

Higher Secondary Course

Computer Applications *Humanities*

XI



Government of Kerala
Department of General Education

State Council of Educational Research and Training (SCERT) Kerala
2026

THE NATIONAL ANTHEM

Jana-gana-mana adhinayaka, jaya he
Bharatha-bhagya-vidhata
Punjab-Sindh-Gujarat-Maratha
Dravida-Utkala-Banga
Vindhya-Himachala-Yamuna-Ganga
Uchchala-Jaladhi-taranga
Tava subha name jage,
Tava subha asisa mage,
Gahe tava jaya gatha
Jana-gana-mangala-dayaka jaya he
Bharatha-bhagya-vidhata
Jaya he, jaya he, jaya he,
Jaya jaya jaya, jaya he.

PLEDGE

India is my country. All Indians are my brothers and sisters.
I love my country, and I am proud of its rich and varied heritage. I shall
always strive to be worthy of it.
I shall give my parents, teachers and all
elders, respect and treat everyone with courtesy.
To my country and my people, I pledge my devotion. In their well-being
and prosperity alone, lies my happiness.

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Foreword

Dear learners,

The State Council of Educational Research and Training (SCERT), Kerala, has prepared this textbook Computer Applications – Humanities, Class XI to help students understand the concepts and uses of computers in a simple and practical way.

Today, computer knowledge is important for students of all streams, including Humanities. This book introduces computing as a useful tool for learning, communication, data handling, and responsible use of technology. The topics are explained in an easy manner with suitable examples, illustrations, activities, and questions to support better understanding.

The book covers essential areas such as computer organization, data processing, green computing, Free and Open-Source Software (FOSS), cyber security, computer networks, artificial intelligence and various application softwares. It also creates awareness about e-waste management and the need for safe and ethical use of technology. The activities included in the book encourage students to connect what they learn with real-life situations.

It is hoped that this book will be helpful for both students and teachers in developing confidence and interest in computer applications.

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Icons used in this textbook for convenience



Trivia



Try Yourself

THE CONSTITUTION OF INDIA

PREAMBLE

WE, THE PEOPLE OF INDIA, having solemnly resolved to constitute India into a ¹**[SOVEREIGN SOCIALIST SECULAR DEMOCRATIC REPUBLIC]** and to secure to all its citizens :

JUSTICE, social, economic and political;

LIBERTY of thought, expression, belief, faith and worship;

EQUALITY of status and of opportunity; and to promote among them all

FRATERNITY assuring the dignity of the individual and the ²[unity and integrity of the Nation];

IN OUR CONSTITUENT ASSEMBLY this twenty-sixth day of November, 1949 do **HEREBY ADOPT, ENACT AND GIVE TO OURSELVES THIS CONSTITUTION.**

1. Subs. by the Constitution (Forty-second Amendment) Act, 1976, Sec.2, for "Sovereign Democratic Republic" (w.e.f. 3.1.1977)
2. Subs. by the Constitution (Forty-second Amendment) Act, 1976, Sec.2, for "Unity of the Nation" (w.e.f. 3.1.1977)

1

Computing System



“Computer is not a device any more. It is an extension of your mind and your gateway to other people.”

Mark Shuttleworth

1.1 Introduction

The journey of computing devices spans thousands of years from simple counting tools to modern supercomputers and smart phones. Over a relatively short period, computing devices have progressed from performing basic calculations to handling complex data processing tasks with incredible speed. Computers today are fast, compact and powerful. But they were not always like this. This chapter covers the historical evolution, technical organisation, concepts of data processing, software classifications, importance of open source software, green computing and issues of e-waste. Studying this evolution and other aspects helps us to realise the development of technology and its ongoing influence on our lives. Now the development is like *‘We dream in the morning, a reality by noon and obsolete by evening’*.

1.1.1 Evolution of Computing

The word compute means to ‘calculate’. Computing devices have transformed from basic calculators to advanced data processors in just a few decades. The *Abacus* is considered to be the first known calculating tool. It uses beads on rods to perform basic arithmetic operations like addition and subtraction. It has been in use for thousands of years across different cultures. *Charles Babbage*, who is known as the *‘Father of the Computer’*, designed a mechanical general-

purpose computer in 1837. Although it was never fully built in his lifetime, the design laid the foundation for modern computing. In 1843, *Augusta Ada Lovelace*, wrote the first algorithm intended for a machine (Charles Babbage's Analytical Engine). She is therefore often regarded as *the first computer programmer*. Although the Analytical Engine was never built in her lifetime, her contributions laid the foundation for the development of computational theory. In 1890, *Herman Hollerith* invented a punch-card-based machine used in the U.S. census. It marked the shift towards data processing. The evolution of computing devices is shown in Figure 1.1

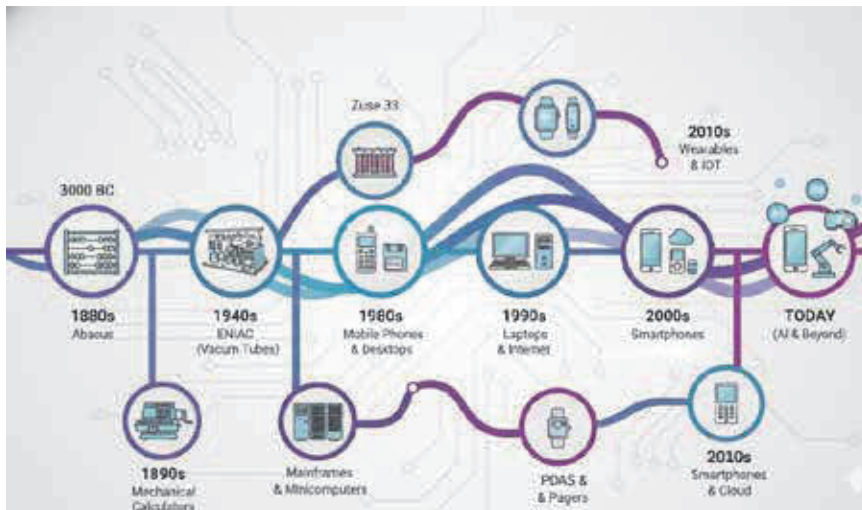


Figure 1.1 - Timeline diagram of generation of computing devices

1.1.2 Generations of Computing

The *Generations of Computing* refers to the classification of computers based on major technological developments over different periods. These developments increased the speed, reduced the size and cost, and enhanced the efficiency of computers. The evolution of computers is classified into *five generations*.

i) First Generation (1940–1956)

This era marks the beginning of modern electronic computing. The technology used was *vacuum tubes* for circuitry, and magnetic drums for memory. These tubes were easily broken, generated a lot of heat, and consumed a huge amount of power. Computers were bigger in size, often occupied the entire room. Programming was done with the help of machine language in which instructions are written using 0s and 1s. *ENIAC* (Electronic Numerical Integrator and Computer) is considered to be one of the first general-purpose electronic computers introduced in 1945. It was used by the U.S. Army for calculating ballistics tables. *UNIVAC I* (Universal



Automatic Computer) was the first commercial computer produced in the United States. It was used to predict the outcome of the 1952 presidential election on live television. Another milestone in this period was *EDSAC* (Electronic Delay Storage Automatic Calculator), one of the earliest stored-program computers, designed and built at the University of Cambridge in England. It became operational in 1949 and played a crucial role in the development of computing.

ii) Second Generation (1956–1963)

The invention of the transistor replaced vacuum tubes in computers. Transistors were much smaller, more reliable, and more energy-efficient than vacuum tubes. This generation saw the rise of the computer industry and the start of widespread use of commercial computers. High level programming languages like COBOL and FORTRAN were developed, making programming easier and more accessible. Computers became smaller in size, and new machines *IBM 1401* and *IBM 7090* were also introduced in this period.

iii) Third Generation (1964–1971)

