6 Keywords

- **Network interface card:** A NIC, network adapter, Ethernet adapter, or card is a hardware device that connects the computer to a network, be it a local area or the Internet.
- **Modem:** A modem (short for modulator-demodulator) is a device that converts digital signals into analogue signals for transmission and vice versa to allow the connection of the computer or network to the Internet Service Provider (ISP).
- **Internet:** The Internet is one of the most commonly used global systems, implemented with computers and other devices connected through the use of standard communication protocols for the transmission of data and information.

11.7 Self-Assessment Questions

1. What is the Importance of the Internet?
2. Describe features of the internet.
3. Explain the History of the Internet.
4. What are the Necessary Equipment for Internet Connectivity?
5. Explain the Network Interface Card (NIC).

11.8 References / Reference Reading

- Fundamental of Computers by Rajaraman.
- Computes Today by B. Sandra.

Unit 12: Using the Internet

Learning Outcomes:

- Students will be able to define the World Wide Web.
- Students will be able to explain the functions of the WWW.
- Students will be able to describe e-mail procedures.
- Students will be able to demonstrate the use of file transfer protocols.
- Students will be able to apply internet safety and best practices in daily activities.

Structure:

12.1 World Wide Web (WWW)

12.1.1 Meaning and Functions

- Knowledge Check 1
- Outcome-Based Activity 1

12.2 E-mail Procedures

12.3 File Transfer Protocols

12.4 Internet Safety and Best Practices

- Knowledge Check 2
- Outcome-Based Activity 2

12.5 Summary

12.6 Keywords

12.7 Self-Assessment Questions

12.8 References / Reference Reading

12.1 World Wide Web (WWW)

The WWW is an information system of linked documents and resources identified with Hypertext markups language that is located on the Internet. It was developed by Sir Tim Berners-Lee in 1989 and has later transformed methods through which people obtain and disseminate information. The WWW makes use of the TCP/IP protocol, particularly the HTTP protocol, to convey information and enables movement from one web page to another through hyperlinks. As an important element of the Internet, it allows the distribution of a wide variety of information, such as websites, documents, multimedia content and services.

Common Terms in the Internet World: WWW

1. Internet: The Internet is a web of computers or networks where computers worldwide can interconnect, share information, and communicate.

2. Website: A website is a group of interrelated web pages that can be accessed through a web server and displayed using a web browser. It commonly contains text, images, audio/video clips, and clickable links.

3. URL: URL stands for Uniform Resource Locator, and it is the address that is used to locate a certain resource on the World Wide Web. The protocol (such as HTTP): In this kind of address, the protocol (http:// or https://), the domain name, and the path to the particular resource are all incorporated.

4. Browser: A browser is an application designed to allow you to open and navigate the Internet. Some of the widely used online browsers include Chrome, Firefox, Safari, and Internet Explorer.

5. WWW: WWW is an information system comprised of hypertext documents and other resources located on the Internet. It was invented by Sir Tim Berners-Lee in 1989 and has come to transform the manner in which people obtain and distribute information. The WWW incorporates the TCP/IP using the HTTP protocol for communication and enables the user to move between web pages through hyperlinks. It is one of the Internet's main components and helps deliver a wide spectrum of Web content, documents, multimedia, and online services.

6. Search Engine: A search engine is an application that enables the user to search the World Wide Web for content based on keywords or queries. Some of the most widely used search engines are Google, Bing, and Yahoo.

7. Social Media: Social media and websites enable the production, sharing, and interaction of content and also allow users to communicate with other users. Some of the social media sites include Facebook, Twitter, Instagram, and LinkedIn.

8. Email: Email, abbreviated from electronic mail, is a form of communication that enables the transfer of messages through electronic means between two or more people. It allows sending and receiving electronic messages, data, and other enclosures.

9. Download: The act of receiving information or a file from a distant server to a piece of hardware like a computer or a mobile phone is referred to as downloading. People use it to download Software, documents, photos, movies, and any other forms of data commonly found on the internet.

10. Upload: Uploading is the action which involves sending information or a file from a local device to a distant server or over the internet. It is frequently employed for file sharing, document, photo, and movie sharing over the Internet with other people.

12.1.1 Meaning and Functions

The letters “www” in a URL stand for World Wide Web; this is a standard prefix used in addressing the web page or website on the Internet. Here's the meaning and functions of "www": Here's the meaning and functions of "www":

Meaning:

World Wide Web (WWW): The abbreviation of www stands for World Wide Web, which is an international network of web documents and resources located and accessible through the Internet. It was developed in 1989 by British Computer Scientist Tim Berners-Lee as a means through which information and resources could be shared over the various Computer Networks.

Functions:

1. Identifying Websites: The “www” prefix is used when referring to a web page or any website on the World Wide Web. It is usually used before the domain name to indicate that the resource being requested is a web page on the World Wide Web.

2. Accessing Web Pages: Specifically, when users type the ‘www’ followed by the URL in the address bar of the web browser (e.g., www. example. com), the browser issues a request to the server where the website resides to fetch that particular web

page. The “www” prefix informs that the resource is situated on the WWW and should be opened with HTTP or HTTPS.

3. Web Hosting: Webmasters have adopted the use of what is in front of a website address to show that the site’s pages are located on web servers and can be accessed via the World Wide Web. Web hosting services may also assign each website a specific domain, and users can enter the domain name directly in their browser, preceded by www.

4. Subdomains: Besides the primary domain, more subdomains can be used with the “www” prefix for the further structure of the website and its sections (for instance, blog.example.com, shop.example.com). Subdomains enable website owners to develop parts of a website that may be different or dedicated areas of the website while giving users direct links to parts of the site they may require.

5. Branding and Marketing: Some website owners may decide to use or not use “www” as part of their URLs for marketing purposes. The “www” prefix has been used for webpages located on the World Wide Web, though many modern webpages do not use it either to simplify the actual URL or to provide a more visually appealing URL.

The “www” prefix in the web address is a standard label that is most often used for web pages and Websites that are present on the Web. They show that the resource being accessed is located on HTTP or web servers and can be accessed with HTTP or web browsers through the Internet. Actually, the “www” prefix is not mandatory in web addresses, although it is widespread; some site owners do not use it in their URLs for various reasons, such as branding or technology.

- **Knowledge Check 1**

  Fill in the blanks

  1. WWW was discovered in approximately the year _____.(1989)
  2. The abbreviation WWW was first found by _____. (Tim Berners-Lee)
  3. WWW stands for _____. (World Wide Web)
  4. URL stands for _____. (Uniform Resource Locator)

- **Outcome-Based Activity 1**

  Students are required to List the differences between WWW and URL.

12.2 E-mail Procedures

Email etiquette concerns cover the activities and processes of handling emails, both in the process of sending and receiving them. Here's an overview of the typical email procedures: Here's an overview of the typical email procedures:

1. Composing an Email:

Open Email Client: Open your mail application or webmail (e.g., Gmail, Outlook, Yahoo Mail).

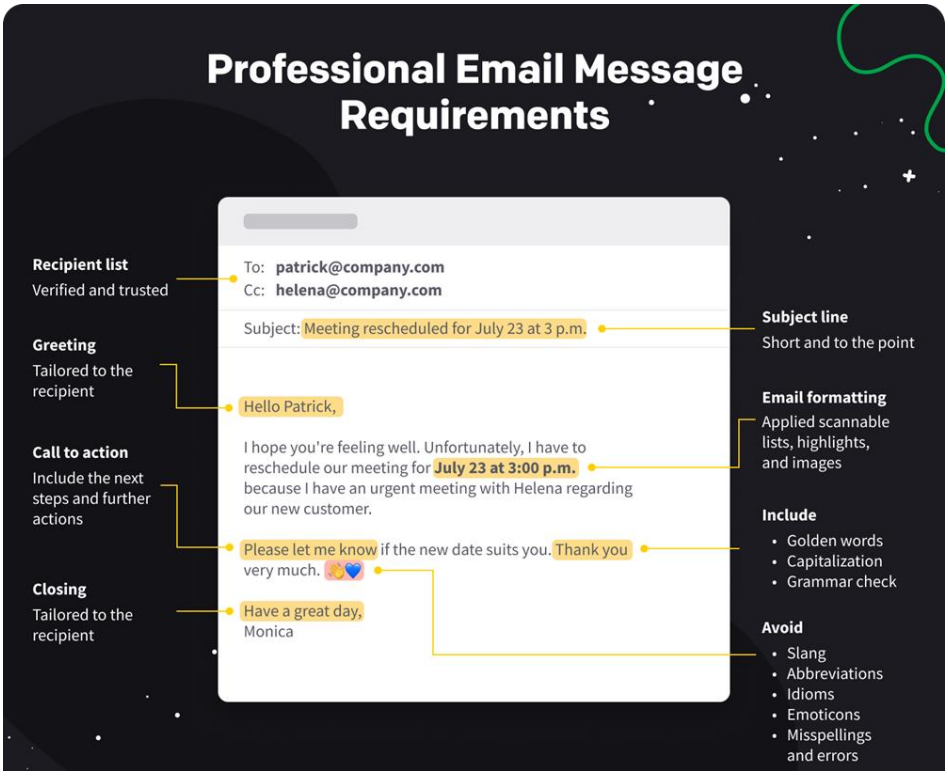
- Click Compose: To begin writing a new email message, please click on the “Compose” or “New Email” button.
- Enter Recipient(s): In the “To” field, enter the email address of the recipient or multiple recipients as the case may be. You can also include other people in the “Cc” or “Bcc” fields if necessary.
- Subject: Type in a brief message that gives an overview of the content of the email.

Compose Message: Your message should be written in the body of the email. The text can be formatted, attachments can be attached, and hyperlinks can also be incorporated as deemed appropriate.

Proofread: Check your emails before sending them to ensure they are error-free in spelling, grammar, and content.

2. Sending an Email:

- Click Send: When you are done writing your email message, go to the Send tab and click on the Send button to dispatch the message to your intended recipient(s).
- Confirmation: If you are in Outlook or any other email client, you may get a message that your email has been sent.



3. Receiving Email:

- Inbox: He drafted that the incoming email messages are received directly into the inbox. Y, open the email client now and then to check for new mail.

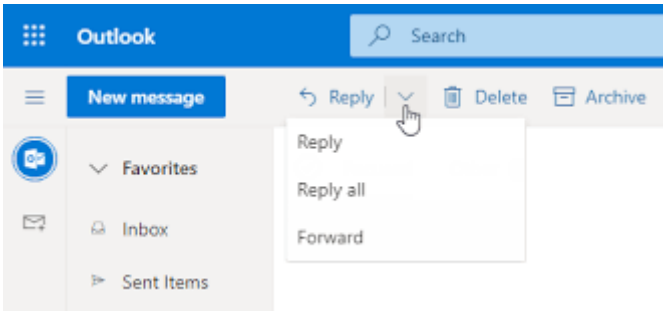
Notification: Some mail interfaces offer the ability to notify the user when a new message has been received, allowing one to work in real-time.

4. Replying to Email:

- Reply: If you find an email that cannot be left unread and you need to reply to it, click on the “Reply” option. The email address of the recipient will be inserted into the “To” section of the composition’s window.