This generation is defined by the *integrated circuit* (IC), which was invented by Jack Kilby and Robert Noyce. It is a small chip, also known as microchip, containing thousands of transistors and other components. Computers became even smaller, faster and more affordable, leading to their use in a wider range of industries. Operating systems were introduced, allowing computers to run multiple programs simultaneously and manage resources more efficiently. *IBM 360* series machines were the newly introduced computing device in this era.

iv) Fourth Generation (1971–Present)

The development of the *microprocessor*, a single IC that contains all the functions of a computer's central processing unit (CPU), marked a turning point. This generation brought computing to the general public, transforming society and giving rise to the digital age. The microprocessor became the brain of the computer. The invention of the *Intel 4004* microprocessor in 1971 is a landmark event. The development of more user-friendly software and the rise of the Graphical User Interface (GUI) made computers accessible to the general public. The invention of the CPU led to the creation of personal computers (PCs), laptops and eventually mobile devices. The internet was also developed during this era. The important machines introduced were *Apple II*, and *IBM PC*.

v) Fifth Generation (Present and Beyond)

While the fourth generation is still prominent, the concept of fifth generation is often used to describe future and present technologies that go beyond traditional computing. We are currently witnessing and utilising the parallel or mixed use of fourth and fifth-generation computers. This generation aims to create computers that can interact with the world in more natural ways and solve problems of incredible complexity, shaping the future of science, medicine and technology. Technologies like Artificial Intelligence (AI), Parallel Processing, Quantum Computing and DNA Computing have been incorporated in to the computing process of this era. Currently, IoT (Internet of Things), Modern AI systems and quantum computers are also in development stage.

- **Artificial Intelligence (AI):** It is the ability of a computer or machine to perform tasks that normally require human intelligence, such as learning, reasoning, linguistic intelligence, perception and problem-solving.
- **Parallel Processing:** It is the use of multiple processors working together to solve a single problem, increasing speed and efficiency.
- **Internet of Things (IoT):** The Internet of Things (IoT) refers to a vast network of physical objects (things) that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet.
- **Quantum Computing:** A new approach that uses the principles of quantum mechanics to perform calculations, with the potential to solve problems that are currently impossible for traditional computers.
- **DNA Computing :** This is a form of biological computation that uses DNA molecules, enzymes, and biological reactions instead of traditional silicon-based transistors to process information.



1. The first known calculating device is _____.
2. The second generation of computers used _____ instead of vacuum tubes.
3. _____ is known as the father of computers.
4. The second generation of computing introduced _____ programming language.





5. GUI was initially used in _____ generation of computers.
6. What are the contributions of Ada Lovelace in computing.
7. Distinguish between first and second generation computers.
8. Expand ENIAC, EDSAC and UNIVAC.
9. What is artificial intelligence?
10. Identify the main technology of each generation of computing

Match the following

1. First Generation	a) Artificial Intelligence
2. Second Generation	b) Vacuum Tubes
3. Third Generation	c) Microprocessors
4. Fourth Generation	d) Transistors
5. Fifth Generation	e) Integrated Circuits

1.2 Computer System

Computer is an electronic data processing machine that can be programmed to input, store and process data to produce output. It is made up of different hardware and software components.

Computer system usually consists of hardware components such as input/output (I/O) units, Central Processing Unit (CPU) and Storage Unit. All these components are mutually dependent and work together as a single unit to produce the desired output. It becomes a system when the different units perform their individual tasks to achieve a common goal. Nowadays, computers come in various forms such as servers, personal computers (PCs), laptops, tablets, and smart phones. Some of the devices are shown in Figure 1.2.



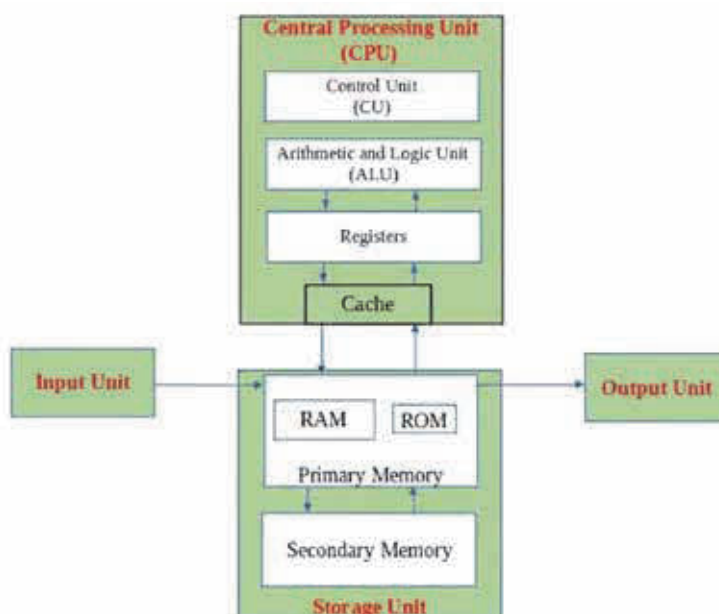
Figure 1.2 - Computing devices

1.2.1 Computer Organisation

A computer is an electronic device that processes raw data into meaningful information. This transformation is made possible through the organised arrangement of various hardware components, known as functional units. A computer operates using both hardware and software, working together to perform the tasks efficiently. Its internal organisation is designed to ensure the smooth flow of data from input devices to processing units, storage components, and finally to output devices. Computer organisation refers to the structure, interconnection, and operation of these hardware components that enable the execution of instructions. This session focuses on understanding the hardware components of a computer and how they are organised to function as an integrated system.

The computer system is organised into different functional units that perform specific tasks. These units work together to achieve the overall purpose of data processing. The main *functional units* are *Input Unit*, *Central Processing Unit (CPU)*, *Storage Unit (Memory)* and *Output Unit*. The basic structure of a computer system can be broken down into three main categories - Hardware, Software and User. Hardware refers to the physical, tangible components of the computer. Software is the set of instructions and programs that tell the hardware to perform a task. User is the one (Human, Device or AI tool) who interacts with the computer system.

1.2.2 Block Diagram of Computer Organisation



The Von Neumann architecture, published by John Von Neumann in 1945, is the foundational design for almost all modern computers. It is based on the stored-program concept, meaning that both instructions and data are stored in the same memory unit. The block diagram is depicted in Figure 1.3.

Figure 1.3 - Block Diagram of Computer Organisation



i) Input Unit

The input unit is used to feed data into a computer system. Input devices accept data and instructions, and convert them into digital form that a computer can understand. The data is encoded into machine-readable form (binary) and is transferred to the processing unit. Some of the input devices are keyboard, mouse, scanner, microphone, barcode reader, touch screen, etc. Specially designed input devices are commonly available today. Besides, we can input data through voice, visuals, biometric sensing, etc. Voice search and mobile biometric passwords are some examples.

Computing has evolved far beyond the traditional usage of keyboard and mouse. Nowadays, we have shifted to 'multimodal' control. This simply means you can pick the easiest way to talk to your devices using your *voice, touch, eyes, or even your thoughts*. Modern gadgets are now 'ambient'. That means, 'ambient gadgets' are devices that work quietly in the background of your life you don't have to think about them or control them like a traditional computer. Instead of a computer sitting on a desk, technology is built into our clothes, our bodies, or the rooms around us. For example smart lights, smart watches and voice assistants. Because these devices are getting smarter, we have changed how we use them to make life faster and easier for everyone. The biggest trend right now is the 'Always-Available' strategy. Think of it like the air around you, it is always there, even if you cannot see it. We use small sensors worn on our body so that we can control your digital world instantly from anywhere. Figure 1.4 depicts some input devices and modern strategies.