- Reply All: If the e-mail was sent to a number of users and you wish to respond to everyone, you have to click on the ‘Reply to All’ button.

- Compose Reply: Type your answer in the email’s main text area and then click on the ‘Send’ button to send the reply.



5. Forwarding Email:

Forward: If you get an email and you want to forward it to other people, use the "Forward" option to forward the email to them.

- Add Recipients: To forward the email to other recipients of your choice, enter their email addresses in the "To" field.

- Compose Forward: When forwarding the email, you can include additional comments or context.

6. Managing Email:

Organise: File your emails in a way that makes them easy to find later, such as by subject, project, or urgency.

- Archive: To clear the inbox while maintaining a backup of the emails that may be useful in the future, organise the emails into folders.

Delete: To save space and keep the mailbox clean, it is necessary to remove unnecessary or non-important messages.

Mark as Unread: Flag emails to purposely leave them unread if you want to be reminded to read them or reply to them later.

7. Email Etiquette:

Professionalism: When writing an email, it is important to act and write formally, especially if it is business-related.

Clarity and Brevity: It is advisable to make your emails brief and unambiguous to convey the intended message to the recipient.

Use of CC and BCC: In the "Cc" line, you can include other people who should be informed of the message's contents. Use the "Bcc" line in cases where you want the recipients to receive the message discreetly.

8. Security and Privacy:

Avoid Phishing: To prevent phishing, refrain from exploring emails from unknown senders and do not open the links or download the attachments.

- Use Strong Passwords: Change your password to a harder-to-guess one, and do not use the same password on other accounts; pair it with a two-factor authentication for protection.

Encrypt Sensitive Information: When typing an email that contains important information or secret information, it is better to use encryption.

12.3 File Transfer Protocols

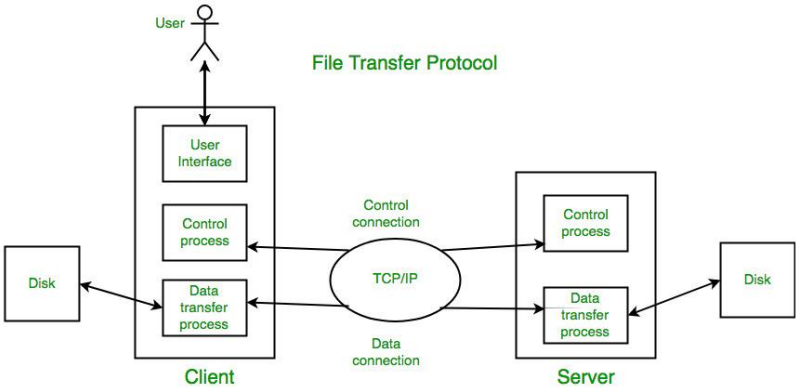
File transfer protocols are the protocols that are employed in the transfer of files from one device or system to another through a network. These protocols encompass the directions on the process of transmission of files and ways of doing it securely. Here are some common file transfer protocols:

1. FTP (File Transfer Protocol):

- Description: Vark and Smillie (2014) explain that FTP is one of the oldest and most popular file transfer protocols. FTP enables the user to copy files from one computer, the client, to another, the server, through a TCP/IP connection like the Internet.

Features: FTP is secure and supports user login, directory listing, file upload, file download, and file operations. It operates in two modes: The two modes that have been distinguished are the active mode and the passive mode.

- Security: FTP does not have any form of encryption and hence can easily be tapped and the data intercepted. FTP with SSL/TLS and SSH FTP provides secure variants to this security issue.



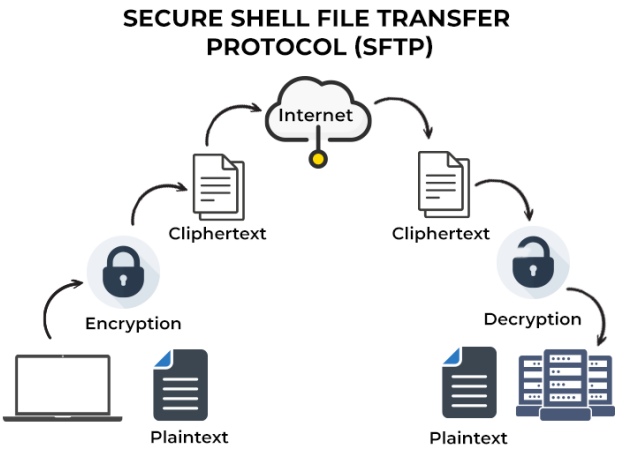
FTP

2. SFTP (SSH File Transfer Protocol): SFTP (SSH File Transfer Protocol):

Description: SFTP is a secure protocol for transferring files and handling remote files over a secure shell (SSH) link.

Features: SFTP enables users to authenticate, encrypt, and transfer files from one server to another, create directories, view them, and even modify file permissions. It works over port 22 by default.

- Security: SFTP covers the authentication process and, more importantly, the data transfer, making it safe to use in unsecured networks.

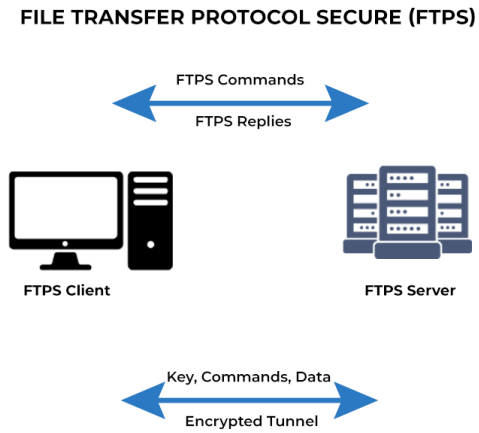


3. FTPS (FTP Secure):

- Description: FTPS is basically an FTP that has been enhanced with SSL/TLS, hence improving the security of the file transfer. It offers authentication, encryption, and data integrity.

- Features: FTPS applies the SSL/TLS protocols to establish a secure connection between the FTP client and FTP server. It supports both explicit SSL/TLS version known as FTPES and the implicit SSL/TLS known as FTPS.

- Security: FTPS employs SSL/TLS for encrypting the data transfer and avoiding leakage or interception of the transferred information.

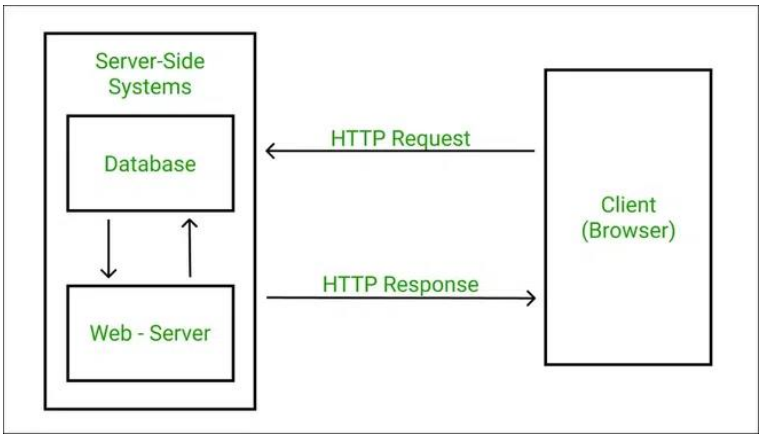


4. HTTP (Hypertext Transfer Protocol):

- Description: HTTP is mostly used for getting web pages and messaging but it can also be applied to transmitting files, mainly downloading files from web servers.

- Features: HTTP involves file downloading from web servers with the help of web browsers or a download manager. The basic version works on port no 80 by default.

- Security: What it lacks is the secure transfer of files that contain sensitive data or information; HTTP is not a secure protocol and cannot be used for transferring files that require security without using HTTPS – HTTP Secure.



12.4 Internet Safety and Best Practices

Internet safety is critical in today's digital age, where personal data and sensitive information are constantly at risk from cyber threats. Here are some essential tips and best practices to ensure a secure online experience:

Internet safety is paramount especially now that people rely so much on the internet where their personal information can easily be targeted by cyber crooks. Here are some essential tips and best practices to ensure a secure online experience:Here are some essential tips and best practices to ensure a secure online experience:

 # 1. Protect Personal Information

- Limit Sharing: Always be careful with the kind of information you reveal such as your full name, address, phone number and your financial status.
- Privacy Settings: Manage the profile privacy of the social networks and other online services to limit the access to your data.

 # 2. Use Strong Passwords

- Complexity: Come up with password that contain alphabetic characters both capital and small letters, numbers and special characters.
- Uniqueness: This means that there should be different passwords for different accounts to avoid a situation where one leak affects all the services.
- Password Managers: It is advisable to avoid using your regular passwords and instead use a password generator to create tough to crack passwords and stored securely.

 # 3. Enable Two-Factor Authentication (2FA)

- Additional Layer: Two-factor authentication increases security since you have to input a second form of identity besides the password, such as a code that is sent to your phone.
- Implementation: Make sure that two-factor authentication is applied where it is available for email, social profiles, and the financial profiles.

 # 4. The phishing scams that are likely to be encountered are -

- Recognize Phishing Attempts: Never open emails, messages, or websites that seek to know more about you or ones that encourage you to click on some links.
- Verify Sources: Verify the sender's e-mail address, search for any signs of spoofing, and, in case of the received sudden message with the request, ensure its authenticity.

 # 5. Secure Your Devices

- Update Regularly: Ensure all your operating system, software and applications are regularly updated as and when security patches and updates are released.
- Use Antivirus Software: Use antivirus software and update them, to minimize the chances of getting infected by malware, viruses, and other similar threats.
- Firewall: Allow the firewall to be activated on the device to prevent unauthorised access to the device as well as the flow of incoming and outgoing traffic.

- **Knowledge Check 2**

  Fill in the blanks

  1. _____ refer to the procedure or process by which email communication is conducted and the most effective practices for organising and processing email messages.(Email protocols)
  2. FTP Stands for _____. (File Transfer Protocol)
  4. FTPS stands for _____. (File Transfer Protocol Secure)
  5. HTTP stands for _____. (Hypertext Transfer Protocol)

- **Outcome-Based Activity 2**

  Discuss the difference between FTP & FTPS in your class.

12.5 Summary

- The World Wide Web (WWW) is an information system of interconnected hypertext documents and resources that are accessed over the Internet.

- WWW was created by Sir Tim Berners-Lee in 1989 and has since revolutionised the way people access and share information. The WWW uses the HTTP (Hypertext Transfer Protocol) protocol for communication and allows users to navigate between web pages by clicking on hyperlinks.
- A browser is a piece of software that allows you to view and navigate websites on the Internet. Chrome, Firefox, Safari, and Internet Explorer are all popular online browsers.
- The maximum quantity of data that may be transmitted via a network connection in a given time period is referred to as bandwidth. It determines the speed and capacity of internet connections and is commonly measured in bits per second (bps).
- Email procedures involve various steps and protocols for composing, sending, receiving, and managing email messages effectively and securely. By following these procedures and adhering to email etiquette guidelines, you can communicate efficiently and professionally via email while safeguarding your privacy and security.
- The "www" prefix in a website's URL serves as a standard identifier for web pages and websites on the World Wide Web. It indicates that the resource being accessed is hosted on web servers and can be accessed via the Internet using web browsers.
- File transfer protocols are protocols used to transfer files between devices or systems over a network. These protocols define the rules and procedures for transferring files efficiently and securely.
- FTP is one of the oldest and most widely used file transfer protocols. It allows users to transfer files between a client and a server over a TCP/IP-based network such as the Internet.
- SFTP is a secure file transfer protocol that provides encrypted file transfer and secure remote file management capabilities over a secure shell (SSH) connection.
- FTPS is an extension of FTP that adds support for SSL/TLS encryption for secure file transfer. It provides authentication, encryption, and data integrity features.