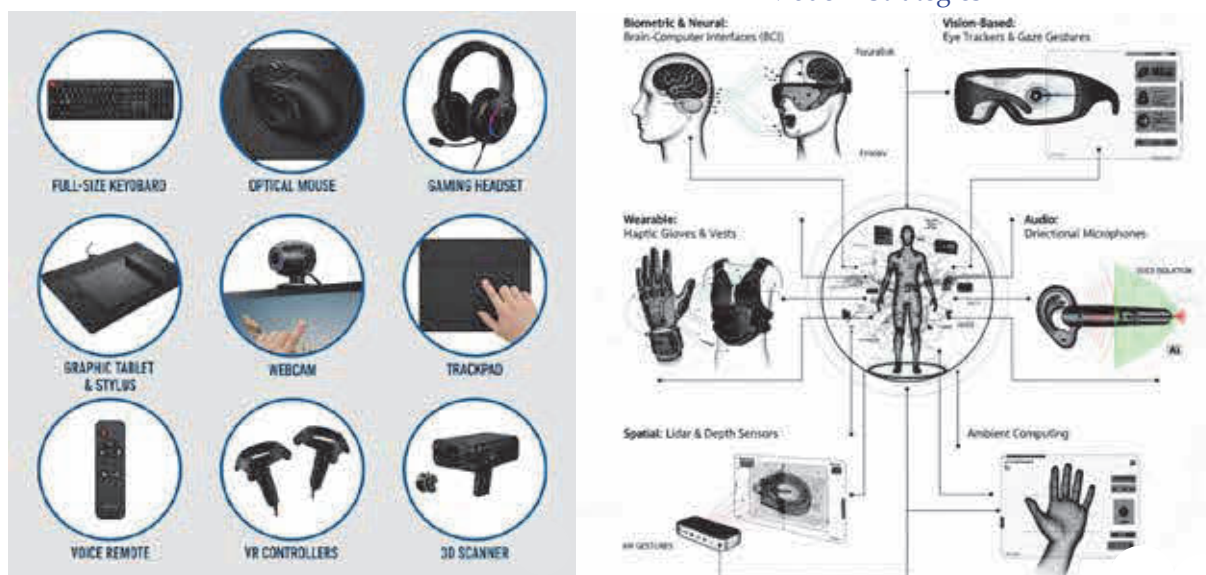


Figure 1.4 - Input devices and modern strategies

ii) Central Processing Unit (CPU)



CPU

It performs all the processing, and controls the functions of other units inside the computing device. CPU is commonly known as the processor. It consists of several microchips usually called Integrated Circuits (IC).

The CPU works based on the instructions given through programs. It fetches data and programs from memory and performs arithmetic and logical operations as per the given instructions to produce results, which are then stored back into memory. During processing, the CPU stores data and instructions in high-speed memory called registers, which are a part of the CPU.

Apart from registers, the CPU has two more main components - Arithmetic Logic Unit (ALU) and Control Unit (CU). CU acts like a 'traffic police man' who controls the traffic system, inside the computer. It directs the flow of data between different functional units and interprets instructions in the programs. ALU performs all arithmetic operations like addition, subtraction, multiplication, division and executes logical operations like comparisons such as greater than, equal to, or less than, etc. This component has the main role in decision-making processes.

Registers are the smallest and the fastest storage locations within the CPU. They temporarily hold data, instructions, and memory address necessary for the CPU to perform operations. CPU registers are categorized based on their specific function in the instruction execution cycle.

The two main categories are *Special-Purpose Registers (SPRs)* and *General-Purpose Registers (GPRs)*. *Special-Purpose Registers (SPRs)* are essential for managing the state and control of the CPU and the program's execution flow. *General-Purpose Registers (GPRs)* are flexible and can be used by the programmer (via assembly language) or the compiler to store temporary data and intermediate results during the execution of a program. The different SPRs and GPRs are listed in Table 1.1. We will discuss more about microprocessors in section 1.2.3.



Table 1.1 - SPRs and GPRs

Special-Purpose Registers (SPR)	General-Purpose Registers (GPR)
Program Counter (PC)	AX (Accumulator)
Instruction Register (IR)	BX (Base)
Memory Address Register (MAR)	CX (Counter)
Memory Buffer Register – MBR(also called Memory Data Register-MDR)	DX (Data)
Status Register	SI (Source Index)
Stack Pointer (SP)	DI (Destination Index)

iii) Output Unit

The *output unit* is responsible for converting the processed data from the computer's digital format into human-readable format. It is used to present the results after processing the data. The monitor, projector, headphone, speaker and printer are some examples. Visual display Unit (VDU) like monitor and projector are the most commonly used *softcopy* output devices, and printer is the most widely used *hardcopy* output device. Inkjet, laser jet and dot matrix are the widely used printers for office purpose. Recently, 3D printers are also available for 3D design printing to build exact physical replicas of 3D images. 3D printing has a wide range of uses in prototyping and manufacturing industries like automotive, aerospace, medical, architectural and construction. Some of the output devices are shown in Figure 1.5.



Figure 1.5 Output devices

iv) Storage unit

The computer system needs to store data and instructions before processing and the results after processing. The storage unit or memory is where data and instructions are held for future use. It is essential to store data temporarily or permanently. At the physical

level data is stored in the form of 0s and 1s. The binary digits 0 and 1 are the basic units of memory called *bits* (**binary** digits). A 4 bit combination of bits is known as *nibble* and eight bit combination is called *byte*. In computing, memory size is measured using a hierarchy of units based on the number of bits. Table 1.2 contains the different memory units and their size.

Table 1. 2 - Memory units and their size

Unit	Abbreviation	Size
Bit	b	1 or 0 (1 bit)
Nibble	N (or nb)	half byte (4 bits)
Byte	B	1 Byte (8 Bits)
Kilobyte	KB	1,024 bytes
Megabyte	MB	1,024 KB
Gigabyte	GB	1,024 MB
Terabyte	TB	1,024 GB
Petabyte	PB	1,024 TB
Exabyte	EB	1,024 PB
Zettabyte	ZB	1,024 EB
Yottabyte	YB	1,024 ZB

Storage unit is generally classified into Primary Storage (Main Memory) and Secondary Storage (Auxiliary Memory). Primary Memory is also called internal memory which is directly accessible by the CPU, and used for short-term storage. RAM (Random Access Memory) is the most common type of primary storage. It is fast but volatile, in the sense that data is lost when the power is turned off. ROM (Read Only memory) and Cache memories are also considered as primary memory due to their direct accessibility by the CPU. RAM and cache are volatile, whereas ROM is non-volatile. RAM is used to hold the data and programs that are being used by the computer system while running. ROM stores essential programs such as the BIOS (Basic Input Output System) and other firmware, which are necessary to start a computer. For example, when we press the power button of a computer, the bootloader stored in to ROM initiates and loads the operating system from secondary storage into RAM. This process is called *booting*.





Boot Loader

A boot loader is a small program that runs every time you power on a computer, smart phone, or any other computing device. Its primary role is to load the operating system into RAM, a process that follows the Power-On Self-Test (POST).

The Cache memory is a small, high-speed memory located inside or very close to the CPU. Usually it is placed in between RAM and CPU. Even though RAM is faster than secondary memory, it is not as fast as CPU. Due to this slowness of RAM, CPU will be idle for an interval of time without getting data from RAM. This may lead to the lack of maximum utilisation of CPU. To avoid this delay, Cache memory is used with CPU. It stores copies of frequently accessed data from RAM. When the CPU needs data, it first searches the cache memory. If the data is in the cache, it is read from there; otherwise, it is fetched from RAM. Different types of Cache memories in the CPU are L1 (Level 1), L2 (Level 2) and L3 (Level 3).



Memory hierarchy

Secondary Storage or External Memory is used for long-term storage of data and programs. It is non-volatile, slower and has a larger capacity than primary storage. Some secondary storage devices are Hard Disk Drives (HDDs), Solid-State Drives (SSDs), USB flash drives, and memory cards. Nowadays, comparing with HDD, SSD is more common in use because it is much faster, more durable, has less noise, lower power consumption, lightweight and compact. The emerging technology like quantum computing may change the existing memory devices. Different storage devices are shown in Figure 1.6.