12.6 Keywords

- **Firewall:** A firewall is a type of security solution that works as a barrier between a computer or network and potential Internet threats. It monitors and filters network traffic to defend against unauthorised access and harmful activity.
- **Bandwidth:** The maximum quantity of data that may be transmitted via a network connection in a given time period is referred to as bandwidth. It determines the speed and capacity of internet connections and is commonly measured in bits per second (bps).
- **Encryption:** Encryption is the technique of encoding data or information so that unauthorised parties cannot read it. It protects the secrecy and security of sensitive information sent over the Internet by converting it into a format that can only be interpreted with the correct encryption key.

12.7 Self-Assessment Questions

1. Explain the term WWW.
2. What are different File transfer protocols?
3. Describe Bandwidth.
4. Discuss Email procedures in detail.
5. Which browser is good in your opinion and why ?

12.8 References / Reference Reading

- Fundamental of Computers by Rajaraman.
- Computes Today by B. Sandra.

UNIT 13: Database Management Systems (DBMS)

Learning Outcomes:

- Students will be able to define key concepts of database management systems.
- Students will be able to explain different types of databases.
- Students will be able to compare various database models.
- Students will be able to apply SQL basics in database manipulation.

Structure:

13.1 Introduction to DBMS

13.2 Types of Databases

- Knowledge Check 1
- Outcome-Based Activity 1

13.3 Database Models

13.4 SQL Basics and Applications

13.5 Normalisation and Data Integrity

- Knowledge Check 2
- Outcome-Based Activity 2

13.6 Summary

13.7 Keywords

13.8 Self-Assessment Questions

13.9 References / Reference Reading

13.1 Introduction to DBMS

A DBMS is a software system that provides the facilities for the creation of database, as well as modification and retrieval of data from the created database. It offers a structure of organising and accessing data in a competitive and efficient way that will enhance the data security and integrity. Here's an overview of the key concepts and components of a DBMS

1. What is a DBMS?

- Definition: A DBMS is an application that communicates with end-users, other applications, and the actual data storage to store and process data. It enables the storage, access and manipulation of information in a well formatted manner.
- Examples: Some of the widely used DBMS software are MySQL, PostgreSQL, Oracle, Microsoft SQL server and SQLite.

2. Components of a DBMS

- Database Engine: The primary service which is used for getting the data and using it according to the requirements.
- Database Schema: Describes how the data is organised logically such as tables, fields, relationships, and constraints.
- Query Processor: Translates the query written in SQL (Structured Query Language) and performs it.
- Transaction Management: Responsible for guaranteeing that all database transactions are performed and are compliant with the ACID properties they include: Atomicity, Consistency, Isolation, Durability.
- Storage Management: Responsible for the storage of data on the disk space.
- Database Administration Tools: Helps in comprehending the state of an unorganised database and assists with upkeep, tracking, and administration.

3. Functions of a DBMS

- Data Storage and Retrieval: Able to store huge amount of data and retrieve the data upon request within a short time.
- Data Manipulation: It supports activities such as insertion, update, deletion and querying activities on the data.
- Data Integrity: Maintains data validity and integrity through constraints as well as those validation rules.
- Data Security: Secures the data and takes precautions to prevent its leakage or misuse by other people.

- Backup and Recovery: They enable backup and recovery of data to minimize on data loss.

- Multi-User Access: Enables two or more user to use the database at a given time without conflicting with the other while at the same time ensuring the integrity of the data stored in the database.

4. Advantages of Using a DBMS

- Data Redundancy Reduction: Reduces data redundancy since data collected is integrated in a single data base.

- Data Sharing: Allows information to be accessed and transmitted by more than one user and/or application.

- Data Integrity and Accuracy: It guarantees the data and its uniformity through integrity constraints.

- Data Security: Safeguards data through the use of user name and password or any other security measures that may be adopted.

- Scalability and Flexibility: Flexible enough in accommodating increased data and also changes in data demand or need.

- Efficient Data Access: Enhances the probability that data will be accessed as and when it is required by creating indexes and efficient query processing.

13.2 Types of Databases

Databases themselves can be of different types, and they all are created to work with certain types of data and applications. Knowledge of the various categories of databases aids in choosing the most appropriate one for the intended use. Here's an overview of the major types of databases:

1. Relational Databases

- Definition: The data in the relational databases is stored in the form of tables known as relations that are made up of rows and columns. They employ what is referred to as Structured Query Language (SQL) for querying and manipulating data.
- Examples: MySQL, PostgreSQL, Oracle, Microsoft SQL Server and so on.
- Use Cases: Applicable for the activities which involve comprehensive queries and transactions, like financial processing, ERP and CRM systems.

2. NoSQL Databases

- Definition: Not Only SQL or NoSQL are a type of databases that are capable of storing unstructured, semi-structured data with a free-form concept.
- Types:
- Document Databases: Store data in JSON, BSON or XML documents such as MongoDB or CouchDB.
- Key-Value Stores: Save data as a key-value pair, for example, Redis, Amazon DynamoDB.
- Column-Family Stores: Suggest storing data in the columns rather than rows (e. g. , Apache Cassandra, HBase).
- Graph Databases: Data should be stored in a graph model suitable for relations and connections (Neo4j, ArangoDB etc.).
- Use Cases: Most suitable for applications, which need to develop and grow, analyze data in real-time, and work with lots of unstructured data, including social networks, IoT, and big data.

3. Object-Oriented Databases

- Definition: Object-oriented databases are the databases in which data is stored as objects to mirror the concept of objects used in object-oriented programming.
- Examples: ObjectDB, db4o, Versant.
- Use Cases: Applied in task that involve data modeling for instances, computer-aided design (CAD), multimedia, and scientific uses.

- **Knowledge Check 1**

  Fill in the Blanks

  1. Understanding _____ is fundamental for managing large sets of structured data. (database management)
  2. Types of databases include relational, _____, and object-oriented databases. (NoSQL)
  3. Database _____ serve as blueprints for organising and structuring data in DBMS. (schemas)
  4. SQL, or Structured Query Language, is used for _____ and managing databases. (querying)

- **Outcome-Based Activity 1**

  In groups, research and prepare presentations on different types of databases (relational, NoSQL, hierarchical, object-oriented).

13.3 Database Models

Database models define the logical structure and organisation of data in a database management system (DBMS). They provide a framework for how data is stored, organised, and manipulated. Here are the main types of database models:

1. Hierarchical Model

- Structure: Organizes data in a tree-like structure with a single root and multiple levels of child records. Each child has only one parent.
- Advantages:
  - Simple to design and understand.
  - Efficient for hierarchical data relationships, like organisational charts.
- Disadvantages:
  - Limited flexibility due to rigid structure.
  - Difficult to reorganize and maintain.
- Example Use Case: File systems and organisational structures.

2. Network Model

- Structure: Similar to the hierarchical model but allows multiple parent-child relationships, forming a graph-like structure.
- Advantages:
  - More flexible than the hierarchical model.
  - Efficient for representing complex relationships.
- Disadvantages:
  - More complex to design and manage.
  - Requires navigational queries.
- Example Use Case: Telecommunications and transport networks.

3. Relational Model

- Structure: Organizes data into tables (relations) with rows and columns. Tables are linked using foreign keys.
- Advantages:
  - High flexibility and simplicity.
  - Powerful query capabilities using SQL.

- Strong theoretical foundation ensuring data integrity and consistency.

- Disadvantages:

- Performance can degrade with very large datasets or complex queries.

- Requires careful design to avoid redundancy and ensure normalisation.

- Example Use Case: Enterprise applications, financial systems, and e-commerce platforms.

4. Entity-Relationship Model (ER Model)

Structure: This uses entities (objects) and relationships to represent data. It is often used in the design phase of a database to create a conceptual blueprint.

- Advantages:

- Intuitive and easy to understand.

- Provides a clear visualisation of data relationships.

- Disadvantages:

- Not directly implementable in a DBMS.

- Requires translation to a relational model for implementation.

- Example Use Case: Database design and planning.

13.4 SQL Basics and Applications

1. SQL Definaton

- Definition: SQL is a standardised language used to communicate with relational databases.

- Functions: SQL is used to create and modify database structures, insert, update, and delete data, and retrieve data from the database.

2. SQL Syntax

- SQL statements are composed of clauses, expressions, and predicates written in a declarative form.

- SQL keywords are case-insensitive, but it's common practice to write them in uppercase.

3. Data Definition Language (DDL)

DDL commands are used to define and modify the structure of the database and database objects.

CREATE: This operation creates a new table, database, index, or view.

```
SQL
CREATE TABLE Employees (
```

```
    EmployeeID INT PRIMARY KEY,
    FirstName VARCHAR(50),
    LastName VARCHAR(50),
    BirthDate DATE
);
```

- **ALTER:** Alters an existing database object, including a table.

```
SQL
ALTER TABLE Employees
ADD Email VARCHAR(100);
```

- **DROP:** Removes an object from a database, provided that it exists in the database.

```
SQL
DROP TABLE Employees;
```

4. Data Manipulation Language (DML)

DML commands are those commands that are used to modify the data stored in databases.

- **INSERT:** used to insert new records into the table.

```
SQL
INSERT INTO Employees (EmployeeID, FirstName, LastName, BirthDate)
VALUES (1, 'John', 'Doe', '1980-01-01');
```

- **SELECT:** Used to search for data in one or more tables.

```
SQL
SELECT FirstName, LastName
FROM Employees
WHERE BirthDate > '1980-01-01';
```

- **UPDATE:** Update information within a table, that is, change certain record values to their new ones.

```
SQL
UPDATE Employees
SET Email = 'john.doe@example.com'
```

WHERE EmployeeID = 1;

- **DELETE:** Avoids a table by deleting rows from it.

SQL

DELETE FROM Employees

WHERE EmployeeID = 1;

5. Data Control Language (DCL)

Security control commands are issued through DCL to regulate data access in the database.

- **GRANT**: Allows a user to do something specific.

SQL

GRANT SELECT, INSERT ON Employees TO ‘user_name’;

- **REVOKE**: Revoke the permission from a user.

SQL

REVOKE INSERT ON Emps FROM user_name; SQL

GRANT SELECT, INSERT ON Employees TO user_name

Applications

SQL is commonly used in numerous applications in different fields for the administration and manipulation of Relational Database Management Systems. Here are some common applications of SQL:

1. Web Development:

Database Integration: SQL stores and accesses data in databases and runs many dynamic web applications. Django, Ruby on Rails, Laravel, and many other web frameworks use SQL for database operations.

- Content Management Systems (CMS): SQL databases are used to store website content that lets users build, modify, and manage websites and articles.

2. Business Intelligence (BI):

Data Analysis: SQL can be used to pull data from big data sources, perform analysis, and make business decisions based on the results of the analysis.

Data Warehousing: One possible application is data warehouse management, where SQL is used to build the structures and manage the collected data and its sources for analysis and reporting.

3. E-commerce:

Inventory Management: SQL databases are used to keep records of products, control stock levels, and process orders and transactions in e-commerce systems.

Customer Relationship Management (CRM): SQL databases are useful for storing customer data, purchase data, and interactions, especially in marketing and customer support.

4. Finance and Banking:

- Accounting: SQL databases handle financial transactions, keep records of expenditures, and prepare the accountants' financial statements.

Online Banking: SQL databases manage user accounts, transactions, and balance inquiries in online banking systems.

5. Healthcare:

Electronic Health Records (EHR): In health care systems, SQL databases help store patients' details, their records, and treatment details.

Medical Research: SQL queries use medical data to analyse trends, patterns, or correlations required in medical research and clinical studies.

13.5 Normalisation and Data Integrity

Normalisation

Normalisation is the process of restructuring the relations in a database to reduce redundancy and enhance data consistency. The primary objectives of normalisation include logical storage of data, removal of data redundancy, and elimination of data characteristics such as insertion, update, and deletion anomalies.

Normalisation, in most cases, involves breaking down a large table into many related tables and defining the relationship between them. This process assists in achieving the right balance and arrangement of the database for efficient data integrity. The stages of normalisation, known as normal forms, include:

1. First Normal Form (1NF): This ensures that the table has a primary key and that all the columns have atomic values. The schema does not have repeating groups or arrays.

2. Second Normal Form (2NF): This is attained once the table is in 1NF and every column depends on the primary key in its fullest form. This eliminates partial dependencies.

3. Third Normal Form (3NF): This is accomplished when a table is in 2NF, and all the columns depend only on the primary key and no other columns.
4. Boyce-Codd Normal Form (BCNF): A stronger normal form than 3NF in which every dependent is a candidate key.
These forms assist in developing a database that is free of duplication and reliance on other components, ensuring that each data component is unique.

Data Integrity

Data integrity is the ability of data held in a database to be accurate, complete, timely and usable whenever required. It ensures that the data is not changed in any way during operations like insertion, update, and deletion. There are several types of data integrity:
1. Entity Integrity: Checks that each table has a primary key and that the columns of the kind primary key contain unique, non-null values only. This ensures that every record has a way of being distinguished from the other.
2. Referential Integrity: Checks that the foreign keys properly and accurately match the primary keys of the related table. This ensures proper integrity between records in different tables and that no records are left without a link to other records.
3. Domain Integrity: This maintains that all values put in a column must conform to a certain set of allowable values or value ranges. This ranges from data types to the format of data to be inputted or retrieved from the database and even default data.
4. User-Defined Integrity: This applies business rules that must be followed and constraints that are beyond those of entity, referential, and domain integrity. These rules are application-specific and used for the particular application and type of use.
Data quality is always important for accurate data analysis, reporting, and decision-making processes: DB constraints, triggers, and application-level validations at the logical data modelling level support it.

- **Knowledge Check 2**

  Fill in the blanks

  1. The principles of database design help to make the _____ convenient to store and access data. (efficient)
  2. In DBMS, data is organised into tables with rows and _____. (columns)

3. Depending on the requirements, different forms of databases are available, like _____ databases for multimedia data. (multimedia)
4. It is important to know database models such as the hierarchical model and the network model for _____. (structures and relationships)

- **Outcome-Based Activity 2**

  Divide into groups of 2 and proceed through the SQL query practice on a sample database schema. Generate statements for selecting records, creating new records, modifying records and deleting undesirable records.

13.6 Summary

- The concepts and significance of DBMS in the aspect of efficient storage and organisation of information.
- Understood the concept of the database and various forms of it, such as relational, NoSQL, hierarchical, and other forms, and the circumstances that they can be applied.
- Database Models covered hierarchical database, network database, relational database, and object-oriented database.
- SQL Basics acquired the knowledge of using the SQL language to work with databases, manipulate data and manage the objects of a database.
- Database Design Principles understood concepts of database design for creating sustainable, high-performing databases.
- Data Integrity understood methods for data accuracy and coherence in the database management systems.
- Indexing and Optimisation understood methods for indexing and optimisation of the databases and queries for faster access to the queries.
- Transactions and Concurrency about the die transaction management and concurrent control in DBMS.
- Security and Authorisation the procedures of security and authorisation to prevent unauthorised access to the databases and to maintain confidentiality.

13.7 Keywords

- **DBMS:** DBMS is a system that provides interfaces to the end user, applications, and the database to retrieve/store/ process information.

- **NoSQL Databases:** NoSQL (Not Only Structured Query Language) is a type of database used to store data that is unstructured or semi-structured and has a nonfixed structure.
- **SQL:** SQL is an international standard used to interface with Relational Database Management Systems.

13.8 Self-Assessment Questions

1. What is the function of a database management system (DBMS) in the organisation and proper management of data? Also, how does it differ from traditional file-based systems?
2. What are the differences between Relational and NoSQL databases and their use cases?
3. Take a moment to describe other forms of database models with examples such as the hierarchical, network and relational types. When, where, and why might you choose one model over the other?
5. Explain why SQL is relevant in the communication process with databases. Would you mind giving an example of how one can practically apply SQL?

13.9 References / Reference Reading

- Fundamental of Computers by Rajaraman.
- Computes Today by B. Sandra.

Unit 14: Cybersecurity and Data Protection

Learning Outcomes:

- Students will be able to define fundamental cybersecurity concepts.
- Students will be able to explain common cyber threats and attacks.
- Students will be able to identify data protection techniques.
- Students will be able to apply best practices in cybersecurity.

Structure:

14.1 Introduction to Cybersecurity

14.2 Common Cyber Threats and Attacks

- Knowledge Check 1
- Outcome-Based Activity 1

14.3 Data Protection Techniques

14.4 Best Practices in Cybersecurity

14.5 Cyber Laws and Regulations

- Knowledge Check 2
- Outcome-Based Activity 2

14.6 Summary

14.7 Keywords

14.8 Self-Assessment Questions

14.9 References / Reference Reading

14.1 Introduction to Cybersecurity

Cybersecurity is the process of safeguarding computers, servers, mobile devices, electronic systems, networks, and data from malicious attacks, digital invasions, cyber threats, and other cyber dangers. It covers a very broad area involving all the technologies, methods, and activities that are used to protect data and information from unauthorised access. Here's an overview of key concepts and components of cybersecurity:

 # 1. Cyber Threats

Definition: Cyber threats, on the other hand, refer to possible risks and risk factors that can threaten the security of online resources.

- Types of Threats:

- Malware: Computer programs with malicious intent to cause harm to or infiltrate the computer systems (for instance, viruses, ransomware, spyware).

- Phishing: Phishing, vishing, smishing, etc. Cyber attacks involve deception, such as impersonation, to get the targeted victim to divulge sensitive information like passwords or financial information.

SQL - Distributed Denial of Service (DDoS): A technique used to inundate a network or a system with traffic, making it almost impossible to use for legitimate purposes.

- Insider Threats: Threats resulting from malicious insiders, users who exploit their authorised permissions to compromise an organisation’s assets or those with ill intentions towards the company.

Advanced Persistent Threats (APTs) are advanced and strategic attacks normally conducted by professional attackers with the intention of gaining access to high-value targets.

 # 2. Cybersecurity Principles

Confidentiality: ensuring that only authorised personnel or organisations can access specific information.

- Integrity: Protecting the integrity of a set of data and a system by inhibiting improper change by an unauthorised individual.

4. Availability: Ensure that the systems, services, and data are always available and up and running as and when required.

- Authentication: Authentication as an aspect of access control is the process of confirming the identity of the users, devices, or entities seeking to gain access to the resources.

- Authorisation: Assigning the right level of permissions and access rights to the users that are authenticated and should perform specific tasks.
- Non-Repudiation: Eliminating the possibility of people denying certain actions or certain transactions took place.

14.2 Common Cyber Threats and Attacks

Basic Forms of Cyber Threats and Assaults

These threats are real and present a very grave danger to anyone who uses computers and the internet or is in any way connected to the digital world. These threats take advantage of the weak points in the computers, networks, and people to steal, damage, or gain control of information and negatively affect the business financially or otherwise. Here are some of the most prevalent cyber threats:

1. Malware

Definition: Malware is a shortened term for malicious software, which is defined as a program designed to cause harm and exploit computers, networks, and devices.

- Types:
- Viruses: Those that copy themselves and spread to other files or other systems.
- Trojans: Applications that look otherwise are actually designed to perform some nasty activities when run.

Ransomware is a type of software that hides or secures files or the operating system and then requests money to unlock the files or unfreeze the system.

2. Phishing

Definition: Phishing is a form of social engineering in which people are sent messages or directed to websites that mimic the look and feel of legitimate organisations. The websites then entice people to reveal personal information such as passwords, credit card numbers, or other personal details.

- Types:

Email Phishing: Phishing emails that require the receiver to send cash, credit card numbers, passwords, or other personal information to fake businesses or persons.

Pharming is the use of phishing websites or Domain Name Systems (DNS) to redirect users to fake websites where they can enter their login details or credit card details.

- Impact: phishing can result in identity theft, financial loss, unauthorised access to other accounts, and damage to reputation.

3. Other attacks include Distributed Denial of Service (DDoS).

- Definition: They overwhelm a target system, network, or service with a large amount of traffic or requests, making it unavailable to genuine users.

- Types:

Volumetric Attacks overload the target with a huge traffic load, putting pressure on the network resources.

Protocol Attacks use vulnerabilities in protocols like TCP/IP to interfere with communication between devices.

- Application Layer Attacks: Floods specific applications or services with malicious requests/traffic to overwhelm them.

Impact: DDoS attacks can interrupt the normal use of various online services, leading to unavailability and slowness and, in the long run, losses for firms.

Cyber Attacks

Cyber crimes refer to unscrupulous acts aimed at creating weaknesses in computers, computer networks, and the conduct of people. These attacks are executed to obtain confidential information to complicate the company's functioning or to seek economic or image losses. Here are some of the most prevalent types of cyber attacks:

1. Malware Attacks

Definition: Malware attacks are instances where an attacker uses a virus or other malicious code to disrupt the functionality of computers, networks, or other devices.

- Types:

- Viruses: A computer virus that must be run by the user and copies itself into other files or systems.

- Worms: A type of virus that can initiate itself on networks without the user's approval, and it infects computers by targeting software flaws.

Trojans are viruses that are embedded in other programs and capable of running on their own with the intention of causing harm.

Ransomware is a virus that locks the operating system or encrypts files and then asks for an amount to be paid to unlock or decrypt the item.

- Impact: The risks of malware attacks involve loss of data, time, money as well as reputation.

2. Phishing Attacks

Definition: Phishing scams employ fake emails, messages, or websites to obtain personal information from a user, such as a password, credit card number, or identity number.