Figure 1.6 Storage devices

1.2.3 Microprocessor

A microprocessor is a computer processor where the data processing logic and control are included on a single integrated circuit (IC), or a microchip. Figure 1.7 shows the image of a microprocessor. Moore's Law, as stated by Intel co-founder Gordon Moore in 1965 (revised in 1975), is the observation that the number

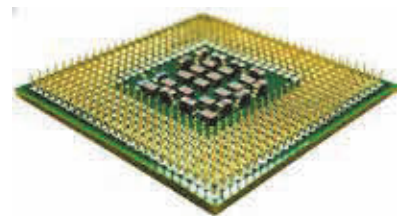


Figure 1.7 Microprocessor

of transistors that can be economically placed on an integrated circuit (IC) doubles approximately every two years. In the early 1960s, SSI (Small Scale Integration) chips were manufactured with approximately 1 to 100 transistors. By the early 1970s, technology moved to MSI (Medium Scale Integration), where between 100 and 1,000 transistors were integrated onto a single chip. Later in 1970s, LSI (Large Scale Integration) chips that consist of 1,000 to 10,000 transistors, in 1980s, VLSI (Very Large Scale Integration) chips that use 10,000 to millions of transistors, and at present ULSI (Ultra Large Scale Integration) chip comprising millions to billions of transistors are introduced. These developments are shown in Figure 1.8.

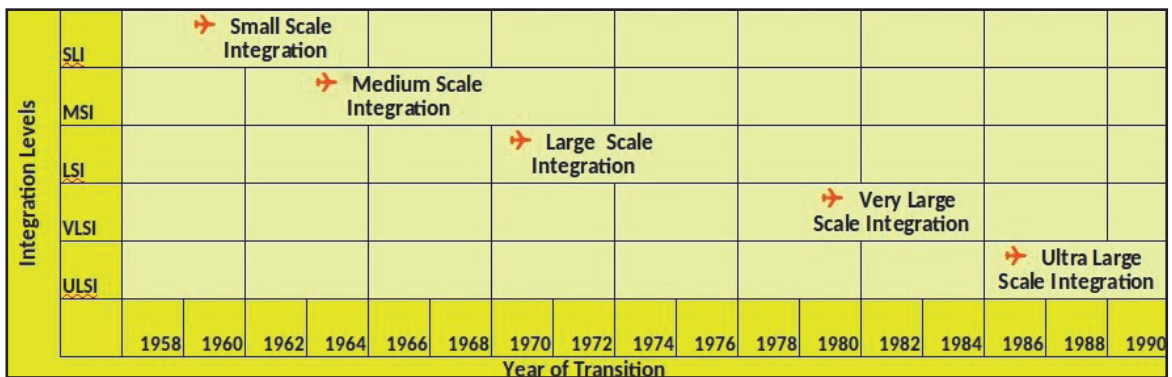


Figure 1.8 . Timeline diagram of micro processor evolution

1.2.4 Performance Characteristics of Microprocessors

The microprocessors are used based on several key criteria that reflect their architecture, performance, and intended applications. The followings are some performance characteristics of microprocessors.

i) Word Length

This refers to the number of bits the microprocessor can process at a time. Table 1.3 shows microprocessors with various word lengths.

Table 1.3 Microprocessors with different word lengths

Microprocessor	Word Length
Intel 4004	4-bit
Intel 8085, Zilog Z80	8-bit
Intel 8086, Motorola 68000	16-bit
Intel 80386, ARM7	32-bit
Intel Core i7, AMD Ryzen	64-bit



ii) Clock Speed

Clock speed simply means the number of pulses generated per second by the clock inside a computer. The clock speed indicates the speed at which the computer can execute instructions. Earlier, it was measured in Hertz (Hz) and Kilohertz (kHz). But with advancement in technology and chip density, it is now measured in Gigahertz (GHz), i.e., billions of pulses per second.

iii) Number of Cores

Imagine an office with only a single worker responsible for every task. If there are two or more workers, tasks can be performed in parallel, resulting in faster job completion. Think of a single-core CPU as an office with just one worker handling every job sequentially. Adding more workers (cores) allows tasks to be done in parallel, leading to much faster performance. Thus we can say core is the physical processing unit within a microprocessor (CPU) that executes instructions. Today we are using multi-core processors such as Dual-core, Quad-core, Octa-core, Hexa-core etc., in modern CPUs.

1.2.5 Motherboard

A motherboard is the main circuit board of a computer. The motherboard acts as the backbone of the computer system, providing power, connections, and communication paths for all hardware components to work together. It is the main printed circuit board (PCB) that connects and allows communication between all major components, such as



Motherboard

- Processor
- RAM, ROM
- Storage devices like HDD, SSD, etc.
- Input/Output devices (keyboard, mouse, etc.)
- Expansion cards (graphics, sound, network cards)



1. _____ is called the brain of a computer.
2. _____ memory stores data permanently.
3. The main function of _____ is to perform arithmetic and logical operations.
4. ULSI stands for _____.
5. 1KB = _____ bytes.
6. Explain the role of Control Unit.
7. What is the importance of cache memory?



8. What is word length?
9. List any six storage devices.
10. Name any six input and output devices.
11. Compare RAM and ROM.
12. Differentiate between Primary and Secondary memories.
13. Differentiate between softcopy and hardcopy outputs.
14. What are registers? List the registers inside CPU.
15. Explain core in a microprocessor.
16. Expand SSI, MSI, LSI.
17. Explain the working of a computer system with the help of a block diagram.
18. Explain the role of motherboard. List any two components connected with it.

Match the following

1. Input Unit	(a) Monitor
2. Output Unit	(b) Keyboard
3. ALU	(c) RAM
4. Storage	(d) Arithmetic operations

Activity

1. Collect the latest computing device configurations from advertisements in periodicals.(Paper cuttings or written documents)
2. Identify different input, output and storage devices in computer lab.

1.3 Software

Computer system is a combination of hardware and software. We are already familiar with the physical parts or hardware of computer system. Hardware of a computer system is nothing unless it is operated by instructions. Software is a set of instructions (programs) that tell the computer to perform an action. Without software, a computer is just an inert machine. Some examples of software are operating systems like Linux, Windows and Android, word processing tools like LibreOffice Writer and Microsoft Word,





Spreadsheets like LibreOffice Calc, Presentations like impress and Powerpoint, video players like VLC Player, photo editors like GIMP and database applications like Base, MS Access, MySql and MariaDB. Based on the mode of interaction with hardware and functionality, software is broadly classified into two types: System Software and Application Software.

1.3.1 System Software

System software is a set of programs designed to control and manage the computer hardware. System software manages the overall functioning of the computer system. It acts as a bridge between the hardware and the user's applications. Without system software, application software cannot run. Examples of system software include operating systems, system utilities, device drivers, firmware, language translators, etc.

i) Operating Systems (OS)

An *Operating System (OS)* is an interface between user and the hardware. It is the main control program that manages all other programs in a computer. The OS is the first software loaded into the computer's memory when the system boots up. Table 1.4 shows the functions of Operating System.

Table 1.4 - Functions of an OS

Functions	Description
Memory Management	Allocating and de-allocating memory for running programs
Process Management	Managing the execution of all tasks and processes
File Management	Organizing and storing files on storage devices
Device management	Controlling all I/O devices such as keyboard, mouse, printer
Security and Access Control	Protecting data and system resources from unauthorized access
User Interface	Providing a way for the user to interact with the computer

Some common examples of Operating Systems are

Desktop/Laptop : Microsoft Windows , MacOS, Linux.

Mobile Phones : Android, iOS.

ii) Utilities

Utility software (Utility program) is used to manage, maintain, and optimize the computer system's performance, security, and disk organization. They are the tools that provide support for the smooth functioning of a computer. Some examples are antivirus software, disk clean up tools, file compression software, backup tools, disk defragmenter, etc. The different utility programs and their uses are shown in Table 1.5.

Table 1.5- Utility programs and their use

Utility Software	Purpose	Examples
Antivirus/ Anti-Malware	Protects the computer system from viruses, spyware, ransomware, and other malicious software	Windows Defender, Avast, Avira, McAfee, Malwarebytes, ClamAV/ ClamWin, Panda
File Compression/ Decompression Tools	Reduces the size of files to save storage space and make files easier to transfer (e.g., via email)	WinRAR, 7-Zip, WinZip, PeaZip, gzip, bzip2, LZ4
Disk Management Tools	Manages the computer's hard drive, including partitioning, formatting, and analyzing disk space	Windows Disk Management, MiniTool Partition Wizard, GParted
Disk Cleanup Tools	Scans the hard drive for unnecessary files (like temporary files, cache, and log files) and removes them to free up disk space	Windows Disk Cleanup, CCleaner
Disk Defragmenters	Reorganizes fragmented data on a hard disk drive to store pieces of each file close together, improving data access speed	Windows Disk Defragmenter (or Optimize Drives), MyDefrag
Backup and Recovery	Creates copies of important data (files, folders, or entire systems) and allows for restoration in case of data loss or system failure	Windows Backup and Restore, Time Machine (macOS), Acronis True Image





Uninstallers	Completely removes unwanted software and all related files and registry entries from the system	Revo Uninstaller, IObit Uninstaller
System Monitoring/ Profiler	Provides real-time information and detailed reports on the system's performance, resource usage (CPU, RAM, disk), and hardware/software inventory	Windows Task Manager, Activity Monitor (macOS), CPU-Z

iii) Device Drivers

Device driver or Driver software is a software component that allows the operating system to communicate with the hardware devices in a computer. It works as a translator and a bridge between the operating system and hardware devices by converting commands into instructions that the device can understand and send data back to the operating system. Manufacturers provide these drivers and keeping them updated is crucial for performance, stability, and accessing all device features. The device driver specifications are listed in Table 1.6.

Table 1.6-Examples of device drivers

Device Type	Driver Function
Printer	Tells the OS how to send print jobs
Graphics Card	Enables screen display, resolution, 3D support
Sound Card	Handles audio input/output
Wi-Fi Adapter	Manages wireless network connections
Touchpad	Provides multi-touch gesture support
USB Ports	Manages connected devices like pen drives

1.3.2 Application Software

Application software, often called an '*app*' is a program designed to perform a specific task or solve a particular problem for the user. It operates between the user and the system software. The figure shows the hierarchy of software and hardware. A computer system cannot work without *system software*, but it can function without *application software*. For example, without an operating system, a computer or mobile phone cannot run. However, even without



Hierarchy of software and hardware

application software such as a calculator, graphics editor, word processor, or spreadsheet, a computer or smart phone can still function. Some application software are web browsers, word processors, computer games, media players, and presentation tools. Application software is classified as follows.

i) General-purpose Software

The application software developed for generic purposes is called General-purpose software. They are usually used for performing common tasks.

So many types of software like Word Processors, electronic spreadsheets, Presentations, Database Management System (DBMS), Web Browsers, Graphics Software are available in this category.

ii) Special-purpose Software

The application software exclusively designed to perform a specific task is called Special-purpose software. Some of the examples are Accounting Software, Reservation Systems, Inventory Control Systems, Payroll Systems and Media Players.

1.3.3 Programming Tools

A *program* is a set of instructions that a computer can execute to perform a specific task. *Programming* is the process of writing, testing, and maintaining these instructions. Programs are written in a specific *programming language*. Programming tools, also known as software development tools, are used to create, debug, test, and execute programs. They are essential for the entire software development process. As we know, if the computer wants to do a particular task, we need to give some instructions to process the input data for the desired output. We can communicate with each other using natural languages like Kannada, Malayalam, Tamil, etc. Humans can understand different languages but computers can understand only machine language (Binary language of 1s and 0s). Programmers write instructions in high level language and computers store and process them in machine language. So there must be a translator for the conversion. They are usually called language translators. To write instructions, code editor like Geany, IDLE or Eclipse is required. Here, we will briefly describe some of the program development components such as Programming languages, Language translators and Program development tools.



i) Programming Languages and Language Translators

Writing instructions in the form of 1s and 0s is a tedious task for the human being. To simplify the difficulties while writing instructions, different types of computer programming languages are introduced. These languages are basically classified into two types, Low-level and High-level languages. Low-level languages include machine language and assembly language, and they are machine dependent. 1s and 0s are used in machine language to write instructions which are directly understood and executed by the computer system. As we mentioned earlier, writing code in machine language by remembering operation codes, character codes and machine addresses is very difficult. Error detection and correction in the code is also difficult. Since the code written in machine language is directly understandable by the computer system, there is no need of a translator.

Assembly language was developed to simplify the code writing by using English like notations as symbolic opcodes and mnemonics instead of 1s and 0s. The main problem of writing code in this language is that, it is totally machine specific or machine dependent. The code written for one machine cannot be executed by another machine. Here the code written in assembly language cannot be directly understood by the computer and hence there should be a translator. The language translator called Assembler will translate a program written in assembly language into machine language.

Opcode(Operation Code)

An opcode is the portion of machine language instructions that specifies the operations to be performed. It is the only language represented in binary, a CPU's control unit understands.

Mnemonics

A mnemonic is an abbreviated name used to represent an opcode in assembly language. Instead of memorizing strings of binary digits, programmers use short words like ADD, MOV, and JMP.

Writing and executing codes in low-level language is very difficult because they are totally machine dependent. To reduce and simplify the coding complexity, high-level languages were introduced. They are machine independent and use English-like sentences. The code written in High-level language is not directly understood by the computer system. Hence, translators are needed to convert high-level language code into machine language code.

The language translators, *compiler* and interpreter are used for this case. A compiler translates the entire high-level language program into machine code all at once before the program is executed (GNU Compiler Collection (GCC), Java compiler, etc.). An *interpreter* translates and executes the high-level language program line by line during runtime (Python interpreter, BASIC interpreter, etc).

ii) Program Development Tools

To write the program codes we need some text editors. An editor is a software that allows us to create a text file when we type instructions and store the file as the source code. Lightweight text editors are specifically designed for coding, offering features like syntax highlighting and code completion. In order to simplify the programming procedure we usually use a single screen environment. These are commonly known as Integrated Development Environments (IDEs). This environment integrates all necessary tools (editor, compiler, debugger, etc.) into a single, comprehensive interface. Python IDLE, Geany, Netbeans, Eclipse, Atom and Lazarus are examples for IDEs.

1.3.4 Free and Open-Source Software (FOSS)

Software that grants users the freedom to run, study, change, and share the software and its source code is called *Free and Open-Source Software (FOSS)*. We use FOSS everyday through different computing devices. Operating Systems such as Linux (e.g. Ubuntu, Fedora, Android are based on the Linux kernel), Web Browsers like Mozilla Firefox, Office Suites such as *LibreOffice* (an alternative to Microsoft Office), *Graphics & Design* software like GIMP (GNU Image Manipulation Program, an alternative to Photoshop), Blender (3D creation suite), Web Servers like Apache HTTP Server and Media Players such as VLC Media Player are some examples of FOSS.

The Free Software Foundation (FSF) is a global movement of individuals who support free software that promotes values and ethics. FSF was founded by Richard Stallman in 1985. *Richard Stallman* is co-founder of the GNU project and the free license movement, which has given rise to the biggest digital commons: GNU/Linux, Mozilla Firefox, LibreOffice, Wikipedia and Creative Commons. The word 'Free' refers to freedom, not price free. You can join the FSF community by becoming a Free Software Supporter. KITE (Kerala Infrastructure and Technology for Education) is a promoter of FSF activities.