- Types:

Email Phishing: Phishing is the act of creating fake emails in the name of an organisation or a competent personality in an effort to deceive the recipients.

Spear Phishing is a phishing attack that is targeted at certain persons or companies and launched using information that can convince the targeted persons.

Pharming: Fraud sites or fake DNS attacks lead users to fake sites where they can enter their credentials or monetary details.

Impact: Losses arising from phishing include identity theft, financial losses, unauthorised access to accounts, and damaging corporate image.

3. DISTRIBUTED DENIAL OF SERVICE (DDoS) ATTACKS

Definition: During a DDoS attack, the attacker sends a large number of requests or traffic to the target system, network, or service, preventing valid users from getting through.

- Types:

- Volumetric Attacks: Floods targets with high volumes of traffic that put a lot of pressure on the resources of the program.

Protocol Attacks take advantage of vulnerabilities in the TCP/IP protocol to interfere with the transmission of information between connected systems.

Application Layer Attacks aim at certain applications or services, flooding them with requests and creating a denial of service.

Impact: These attacks can interrupt normal operations of online services, bring websites and/or services down, slow down performance, and cost money.

- **Knowledge Check 1**

  Fill in the Blanks

  1. Speaking about cybersecurity basics, it is necessary to mention that it deals with the protection of _____ and other pertinent data. (networks)
  2. Other threats and cyber attacks range from _____ and phishing. (malware)

3. Methods of data protection include encryption and _____ to protect the data from tampering.(integrity checks)
4. Some of the strategies that are considered to be effective in cybersecurity are _____ and training of employees. (software update)

- **Outcome-Based Activity 1**

  List down frequent types of cyber threats and attacks like viruses, phishing, and ransomware. Explain how they work, what effects they have, and how they can be prevented.

14.3 Data Protection Techniques

1. Encryption

Definition: Encryption, on the other hand, is the conversion of plain text data into cypher text using cryptographic algorithms and keys to make the data indecipherable by those who are not supposed to access it.

- Types:

- Symmetric Encryption: Works with the same key and is good for encrypting data that will be stored in the database or other storage means.

Asymmetric Encryption Employs both a public and a private key for encrypting and decrypting messages, which is useful in the secure communication and exchange of keys.

Applications: Data protection in the form of files, databases, communication, and media storage and preventing unauthorised access.

2. Access Controls

Definition: Controls limit and monitor users' access rights to data and resources in accordance with their identities, functions, and authorities.

- Techniques:

- Authentication: Confirming the legitimacy of users using credentials such as passwords, fingerprints, or token credentials.

- Authorisation: Allowing specific access to the application for credentialed users depending on their roles in the organisation.

Multi-Factor Authentication (MFA): This method forces users to provide multiple individual checkpoints in order to gain access to certain data or applications.

3. Data Backup and Recovery

Definition: Data backup and recovery refer to the processes of creating duplicates of vital data and storing them for quick accessibility and protection from loss or damage.

- Techniques:

- Regular Backups: Automated or periodic copies of data to secondary storage media or cloud storage.

Incremental and Differential Backups: Save updated data or new data only to the backup since a backup can take time and space, especially if it was done a long time ago.

- Offsite and Cloud Backup: Having multiple copies at sites in different geographical regions or on the cloud for business recovery or continuity.

- Applications: Preserving against data loss resulting from hardware failure, floods, viruses or hackers, or deletion by an employee.

14. 4 Best Practices of CyberSecurity

Cyber security guidelines are very crucial in safeguarding systems, networks, and data against cyber threats and attacks. These practices incorporate a variety of measures, including preventive measures, security controls, and tactics that are employed to minimise risks and develop a good security system. Here are some key best practices in cybersecurity: Here are some key best practices in cybersecurity:

1. User Education and Awareness

Training Programs: It is also important to conduct periodic training sessions and create awareness among employees regarding common threats, phishing attacks, and security measures.

Policy Enforcement: Security policies, guidelines, and acceptable use of IT systems should be set and complied with to reduce security incidences.

2. Patch Management

- Regular Updates: The patch management best practice should be followed to ensure that all operating systems, software, and firmware are updated with the latest patches and fixes to known vulnerabilities.

- Vulnerability Scanning: Perform vulnerability assessments and scans to know which vulnerabilities are suitable for addressing and fixing.

3. Access Controls

Least Privilege: Follow the principle of least privilege, which limits user privileges to what is needed to complete the user's task by barring them from having excessive permissions that may lead to vulnerabilities if compromised.

Strong Authentication: Use MFA methods to ensure that the user and the device are real and not fake by going beyond the use of passwords.

4. Network Security

Firewalls: Secure the system by installing firewalls and intrusion detection/prevention systems (IDS/IPS) to filter traffic and prevent unauthorised traffic access in the networks.

Segmentation: Segment networks into different zones or subnets according to the level of security needed to prevent breaches and minimise attacker movement.

5. Data Encryption

Data Protection: Proper data encryption methods can be employed to protect data both at rest and in motion so that even with a breach, the information will remain safe.

Secure Communication: Implement the use of TLS/SSL to ensure the transfer of data over the network, especially when dealing with essential information such as money transactions or personal information.

14.5 Cyber Laws and Regulations

Cyber laws and regulations are legal instruments adopted by governments and other international organisations to control and protect rights in cyberspace, privacy, data protection, electronic commerce, etc. Such laws are intended to safeguard people, groups, and society against cyber dangers, guarantee the reliability of online services and products and set expectations for the proper use and management of cyberspace. Here are some key cyber laws and regulations:

1. General Data Protection Regulation (GDPR)

- Jurisdiction: European Union for short, EU

- Purpose: GDPR provides regulations on how the personal data of any person within the EU and EEA should be protected.

- Key Provisions: - Key Provisions: - Key Provisions:

- The data subject's rights, which include the rights to obtain, correct, erase, and port personal data.

- Measures that the data controllers and processors must undertake in order to ensure that adequate data protection is undertaken.
- Data breach notification laws and penalties for violation of the rules.

2. HIPAA stands for Health Insurance Portability and Accountability Act.

- Jurisdiction: United States of America (USA)

Purpose: HIPAA sets the requirements to ensure the privacy and security of individuals' medical records and their PHI, which is in the possession of covered entities, including healthcare practitioners, healthcare facilities, health plans, and other entities that process healthcare information electronically.

- Key Provisions:

Privacy Rule: This rule controls the utilisation and disclosure of PHI and grants the rights to an individual's health information.

Security Rule: This rule mandates that entities implement measures to ensure the privacy, security, and accessibility of ePHI.

- Breach Notification Rule: It is required that covered entities inform the individuals and the authorities when PHI is compromised.

3. Also, on the federal level, there is the Computer Fraud and Abuse Act (CFAA).

- Jurisdiction: United States

- Purpose: CFAA is a federal law that deals with the break into a computer and computer fraud and related crimes.

- Key Provisions:

- Outlaws gaining access to computers in violation of the law or gaining access to the data that is protected under the law, gaining access beyond the authority permitted by the law and damaging computers.

It outlaws almost all forms of cybercrime, such as computer hacking fraud, identity theft, and trafficking in passwords or other access devices.

- **Knowledge Check 2**

  Fill in the Blanks

  1. The legal and ethical issues in cybersecurity are defined by _____ and privacy. (regulations)
  2. Multi-factor authentication enhances _____ to an organisation's computer networks and information. (security)

3. Data _____ and backups are necessary for the process of countering cyber threats. (encryption)
4. Cybersecurity policies and procedures' main goal is to _____ and manage potential risks and weaknesses. (mitigate)

- **Outcome-Based Activity 2**

  Research cybersecurity laws and regulations such as GDPR, HIPAA, and PCI DSS. Divide the class into teams and assign each team a specific law or regulation to debate its importance and effectiveness in protecting individuals' privacy and organisations' data.

14.6 Summary

- Acquired knowledge about cybersecurity ideas and threats, and got recognize the risks associated to it. Cybersecurity is the process of safeguarding computers, servers, mobile devices, electronic systems, networks, and data from malicious attacks, digital invasion, cyber threats, and other cyber danger.
- Cyber threats on the other hand means possible risks and risks factors that can threaten the security of the online resources. Typical cyber threats, including malware, phishing, ransomware, etc. , and their effects.
- Phishing is a form of social engineering where by people are sent messages or directed to websites that mimic the look and feel of legitimate organizations and then entice people to reveal personal information such as passwords, credit card numbers, or other personal details.
- Encryption on the other hand is the conversion of the plain text data into cipher text using the cryptographic algorithms and keys to make the data indecipherable by those who are not supposed to access it.
- Cyber security guidelines are very crucial in safeguarding systems, networks, and data against cyber threats and attacks. These practices incorporate a variety of measures including preventive, security controls etc.
- Cybersecurity legal and ethical concern is important in establishing the aspects of risks that surround information security and what roles are played. Hence, it is crucial to fix these problems for organizations, governments, and people as cyber threats increase in number and complexity.

14.7 Keywords

- **Cybersecurity**- It is defined as the protection of computer systems, networks and their associated data against unauthorised access, attack and malfunction.
- **Malware**—Malware is a term for malicious software designed to harm or exploit computers, networks, and devices.
- **Data Loss Prevention**—Data Loss Prevention (DLP) solutions involve products that identify and control the transfer of confidential information over the network, on endpoints, and in storage devices.

14.8 Self-Assessment Questions

1. What measures can persons and companies take to avoid or prevent usual threats and cyber-attacks?
2. Enumerate the different methods of data security (for instance, encryption and access control) and their efficiency in protecting information from unauthorised access.
3. List some of the measures that one or any organisation can take in order to improve the security of their systems.
4. some legal and ethical issues should be taken into consideration when deploying security measures for cyberspace. How do the above factors differ across the various legal systems?
5. In what ways do cybersecurity awareness and training programs assist in decreasing security threats and cultivating a security mindset in an organisation?

14.9 References / Reference Reading

- Fundamental of Computers by Rajaraman.
- Computes Today by B. Sandra.

Unit 15: Software Development and Programming

Learning Outcomes:

- Students will be able to define different programming languages.
- Students will be able to explain the basics of Python programming.
- Students will be able to describe the software development life cycle (SDLC).
- Students will be able to identify key aspects of Agile methodologies.
- Students will be able to apply basic concepts of object-oriented programming.

Structure:

15.1 Introduction to Programming Languages

15.2 Basics of Python Programming

- Knowledge Check 1
- Outcome-Based Activity 1

15.3 Software Development Life Cycle (SDLC)

15.4 Agile Methodologies

15.5 Introduction to Object-Oriented Programming

- Knowledge Check 2
- Outcome-Based Activity 2

15.6 Summary

15.7 Keywords

15.8 Self-Assessment Questions

15.9 References / Reference Reading

15.1 Introduction to Programming Languages

Overview of Programming Languages

A programming language is a formal language used to pass instructions to a computer. It allows programmers to develop scripts that can be run on computers for some particular functionality. There are several types of programming languages, including high-level, low-level, and scripting languages.

Common Programming Paradigms

Programming paradigms specify the kinds and manners of programming. Some common paradigms include:

Key Provisions: Imperative Programming emphasises explaining how a program behaves through sequences of statements that alter a program's state.

- Declarative Programming: Stresses what needs to be done and not how it should be done.
- Functional Programming: Relies on the idea of computation as the application of functions to values and does not modify state and mutable data.
- Object-Oriented Programming (OOP): Structures software design on objects, which are entities of both the data and the behaviour.

Examples of Programming Languages

Different programming languages are used for a variety of purposes here some them Some popular programming languages include:

- C: A multiparadigm language that is mainly a procedural language characterised by its high efficiency and direct control of the computer hardware.
- Key Provisions: - C++: An extension of C language that provides Object-oriented programming and other features.
- Java: An advanced third-generation language that is used for developing applications that are platform-independent and strong.
- Python: An all-purpose, general-purpose language that is praised for its easy syntax, well-structured code and the availability of many standard packages.

JavaScript is another language mostly used in creating websites. It makes the site dynamic and interactive.

15.2 Basics of Python Programming

Introduction to Python

Python is one of the most popular interpreted languages. It is easy to learn and highly efficient. Guido van Rossum invented it and introduced it to the public in 1991. Because of its easily understandable syntax, Python is one of the easiest programming languages to learn and use. It is widely utilised in web development, data science, machine learning, artificial intelligence, scientific computing, and automation.

Getting Started with Python

To begin programming in Python, you must download the Python interpreter on your computer. Python comes with different distributions for different operating systems, such as Windows, macOS, and Linux. These distributions are installed and arranged so that you can write and run Python code with a simple text editor or an IDE. Python files are usually saved with a . py file extension.

Python Syntax and Indentation

In Python, blocks of code like loops, conditionals, and function definitions are defined through indentation. Indentation is one of the most important and distinctive features of Python and is used uniformly. This feature makes the code easier to read and ensures that everyone is following the coding standards.

Basic Data Types

Python supports several built-in data types, including Python supports several built-in data types, including:

- Integers: Integers which are whole numbers and do not include decimal points (for example, `42`, `-10`, `1000`).
- Floats: Decimal numbers (for example, `. 3. 14, -.5, 2.718).
- Strings: Strings are sequences of characters enclosed in one or two single or double quotes, for example ``'hello', "world", or python.
- Booleans: Boolean values are real values that represent the true or false (e.g., `True`, `False`).

Control Structures

Python provides various control structures for flow control, including Python provides various control structures for flow control, including:

- Conditional Statements: Conditional statements such as `if`, `elif`, and `else` for running one or the other set of instructions as per certain conditions.

- Looping Structures: `for` loops are used whenever there are sequences that need to be iterated through, and `while` loops are used when the code needs to be run as long as a certain condition is met.

Functions and Modules

Functions in Python allow you to create and use a block of code repeatedly just by calling its name, followed by arguments. Python also has modules, which are files of Python code that can be imported to other programs. Modules make program code manageable and can be reused and abstracted.

Data Structures in Python

Python provides built-in data structures for organising and manipulating data efficiently, including Python provides built-in data structures for organising and manipulating data efficiently, including:

- Lists: Lists that can be changed (e.g., `[1, 2, 3]`; `['a', 'b', 'c']`).
- Tuples: Data objects for which their order cannot be changed (e. g. , `(1, 2, 3)`, `('apple', 'banana', 'cherry')`.
- Dictionaries: Pairs of keys: values that can be used when mapping keys to values (for example, `name: John, age: 30`).
- Sets: Lists of different elements without specified order, e.g., `[1, 2, 3], ['apple', 'banana', 'cherry'].

- **Knowledge Check 1**

  Fill in the Blanks.

  1. Introduction to Programming Languages also helps in familiarising the _____ used in developing software. (syntax)
  2. Fundamentals in Python Programming are the concepts and elements of the _____ language. (Python)
  3. Software Development Life Cycle (SDLC) describes the _____ processes from the idea to their implementation. (development)
  4. Agile Methodologies focus on the development through the cycles and _____ for the change in requirements. (adaptability)

- **Outcome-Based Activity 1**

  The participants engage in role-playing concerning different roles in the Software Development Life Cycle (SDLC), including project manager,

developer/programmer, tester, and client/stakeholder. The phases of SDLC, such as requirements, design, implementation, testing, installation, and maintenance, should be modelled. What risks and opportunities does the implementation of the SDLC process present in software development?

15.3 Software Development Life Cycle (SDLC)

Overview of SDLC

SDLC is a systematic way of developing software. It describes the processes that should be followed when planning for and developing software systems. It is a system development life cycle with the objective of developing quality software that meets customers' needs within the cost and time constraints. Commonly, the SDLC is made up of several phases, each with its goals and products.

Phases of SDLC

The phases of SDLC may vary depending on the methodology and organisation, but they generally include the following stages:

1. Planning: Stating the project scope, goals, specifications or expectations and available or needed equipment.
2. Analysis: Collecting and assessing users' demands and expectations to determine the needs of the stakeholders.
3. Design: Develop a clear plan regarding the kind of software and architectural structure, the interface to be developed, and the components to be integrated.
4. Implementation: The process of composing program code, constructing computer programs and components, and assembling the elements into an operative system.
5. Testing: Ensuring the proper functioning of the software by checking its quality by using Unit Testing, Integration Testing and System Testing.
6. Deployment: Deploying the software and making it ready for use in the environments where it will be marketed and used by customers.
7. Maintenance: Offering updates and improvements on templates that can help with specific problems or improve the performance of software.

Waterfall Model

The Waterfall Model is a linear and phased approach to SDLC. All phases are sequential; that is, one can only start the next phase once the previous one has been completed. The phases flow one after the other in a continuous sequence, and there is no going back to an earlier stage. The Waterfall Model is good in that there is a clear

sequence of steps. However, this comes with the disadvantage of being comparatively inflexible to changes in requirements or to the development of better technologies.

Iterative and Incremental Models

Another framework that can be used to categorise the software development process is iterative and incremental models, such as Agile. The cycles are made up of planning, development, testing, and review, and they enable modification as a result of changing needs. Agile development is based on flexibility, teamwork, and customer feedback to deliver working software in increments.

15.4 Agile Methodologies

Introduction to Agile

Agile is a software development framework focused on processes that must be flexible and customer-oriented. Traditional methods do not encourage much flexibility, allow new requirements to enter the development cycle, and create working software in small, frequent cycles. The Agile Manifesto, developed in 2001, gives an outline of the principles that are followed in Agile development.

Scrum Framework

There are numerous Agile frameworks, and one of the most well-known is Scrum, which increasingly focuses on collaboration, visibility, and value. The Scrum framework consists of several key elements: The Scrum framework consists of several key elements:

- Roles:

- Scrum Master: Supports Scrum, resolves issues that hinder Scrum and guarantees compliance with the principles of Scrum.

- Product Owner: Acts for the stakeholders and determines the requirements and the vision of the product.

- Development Team: An organisation of people who are not limited to a specific function and share the responsibility of creating a deliverable, releasable increment of working software.

- Events:

- Sprint: A 2 to 4-week sequence in which a potentially shippable product increment is developed.

- Sprint Planning: A cross-functional team will be formed to decide which of the items in the product backlog should be taken to the next sprint.

Daily Standup: A daily standup is a brief conference call during which the team members can align their activities, share information about their work progress, and define the issues that hinder their performance.

- Sprint Review: Final review of the completed work in front of the stakeholders and taking their feedback for the improvement of the job done.

Sprint Retrospective: A post-sprint retrospective meeting to review what worked well and what did not in the design thinking sprint.

- Artifacts:

- Product Backlog: List of all priorities for improvements, additions, and changes to the product.

- Sprint Backlog: Actual items that are to be worked on during the implementation of the sprint cycle.

- Increment: A potentially shippable product increment developed at the end of each sprint.

Kanban Method

Kanban is one of the Agile methodologies used in managing and developing processes and systems, where the main emphasis is on the visualisation of the work process, the restriction of work in progress (WIP), and the continuous improvement of the workflow. Key principles of the Kanban method include:

- Visualising Workflow: Applying columns and swim lanes in order to depict work items, process steps, and status.

- Limiting WIP: WIP limits control on every stage of the Wf to avoid excessive loading and maintain work in progress.

- Continuous Delivery and Improvement: Promoting the behaviour of delivering small, valuable increments on a regular basis and building the feedback loops which support this behaviour.

Agile Practices

Agile methodologies promote several practices to support Agile principles, including:

- Iterative Development: Dividing work into small portions or small deliverable units and often delivering a running system.

- Cross-Functional Teams: Creating teams out of individuals with complementary skills and experience to form high-performing functional teams.

Customer Collaboration involves involving customers and other stakeholders in the development process, with the aim of getting their feedback and ensuring the emerging product meets the business requirements.

- Adaptive Planning: Accepting change and being able to adapt the strategies and goals as a result of feedback, new specifications or changes in the market.

Benefits of Agile

Agile methodologies offer several benefits, including:

- Flexibility: It is flexible when the requirements and priorities of a project have to be changed rapidly.
- Faster Time-to-Market: Releasing working software in small and regular batches to cut down the time to the market and obtain quicker feedback.

Improved Quality: Hence, there is more emphasis on testing and evaluating software and also on changing the process to improve quality.

Increased Stakeholder Satisfaction: Engaging stakeholders in the development process and providing value often improves satisfaction and synergy with the business's objective.

15.5 Introduction to Object-Oriented Programming

Fundamental Concepts of OOP

OOP is the programming paradigm where the software design revolves around objects that comprise data and behaviours. Key concepts of OOP include: Key concepts of OOP include:

Classes and Objects: Classes are structures that hold attributes and methods for fabricating objects, and objects are specific manifestations of classes that are used to model real-life concepts.

- Encapsulation: Abstraction features include encapsulation, which conceals the details of the objects' inner workings and only provides them with interaction through specific interfaces.

Inheritance: Inheritance allows classes to be derived from another class, enabling the reuse of code and producing a structure of classes and objects.

Polymorphism: Polymorphism helps to work with objects of different classes uniformly using an interface, providing flexibility and extensibility.

Use of the OOP Concepts in Python

Python supports object-oriented programming and provides features to implement OOP concepts effectively: Python supports object-oriented programming and provides features to implement OOP concepts effectively:

- Defining Classes and Objects: In Python, classes are created using the keyword 'class', and objects are made from the class by the '__init__' method.

Access Modifiers: The naming convention in Python for declaring the visibility of class members includes one underscore (_) for protected members and two underscores (__) for private members.

Method Overriding and Overloading: Yes, Python also supports method overriding. This means that the subclass is allowed to implement the strategies available in the parent classes in its own way. Method overloading is not supported directly in Python, unlike method overloading, which is supported in some other programming languages.

Advantages of OOP

Object-oriented programming offers several benefits for software development: Object-oriented programming provides several benefits to software development:

Reusability: OOP employs the concepts of inheritance and composition to enhance code reuse and, hence, eliminate code duplication.

Modularity: Another advantage of OOP is that it promotes modularity, whereby a large system is developed in subsystems; hence, it is easier to manage.