Richard Stallman





i) Free Software

Free software refers to software that grants users the freedom to run, study, modify, and distribute it. It is important to note that *open-source* and *free software* are usually the same things, just with different goals. The goal of the free software movement is *social justice* and *user liberty*, whereas the open source movement focuses on *better software development*. The following are the four essential freedoms for free software.

1. **Freedom 0** :-Freedom to run the program for any purpose.
2. **Freedom 1** :-Freedom to study how it works and changes it.
3. **Freedom 2** :-Freedom to redistribute copies.
4. **Freedom 3** : Freedom to distribute modified versions.

ii) Open Source Software

Open Source Software is one in which, the *source code is made publicly available* to anyone. Users are typically granted the right to *view, modify, and distribute* the code under the terms of an open source license. Some examples are Ubuntu, Fedora, Android, Mozilla Firefox, Chromium, LibreOffice, Apache HTTP Server, WordPress, etc.

1.3.5 Closed Source Software

Closed Source Software, also known as *Proprietary Software* is the software whose *source code is kept confidential* and is only accessible to the original developers or the organization that owns it. Some examples are Microsoft Windows, Apple Mac-OS, Apple iOS, Word, Excel, PowerPoint, Adobe Creative Suite(Photoshop, Illustrator), Zoom, etc. Table 1.7 shows the features of Open -Source and Closed-software.

Table 1.7 - Features of open and closed source software

Feature	Open-Source Software	Closed-Source (Proprietary) Software
Source Code	Open. You can view, study, and modify it	Closed. Kept secret by the company
Updates/Fixes	Collaboration by a global community; fixes can be rapid	Only the developing company can apply fixes
Security	Transparent. "Many eyes" principle, vulnerabilities are often found and fixed quickly	Obscure. Must trust the vendor that no backdoors or bugs exist
Customization	High. You can change the program to suit your needs	Low. You must wait for the company to add a feature



Richard Stallman - The Father of Free Software

Richard Matthew Stallman (born March 16, 1953), often known by his initials RMS, is an American computer programmer and the founder of the Free Software Movement. He is one of the most influential figures in the history of computing, advocating for the ethical right of users to control their own technology.

Early Life and Career

Stallman's journey began in the early 1970s at the MIT Artificial Intelligence Laboratory. During this time, programmers lived in a "hacker culture" where they freely shared and improved each other's code. However, by the early 1980s, software began to be 'privatised', meaning companies restricted access to the source code. Stallman found this ethically wrong, believing that software should be a community resource.

Major Contributions

Stallman is best known for three landmark contributions to the world of Information Technology.

The GNU Project (1983): He launched this project to create a complete, Unix-like operating system that was entirely free. The name GNU is a recursive acronym for 'GNU is Not Unix.'

The Free Software Foundation (FSF) (1985): A non-profit organization established to support the GNU Project and promote the legal and philosophical principles of software freedom.

GNU General Public License (GPL): Stallman introduced the concept of Copyleft. Unlike traditional copyright that restricts users, the GPL uses law to ensure that the software remains free for everyone to use, modify, and redistribute.



- _____ software manages the hardware and provides a platform for application software.
- _____ is an example for open-source software.
- Programs designed for specific tasks like word processing are called _____.
- FSF was founded by _____.
- Expand FOSS.
- Distinguish between system software and application software.
- Write the functions of an operating system.
- Give two examples each for open source and free software.
- Explain different freedoms related to software.
- Explain the use of Device drivers.





11. What do you mean by utility program? Give any two examples.
12. Explain the types of software with examples.
13. Describe the role of utility software in a computer system.
14. Differentiate between open source and free software with examples.

Match the following

1. Operating System	(a) Mozilla Firefox
2. Utility Software	(b) Spreadsheet
3. Application Software	(c) Windows
4. Open Source	(d) Disk Cleanup

Activity

Install any one open source software (including device drivers) in a computer.

1.4 Data and Information

Data and information are extremely important in the modern world of Artificial Intelligence (AI). They serve as the fundamental basis for knowledge, decision-making, and innovation across all sectors, including business, science, government, and even in daily life. In our daily activities, we encounter large quantities of raw facts—such as numbers, words, figures, or symbols. When these raw facts are scattered or unorganized, they lack specific meaning or context. However, they become useful once they are organized, structured, and processed. Computers are widely used for data processing because of their inherent speed, accuracy, and reliability. A computer system treats everything as data such as characters, pictures, audio, video, documents, and instructions. Most people use the terms data and information interchangeably, even though they are actually quite different. You will understand the critical distinction between data and information, the various stages of data processing, and the essential role computers play in this transformation. The following are the different stages of data transformation depicted in the pyramid diagram.



Pyramid diagram of data transformation

Data

Data is a raw, unorganized fact or a set of facts, such as numbers, text, images, audios, videos, etc. Data on its own has no complete meaning. For example, exam scores of a student, like 85, 92, 78, 95, are data.

Information

Processed data is called *information*. From the previous example, we can generate information such as total score or average score by processing the scores.

Knowledge

Knowledge is the ability to use information to make decisions. For example, by comparing a student's marks with the class average, we can understand whether the student needs improvement.

Intelligence

Intelligence is the ability to apply knowledge to solve problems in different situations. To improve the scores of students, apply strategies such as grouping them based on their learning styles and giving them different types of homework.

Wisdom

Wisdom is the ability to use knowledge and experience to make good decisions in real life situations. For example, a student notices that their maths score is low in two exams. Instead of feeling upset, he decide to change the study plan by practice daily, ask the teachers help, and revise weak topics.

1.4.1 Data Processing

Data processing is a series of activities carried out to convert raw data into meaningful information. It includes collection, manipulation and transformation of data into information. It involves a systematic set of operations performed on data to achieve a desired outcome. This process can be done manually or electronically.

i) Manual Data Processing (MDP)

It is performed using human effort with simple tools like a pen and paper. This method is slow and prone to errors.

ii) Electronic Data Processing (EDP)

It is the most common method today, which uses electronic devices like computers. It is highly efficient, fast, and accurate.





1.4.2 Stages of Data Processing

The data processing involves different stages that transform raw data into meaningful information. These stages are very important in decision-making. Modern data processing has evolved from simple 'collect-input-process-storage-output' cycles into a complex, continuous process. Nowadays, the concept is defined by real-time intelligence, cloud architecture, and AI-driven automation. Data processing has evolved from a rigid, manual, and localised activity into an automated, global, and real-time operation. Instead of waiting for reports at the end of the day, modern systems process data as it happens, allowing the environment to respond to events in milliseconds. Stages of data processing are shown in Figure 1.9.

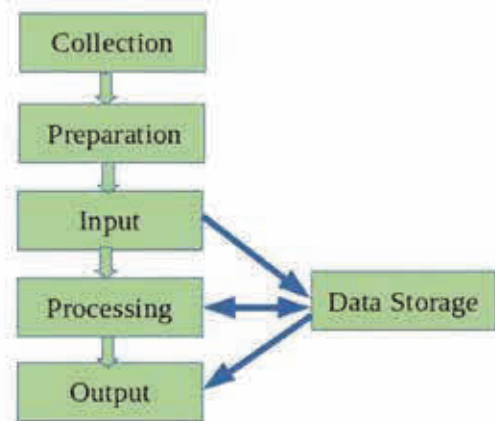


Figure 1.9. Stages of data processing

i. Collection

This is the first and most critical stage. Gathering raw data from various sources is called data collection. Data is collected from sensors, surveys, transaction logs or physical documents. This stage ensures that the data gathered is accurate and complete. For example, collecting marks of students, recording daily sales or registering patients in a hospital.

ii. Preparation

Raw data often contains errors or unnecessary information. In this stage, data is 'cleaned and organized'. The main tasks of this stage are removing duplicates, correcting errors, and filtering out irrelevant facts (often called "Garbage In, Garbage Out" or GIGO). Here we ensure that only high-quality data moves to the next stage.

iii. Input

It is the activity of entering the collected data into the computer system using input devices and other strategies. The cleansed data is converted into a machine-readable format and entered into the computer system. For example, entering sales figures using a keyboard, barcode scanner or by importing digital files.

iv. Processing

This is the stage where the computer actually works on the data. The CPU performs various operations based on instructions.

Manipulating the input data according to given instructions is known as processing. Processing may involve calculations, comparisons, sorting, classifications, or summarising. For example, calculating total sales or generating grades from exam scores.

v. Storage

Storage is the mechanism that holds the data for each transformation phase in data processing. The processed data and results are stored here for future use. Data can be stored temporarily in primary memory (RAM) or permanently in secondary storage (hard disks, SSDs). Nowadays the storage types like cloud, database, archives, etc. are also in use.

vi. Output

Presenting the information in a human-readable form using output devices is called the output. This is the real stage to present the “Information” in a way that users can easily interpret for decision making. For example, displaying the reports, graphs, charts, tables on the monitor, printing an invoice or presenting audio/video.

1.4.3 Computer as a Data Processing Machine



Computer - a data processing machine

The different functional units of computer are used to perform the activities involved in data processing. Inputting can be done with keyboard/mouse, to store the data use devices like HDD, CD, Pen drive, etc., use CPU for processing and display output using monitor, projector, etc. Today computers are widely used for data processing because of their tremendous features. Some of which are the following.

- Speed** : Computers can process millions of instructions per second.
- Accuracy** : Errors are minimal if correct instructions and data are given.
- Storage** : Computers can store large volumes of data.
- Diligence** : The ability to work for hours without getting tired or bored.
- Automation** : Once a program is given, computers can perform tasks automatically.
- Versatility** : The ability to perform different kinds of work. It is used in every walk of human life.





1. Raw facts and figures are called _____.
2. Processed data is called -----
3. _____ stage converts data into meaningful information.
4. Define data and information. Give examples.
5. List the different stages of data processing.
6. Computers are called data processing machines. Why ?
7. Differentiate between data and information.
8. Explain the stages of data processing.
9. Briefly explain the features of a computer system.
10. What are the different types of data processing?
11. Explain manual and electronic data processing.

Match the following

1. Data	(a) Organised and meaningful
2. Information	(b) Raw facts and figures
3. Input	(c) Keeping processed results
4. Storage	(d) Entering data

Activity/Case study

List and write the steps involved in plus one admission procedure (SWS) through hscap.

1.5 Green Computing

Computers and electronic devices have become an integral part of our daily life. However, their tremendous use has created two major concerns-environmental impact of computing and electronic waste (e-Waste) management. By the end of this session, you will learn about green computing and the problems posed by e-waste, as well as the various methods for its disposal.

To reduce harmful effects on the environment, the concepts of Green Computing and proper e-Waste disposal have become very important. Green computing, also known as green IT, is the practice of designing, manufacturing, using, and disposing of computers and related subsystems (like monitors, printers, and storage



Green Computing

devices) in an environment (eco) friendly and energy-efficient way. The goal is to minimize the negative impact of technology on the environment. Many corporate IT departments have green computing initiatives to reduce the environmental effect of their IT operations. Computers and electronic devices are to be used responsibly to support sustainable development. Through Green Computing and safe disposal of e-Waste, we can ensure that technology benefits society without harming the environment.

The key principles of green computing include

Energy Efficiency: Energy efficiency is the practice of using less power for devices and data centres. This involves using energy-saving hardware and implementing power management features.

Eco-Friendly Materials: Designing and manufacturing devices with biodegradable materials that are less harmful to the environment and which can be recycled.

Waste Reduction: Extending the lifespan of devices to reduce the amount of electronic waste produced. This is a key focus area.

Responsible Disposal: Ensuring that old and obsolete equipment is handled and disposed properly and safely.

1.5.1 E-waste

E-waste, or electronic waste, refers to discarded electrical or electronic devices such as computers, mobile phones, televisions, printers,



E-waste

and other gadgets. As technology rapidly evolves, consumers and manufacturers frequently upgrade devices like smart phones, laptops, and televisions, creating a massive amount of e-waste.

The main problem with e-waste is its composition. It contains both valuable materials like gold, silver, copper, and palladium, and hazardous substances such as lead, mercury, cadmium, bromine and arsenic. When e-waste is improperly

disposed of, the toxic substances can dissolve into the soil and groundwater, contaminating ecosystems and posing serious health risks to humans and animals.



1.5.2 E-waste Disposal Methods

Responsible disposal of e-waste is crucial for protecting the environment and human health. Here are the main e-waste disposal methods, including both safe and harmful or unsafe.

i) Safe Methods

Reuse: If a device is still functioning after its long term usage, sell it, or give it to someone (Schools, Individuals in need, etc.) who can use it.

Recycle: For devices that are no longer working, ensure they are sent to a certified e-waste recycling facility. These facilities can safely dismantle devices, separate hazardous materials, and recover valuable metals and plastics for use in new products.

Manufacturer Take-Back Programmes: Many electronics companies (e.g., Apple, Dell and HP) offer free return trade-in programme.

ii) Unsafe Methods

Land filling: E-waste is simply buried in landfills, where its toxic chemicals can contaminate the surrounding environment.

Incineration: Burning e-waste at high temperatures reduces its volume but can release harmful toxins and gases into the atmosphere.

Acid Baths: In some informal recycling operations, components are submerged in strong acids to dissolve metals. This is highly dangerous and produces toxic chemical waste that is often improperly disposed of, polluting local water sources.

Exporting to Developing Countries: Illegal or unethical export of e-waste to countries with poor regulations leads to environmental pollution and health hazards for workers handling e-waste without protection.



E-Waste disposal

1.5.3 What Should Be Done

To protect ecosystems from e-waste damage, we need to

Recycle electronic devices responsibly via certified recyclers.

Reduce e-waste by buying less or repairing devices.

Proper disposal of e-waste with drop-off centres or manufacturer take-back.

Educate people to handle the e-waste safely.



1. The eco-friendly use of computers is called _____.
2. Discarded electronic devices are known as _____.
3. Toxic substances like mercury and lead are found in _____.
4. Define Green Computing. Write about any two green computing practices .
5. What are the health hazards caused by e-Waste?
6. Distinguish between reuse and recycling.
7. What are the key principles of green computing?
8. Why do we protect our ecosystems ? Explain.
9. Explain the concept of e-Waste and its problems.
10. Discuss the disposal methods of e-Waste with examples.
11. How does Green Computing contribute to environmental protection?

Match the following

1. Green Computing	(a) Discarded computers
2. e-Waste	(b) Energy-efficient use of technology
3. Recycling	(c) Producer responsibility
4. Take-back programmes	(d) Extracting valuable materials from old devices

Activity

Collect the e-wastes in your school and segregate them into reusable, recyclable, and unusable categories and suggest appropriate e-waste disposal methods for each of them.

Summary

A computing system is a programmable electronic machine that transforms raw data into information. Most modern systems follow the Von Neumann architecture, which utilises a Central Processing Unit (CPU) to fetch and execute instructions stored alongside data in a single memory unit. Data processing has evolved significantly from early manual tools like the Abacus to high-speed electronic machines which are capable to handle complex tasks in fractions of a second. Beyond hardware, the system depends on software, which is broadly classified into system software





and application software. Free and Open-Source Software (FOSS) is a vital part of this ecosystem, granting users the freedom to run, study, modify, and redistribute the source code. In contrast, closed-source or proprietary software keeps its source code confidential and freedoms are restricted to the users. The rapid pace of development means that new technologies emerge quickly which often leads to significant environmental challenges such as the accumulation of e-waste. E-waste consists of discarded devices like old computers and smart phones that can release toxic substances if not handled correctly. To tackle this situation effectively, green computing practices emphasis on energy efficiency and the responsible recycling or reuse of electronic components to protect ecosystems. As a whole this chapter covers the technological developments from historical roots to the modern organization of computing systems.