Example of OOP in Python with a detailed analysis of OOP concepts

Here's a simple example of implementing OOP concepts in Python: Here's a simple example of implementing OOP concepts in Python:

```python
>#  Next, define a class that will represent a person
Class Person:
def __init__(self, name, age):
self. Name = name
self. age = age

def greet(self):
print("Hello, my name is " + self. name + " and I am " + str(self. age) + " years old. ")
```

```
# Define an object of the class Person
person1 = Person("Bob", 30)

This allows you to access object attributes and call methods and allows objects to be created dynamically at runtime.
print(person1. name) # Output: Bob
person1. greet() # Output: Hello, I am Bob, and I am 30 years old.
```

In this example, the `Person` class stores name and age (data) and greeting function (behaviour), which makes it an example of both encapsulation and abstraction in OOP.

- **Knowledge Check 2**

  Fill in the Blanks.

  1. Introduction to Object-Oriented Programming explores the concept of _____ and inheritance in programming. (classes)
  2. Java, C++ and _____ are some common languages that are used to design and develop various software. (Python)
  3. System like Git enables _____ and contributes to Software Development. (version control)
  4. Integrated Development Environments (IDEs) offer _____ for writing as well as testing code. (tools)

- **Outcome-Based Activity 2**

  Write a program having OOP concepts.

15.6 Summary

- Students became familiar with various programming languages and their role in software development, and I got a brief idea of coding and syntax.
- The Python programming language and its basics, such as variables, data types, control structures, functions, and their uses in different fields.

- Examined the stages of the Software Development Life Cycle (SDLC), such as requirement gathering, analysis, design, implementation, testing, deployment, and maintenance, and the relevance of each stage in developing quality software.
- Explained the concept of Agile with reference to two frameworks, namely Scrum and Kanban, and their ability to adopt iterative and incremental approaches to system development. Agile outperformed traditional methodologies due to its focus on the customer.
- Familiarised with classes, objects, inheritance, polymorphism, and encapsulation as a basis for constructing Object-Oriented Programming languages and both low and high-level modular and reusable software components.
- Understood Version Control Systems or Distributed Version Control Systems like Git and SVN, their use in Version Control, and changes tracking.
- Learned about unit testing, integration testing, and some of the testing tools used in debugging to minimise defects in software products.
- Explain the concept of code documentation and some of the common cod documentation practices like using comments in the code, adding a README file and using specific tools.
- Understood the deployment types, which include manual deployment, CI/CD, and DevOps, to help deploy new updates efficiently.
- Discussed software updates and bugs where people often get confused between bug fixing and updates and why it is necessary to refactor the code so that the code can be easily understandable for future developers.

15.7 Keywords

- **OOP—**Object-oriented programming (OOP) is a way of software development based on objects that contain data and code that operates on them.
- **Scrum Framework—**Scrum is one of the most used Agile frameworks. It focuses on team collaboration, process transparency, and flexibility.
- **SDLC—**The software development life cycle (SDLC)is a model for software development that outlines the development processes of planning, creating, testing, deploying, and maintaining.

15.8 Self-Assessment Questions

1. Compare the software development life cycle (SDLC) with agile methodologies, highlighting their differences and similarities.
2. Discuss the basics of Python programming and its applications in software development.
3. How do different programming languages cater to diverse software development needs?
4. Explain the principles of object-oriented programming and its advantages in software development.
5. How does understanding programming languages contribute to effective software development?

15.9 References / Reference Reading

- Fundamental of Computers by Rajaraman.
- Computes Today by B. Sandra.

Unit 16: Emerging Technologies in Computing

Learning Outcomes:

- Students will be able to define AI and ML concepts.
- Students will be able to explain the role of IoT in modern computing.
- Students will be able to describe blockchain technology.
- Students will be able to identify future trends in computing.
- Students will be able to evaluate the potential impact of quantum computing.

Structure:

16.1 Artificial Intelligence (AI) and Machine Learning (ML)

16.2 Internet of Things (IoT)

- Knowledge Check 1
- Outcome-Based Activity 1

16.3 Cloud Computing

16.4 Blockchain Technology

16.5 Quantum Computing

- Knowledge Check 2
- Outcome-Based Activity 2

16.6 Summary

16.7 Keywords

16.8 Self-Assessment Questions

16.9 References / Reference Reading

16.1 Artificial Intelligence (AI) and Machine Learning (ML)

Understanding Artificial Intelligence (AI)

It is the operation of machines in a way that is comparable to human intelligence to learn, reason, and make decisions, among other things. This umbrella term covers such things as learning ability, the ability to reason, to solve problems, to perceive, and the ability to understand language. AI systems can be classified into two types: There is a narrow AI intended for a particular task, for example, face recognition or search for information on the Internet, and general AI, which can solve any problem that is within a person's capabilities.

The history of AI dates back to the mid-20th century and John McCarthy's creation of the term in 1956. AI-based research in its early stages was based on symbolic methods and problem-solving. The field has developed over the years as it has adopted new computing capabilities, increased data availability, and better algorithms.

Exploring Machine Learning (ML)

Here is Machine Learning (ML) a branch of AI that focuses on a computer's ability to learn on its own and become wiser through practice. In contrast to the typical imperative programming, where the computer is told step by step how to solve a problem, in ML, a model is trained on a dataset, and when new data come in, the model makes a decision or a prediction without being programmed for that immediately.

ML can be broadly categorised into three types:

1. Supervised Learning: In this approach, the training data is labelled, which means that each training example has an output label. The model learns to forecast the output from the input data. Some of the applications include classification and regression problems.

2. Unsupervised Learning: Here, the model is fed information and does not know what to do with it, which means it does not have any specific duties or responsibilities. The objective of this model is to understand the patterns and structure of such data. Some of the most used methods are clustering and dimensionality reduction.

3. Reinforcement Learning: This type of learning occurs when an agent is trained to make a sequence of decisions by being given a reward or punished for an action. Over time, the agent learns to acquire the biggest sum of rewards.

AI and Machine Learning Key concepts

1. Algorithms

It is a series of procedures or instructions that are provided to an AI or ML model to enable it to find insights from data. It is the foundation of any AI or ML solution and helps systems accept input, analyse it, and generate results.

2. Data

Information is the most important aspect of AI and ML. It is made up of the data that is actually used to feed algorithms and build models. Structured data includes databases, while unstructured data includes text and images, among others. The quantity and quality of data affect the performance of AI and ML.

3. Training and Testing

Training in the scope of ML implies utilising a dataset to introduce an ability to make predictions or decisions in a model. This process involves evolving the parameters of the model to suit the results obtained from it. Testing is the process of assessing the accuracy of the model on a new data set to check the model's performance.

4. Features

Feature is the independent variable that is plugged into the model to help conclude. Features in a dataset are the columns, and each line refers to a record. They named the procedure of choosing the subset of features that should be used in the model as a feature selection.

5. Models

A model is one of the training outcomes in ML. It is a mathematical model derived from the data that can be used to forecast or make a decision. The models can range from simple linear models to more complex neural networks.

6. Supervised Learning

Supervised learning is one of the ML techniques in which the model is trained, with each training example associated with an output label. The model builds a relationship between the input data and the output it expects to obtain. For instance, classification is the process of grouping data, while regression estimates numerical values.

7. Unsupervised Learning

The second one is the process of training models on data for which there are no responses available. The aim is to gain insights into the data analysis and look for relationships within the data set. Some of the most used techniques of unsupervised

learning are clustering, which involves grouping similar data, and dimensionality reduction, which involves decreasing the size of the feature vector.

8. Reinforcement Learning

Reinforcement learning is a branch of ML in which an agent learns how to act in an environment to maximise rewards or minimise penalties. The agent's goal is to accumulate rewards over the longest period possible, and in this process, the agent has to make corrections.

AI and ML are used in algorithms, as discussed in the following sections.

1. Linear Regression:

Example: Regression analysis helps identify how some features of a house, such as its size, the number of bedrooms, or its location, can be used to estimate its price.

- Application: Market research and prediction of the stock market.

2. Decision Trees:

Example: Determining whether an email is spam or not based on the presence of certain attributes, such as certain keywords.

- Application: C. Email filtering systems.

3. Support Vector Machines (SVM):

- Example: Recognising handwritten digits by clustering in a high-dimensional layer with different classes.

- Application: Optical Character Recognition, sometimes referred to as optical machine recognition.

16.2 Internet of Things (IoT)

What is IoT?

The IoT is the connection of physical objects, such as vehicles, buildings, and other objects, with sensors, software, and network connectivity through which these objects can gather and share information. The main purpose of IoT is to connect the physical world and the cyber world, where devices can share data, interpret it, and respond to it.

Key Components of IoT

1. Sensors and Actuators: Sensors gather information from the surroundings and relay it where aspects like temperature, humidity, light, movement, and others are involved. Executors take action on the data, such as adjusting a valve or switching on a light.

2. Connectivity: Devices also require a way to broadcast to other devices and a central system. Different communication interfaces and technologies, such as Wi-Fi, Bluetooth, Zigbee, cellular networks, etc., can achieve this.

3. Data Processing: Collected data is analysed either at the edge, which is closer to the source, or in the cloud. This processing can range from data sorting to data analysing.

How IoT Works

1. Data Collection: Sensors, as well as devices, acquire data from their surroundings.

2. Data Transmission: This data is sent over a network to a central system and may be passed through gateways when the two systems employ different types of communication.

3. Data Processing and Analysis: The central system helps gather, interpret, and decide on the information collected from the subsystems.

4. Action and Feedback: According to the findings made above, the system can cause actions through actuators and provide feedback to the users.

5. User Interaction: Using interfaces, a user can provide commands to the system and/or receive information from the system.

IoT examples and real-world use cases

1. Smart Homes:

Example: Smart thermostats such as Nest learn the user's preferences and habits and then automatically control the house's temperature.

- Application: Home automation is used to save energy, protect the house, and increase comfort.

2. Wearable Devices:

- Example: There are wearable fitness devices such as Fitbit that measure activity, heart rate, and sleep.

- Application: M-Health to monitor personal health and fitness.

3. Industrial IoT (IIoT):

Example: Some advanced factory systems include predictive maintenance, where the health of equipment is monitored to predict failure.

- Application: Less operational downtime and improving on their efficiency.

4. Smart Cities:

- Example: Smart traffic systems change the traffic signals in real-time to ease congestion of the road.

- Application: Enhancing the physical facilities in urban areas and the overall welfare of the inhabitants.

- **Knowledge Check 1**

  Fill in the Blanks

  1. AI-powered chatbots improve _____ and customer relations. (efficiency)
  2. AI and ML transform _____ and decision-making procedures. (Automation)
  3. Internet of Things (IoT) links _____ devices and allows the exchange of information. (connected)
  4. IoT applications can be extended from _____ management to smart home gadgets. (Industrial)

- **Outcome-Based Activity 1**

  Identify new technologies like Artificial Intelligence, the Internet of Things, Cloud Computing, Blockchain, and Quantum Computing. Divide the applicants into groups and ask them to indicate possible applications, advantages, and disadvantages of each technology. In what ways do these technologies determine the development of computing and alter sectors?

16.3 Cloud Computing

Introduction to Cloud Computing

Cloud computing revolutionises the way businesses approach a specific information technology asset. Instead of having their own computer systems and data centres, companies can lease anything, from applications to storage, from a cloud service provider. The following is a look at the several unique selling propositions of this model that have made it popular among users.

What is Cloud Computing?

Cloud computing is a model of using various services from remote servers via the Internet. Some of these services are tools or applications such as data storage, servers, databases, networking, and software. When organised using a cloud model, there is no

need to invest in their own IT facilities and equipment, and businesses get only what they need for the time they need it.

Key Characteristics

1. On-Demand Self-Service: This enables users to access computing resources like servers and storage on-demand or as required, without the service provider having to become personally involved.
2. Broad Network Access: These resources can be accessed over the network using standard interfaces, and they encourage usage by different thin or thick client platforms such as mobile phones, tablets, laptops, and even workstations.
3. Resource Pooling: The provider's computing resources are shared to accommodate many consumers through the sharing of physical and virtual resources, which are dynamically allocated and de-allocated according to consumer utilisation patterns.
4. Rapid Elasticity: Another characteristic of capabilities is that they can be dynamically provisioned and released, in some cases even in an automatic manner, to expand and shrink with speed in proportion to the need.
5. Measured Service: This is attained by a metering capability at some level of abstraction relevant to the type of service (storage, processing power, bandwidth, active user IDs, etc.), where the cloud systems self-manage and self-optimize resource usage.

Service Models

1. Infrastructure as a Service (IaaS): This is the simplest form of cloud computing service. IaaS is the process where one pays for IT infrastructure such as servers and virtual machines, storage, network, and operating system from a cloud service provider for a specific period.
2. Platform as a Service (PaaS): PaaS offers customers a solution where they can create, implement, and execute an application without the need to create the underlying physical structure required for its creation and deployment.
3. Software as a Service (SaaS): SaaS is the distribution of software applications through the Internet on the basis of subscription. Subscribers rely on cloud providers to run the software application and the associated infrastructure and for upkeep, such as software updates and security patching.

Deployment Models

1. Public Cloud: Products are received through the public internet and consumed by different organisations.

2. Private Cloud: A private cloud is a form of cloud computing used only by the organisation that possesses it.

3. Hybrid Cloud: This is the integration of two clouds, public and private, connected by technology that makes data and applications transferable between them.

Main Sub-Components of Cloud Computing

Cloud computing is a system that is composed of many parts, and each of these parts plays an important role in providing scalable, reliable and efficient computing services. Here are the key components of cloud computing: Here are the key components of cloud computing:

1. Compute Resources

Virtual Machines (VMs): These are copies of physical servers that act like physical servers in that they have operating systems and applications running on them.

- Containers: These are lighter than VMs and can contain an application and all its required components that can be run in any environment.

Serverless Computing: This enables developers to develop and host applications without having to bother with the infrastructure underneath it, which self-provisions when needed.

2. Storage

- Object Storage: Built for the purpose of archiving various forms of 'big data', such as images, videos, and backup files. Some examples are Amazon S3 and Azure Blob Storage.

Block Storage: This option offers block storage volumes that can be directly connected to the VMs, especially for databases and files. Some examples are Amazon EBS and Google Persistent Disks.

File Storage: This supports distributed storage of files, where multiple users or virtual machines can work on the same file at the same time, like file servers. Some examples include Amazon EFS and Azure files.

3. Networking

- Virtual Private Cloud (VPC): A kind of PUBLIC CLOUD which isolates resources and offers a network environment.

Content Delivery Networks (CDNs) Replicate content in different geographical areas so that it loads faster on users' machines.

- Load Balancers: Load balance incoming traffic so that no single server is overloaded with traffic. This would make the system more reliable and faster.

4. Management and Monitoring Tools

Cloud Management Platforms: Ensure that there is a single point of control for all cloud services, such as deployment, automation, and consolidation. Some examples of consoles are the AWS Management Console and Azure Portal.

16.4 Blockchain Technology

Introduction to Blockchain

Blockchain technology, which is now known as the technology behind cryptocurrencies, has been considered revolutionary in the recent past. In essence, Blockchain can be described as a decentralised, distributed digital ledger technology that is used to create a new, improved, and more efficient method of recording information. Let's explore the key concepts and components of blockchain:

1. What is Blockchain?

- Blockchain is a growing database placed on a chain of blocks, each containing a list of transactions.

- These blocks are connected by cryptographic algorithms that provide a chronological and secure chain of transactions.

2. Decentralisation

- While in conventional centralised databases, the data is managed and owned by a single central authority, blockchain works on a distributed network of nodes.

Every node has a copy of the blockchain to prevent the system from having a single point of failure and to make data immune to censorship and manipulation.

3. Transparency and Immutability

The activities performed as a result of the transactions captured on the blockchain are available to all the network participants, increasing the level of integrity.

- Once a transaction is stored, it cannot be changed or removed from the block – which is the case in blockchain since it can only be changed through consensus among the nodes within the network.

4. Consensus Mechanisms

A consensus mechanism can be described as the procedures that help all the nodes in the network agree on the validity of the transaction and the order in which the transactions should be recorded.

Some commonly known consensus mechanisms are the Proof of Work (PoW), Proof of Stake (PoS), and Delegated Proof of Stake (DPoS).

5. Cryptographic Security

- Blockchain applies encryption through cryptographic algorithms to make transactions safe and avoid forgery.
- In this case, public and private key pairs are used for user authentication and digital signatures.

6. Use Cases

Blockchain technology is versatile and can be used in various sectors, such as finance, supply chain, health, property, and many more.

Some of the areas where blockchain is applied are cryptocurrency, Identity management, Financial assets, Supply chain management, Voting, and many others.

16.5 Quantum Computing

Introduction to Quantum Computing

Quantum computing is a revolutionary technology based on the laws of quantum mechanics. It uses quantum bits, or qubits, to store and manipulate data in quantum states, solving problems that would be impossible for classical computers to solve. In contrast to classical computers, which employ bits as the elements of information, quantum computers use quantum bits, or qubits, to store and manipulate data in quantum states. Let's explore the key concepts, examples, applications, and challenges of quantum computing.

Key Concepts

1. Superposition

It causes qubits to have a state of superposition, where they can represent 0 and 1 at the same time, allowing quantum computers to compute different values at a time.

2. Entanglement

- They are quantum interactions and co-dependencies that occur between two or more qubits irrespective of the physical distances between them. This property allows

quantum computers to carry out computations that are highly intertwined in a very efficient manner.

3. Quantum Gates

- A quantum gate is similar to a classical gate and is defined as the basic unit of a quantum circuit. They selectively change the quantum state of qubits for operations such as superposition, entanglement, and measurement.

4. Quantum Algorithms

- Quantum algorithms refer to algorithms that are devised to solve certain computational problems with the help of quantum mechanical characteristics that are superior to those of classical algorithms. For instance, Shor's algorithm is used in the field of integer factorisation, and Grover's algorithm is used for the unstructured search.

Examples and Applications

1. Cryptography

- a quantum computer can attack RSA and ECC encryption techniques because Shor's algorithm can factor large numbers with great efficiency. On the other hand, post-quantum cryptographic algorithms like lattice-based cryptography secure future communication systems.

2. Optimisation

- Optimisation problems can also be solved using quantum computers more efficiently than classical computers with the help of quantum algorithms such as the Quantum Approximate Optimisation Algorithm (QAOA). Some of the uses include asset allocation, procurement and supply chain, and delivery networks.

3. Drug Discovery

- Current quantum computers can emulate the molecule's formation and behaviour much faster than other forms of computers, enabling faster drug discovery. Modern quantum algorithms such as VQE and QCS are used to model chemical reactions and screen candidates for drug discovery.

Challenges

1. Hardware Constraints

Physical implementation and growth of quantum hardware with enough coherence of qubits, connections between them, and errors still pose a challenge. Modern quantum processors suffer from noise, decoherence, and a small number of qubits, which limits the applicability of quantum algorithms.

2. Quantum Error Correction

Quantum error correction requires a greater number of qubits and more complex error correction codes, which leads to higher overhead and more resources required for quantum computation. The ability to correct errors is critical as well to ensure that the computations are accurate without requiring heftier hardware.

3. Algorithm Development

The development and enhancement of quantum algorithms for practical purposes involve knowledge of quantum mechanics, computer science, and the domain of application. The challenge of creating quantum algorithms that solve problems faster than classical algorithms for a vast number of issues has yet to be achieved.

- **Knowledge Check 2**

  Fill in the Blanks

  1. Some future trends in computing comprises _____ computing and edge computing.(cloud)
  2. Quantum computing has the potential to solve complex problems and identify novel _____ and cyphers. (algorithms)
  3. Blockchain technology guarantees _____ and decentralised transaction integrity. (security)
  4. Algorithms used in quantum computing can _____ problems in science and finance. (modernise)

- **Outcome-Based Activity 2**

  Discuss the tendencies of the further evolution of computing with the participation of artificial intelligence, edge computing, serverless structure, and the use of technology for the improvement of human life.

16.6 Summary

- Learned about artificial intelligence and machine learning, their working mechanism, how algorithms learn from the data and make predictions or decisions, and how these technologies are used in different fields.
- Exploring IoT as a concept that focuses on connecting different physical gadgets and facilitating data sharing over the internet and its use in smart cities, health, agriculture and industry.

- Explained the cloud computing service models, including IaaS, PaaS, and SaaS, as well as the deployment models, which are public, private, and hybrid cloud. Understand the advantages of cloud computing, such as scalability, flexibility, and cost.
- Based on blockchain, understood that it is not just an appendage of cryptocurrencies but also supply chains, digital signatures, and contracts.
- Learned the basics of quantum computing and how it can solve certain problems exponentially faster than classical computers, with uses in cryptography, optimisation, and simulation.
- Touched upon edge computing as a concept and its role in computing involving the processing of data closer to the point of origin, increasing efficiency and decreasing factors such as latency and bandwidth consumption, as well as integral real-world applications such as the IoT and self-driving automobiles.
- This paper also discussed serverless computing models, in which the cloud providers' premises manage the infrastructure, but the developers are only concerned with writing and deploying their code. It also discussed the advantages of this model, including scalability and cost efficiency.
- Explained the use of combining AI and ML to software development lifecycle, creating code, testing, and deployment tools and its capability of promoting productivity.

16.7 Keywords

- **Artificial intelligence—**Artificial intelligence, or AI, is a branch of computer science that deals with the development of intelligent machines that work like humans.
- **Machine Learning—**Machine Learning (ML) is a category of AI that employs algorithms and statistical models to allow computers to learn from experience and perform a given task efficiently.
- **Blockchain—**A blockchain is a distributed digital database made of a chain of blocks, each block containing a record of transactions.

16.8 Self-Assessment Questions

1. Examine the areas where AI and ML are likely to be used in various industries.
2. Discuss the meaning of the Internet of Things (IoT) and the prospects of interconnected items and smart networks.
3. What are some of the other applications of blockchain apart from its use in cryptocurrencies?
4. Get your ideas behind the trends that would shape the future of computing, like edge computing, serverless architecture, quantum computing
5. What are some challenges associated with IoT adoption?

16.9 References / Reference Reading

- Fundamental of Computers by Rajaraman.
- Computes Today by B. Sandra.