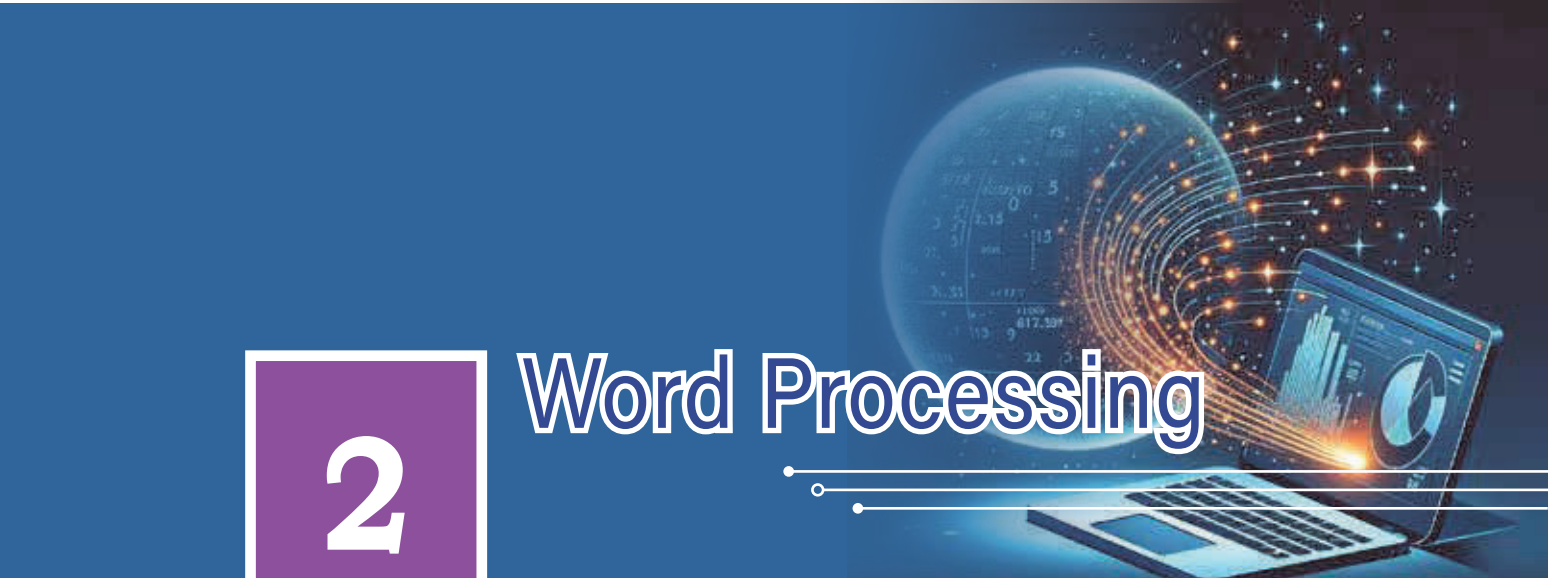
1. ROM stands for _____ .
2. Data processing converts raw data into _____.
3. Removing duplicate records is done during _____ stage.
4. Which unit acts as a 'traffic policeman' by directing the flow of data between functional units?
 - a) Arithmetic Logic Unit b) Accumulator c) Control Unit d) Status Register
5. In the memory hierarchy, which unit is exactly equal to half a byte?
 - a) Bit b) Nibble c) Kilo byte d) Peta byte
6. Which of the following is considered a "hardcopy" output device?
 - a) Monitor b) Projector c) Printer d) Speaker
7. Which organization was founded by Richard Stallman in 1985 to promote software ethics?
 - a) OSI b) FSF c) KITE d) GNU Project
8. Which stage of data processing removes errors and duplicates?
 - a) Collection b) Input c) Preparation d) Output
9. Which unit of the computer performs processing?
 - a) Input unit b) Output unit c) Storage unit d) CPU
10. "Garbage In, Garbage Out (GIGO)" is related to which stage?
 - a) Collection b) Preparation c) Storage d) Output
11. Which of the following is a hazardous substance found in e-waste?
 - a) Oxygen b) Mercury c) Nitrogen d) Helium
12. Which is a safe method of e-waste disposal?
 - a) Incineration b) Land filling c) Recycling d) Acid bath

13. Manufacturer take-back programmes are offered by
a) Schools b) Hospitals c) Electronics companies d) Farmers
14. Distinguish between General-purpose and Special-purpose application software.
15. Explain the hierarchy and relationship between the CPU, Cache memory, and RAM.
16. How does Cache memory improve CPU utilization?
17. Compare Open source and Closed source software.
18. What is the primary function of a “Device Driver”?
19. Give any two examples of “Ambient gadgets”.
20. What are the three levels of Cache memory?
21. List the different functions of an Operating System.
22. Explain the modern Input strategy and the “Always-Available” Concept.
23. Explain the features of computer system.
24. Define data processing.
25. Write the advantage of electronic data processing.
26. Write any two differences between MDP and EDP.
27. List the stages of data processing.
28. Write any two advantages of computers in data processing.
29. What is meant by storage in data processing?
30. Give two examples of data collection.
31. Explain Manual Data Processing and Electronic Data Processing with examples.
32. Explain any four features of computers as a data processing machine
33. Explain the role of a computer as a data processing machine.
34. Draw and explain the Stages of Data Processing.
35. Define e-waste.
36. Name any two hazardous substances found in e-waste.
37. Give two examples of an electronic device that becomes e-waste.
38. Write any one objective of green computing.
39. What is a manufacturer take-back programme?
40. List any two principles of green computing.
41. Write any two problems caused by improper e-waste disposal.
42. Write any two safe methods of e-waste disposal.
43. What are the hazardous substances present in e-waste?
44. Explain green computing in detail. Discuss its key principles.
45. Describe the safe and unsafe methods of e-waste disposal.



2

Word Processing



“Libre Office is about more than software. It’s about people, culture, creation, sharing and collaboration”

The Document Foundation

2.1 Introduction

In today’s digital learning environment, digital documents are more important than ever. When you prepare an assignment, draft a project report, or design a newsletter, a word processor makes the task simpler, faster and more professional. One such powerful tool is LibreOffice Writer, an open-source application that provides nearly all the features of paid software such as Microsoft Word but without cost. It supports universal file formats, making it a perfect choice for students, teachers and professionals.

This chapter takes you on a complete tour of LibreOffice Writer from creating a document, basic editing to advanced document design. It blends real-world examples, hands-on exercises and creative challenges to help you become confident in digital documentation.

2.2 Getting Started with LibreOffice Writer

Before exploring LibreOffice Writer, let’s discuss what a word processor is and what its key features are.

Word Processor: A word processor is software used to create, edit, format and print documents such as letters, reports and projects. It offers many useful features that make typing faster and more accurate. Word processors can be offline applications installed on your computer (like LibreOffice Writer and Microsoft Word) or online web-based tools (like Google Docs and Microsoft Word Online).

Features of a word processor

Some of the key features of a word processor are given below:

- Editing tools like cut, copy paste, undo and redo to correct or rearrange text easily.
- Formatting options to change font type, size, color, alignment, line spacing and apply styles.
- Spell check and grammar check to reduce language mistakes.
- Page layout settings to set margins, page size, headers, footers and page numbers.
- Tools to insert tables, pictures, symbols and charts to make documents more attractive.
- Find and replace to quickly search and change specific words or phrases.
- Auto-save and support for file formats like .odt, .docx, or .pdf for safe storage and sharing.

These features help you prepare neat, readable and professional documents.



Did You Know? The AI Revolution in Word Processing

Modern word processors are evolving beyond simple text editors into intelligent writing assistants powered by **Artificial Intelligence (AI) and Natural Language Processing (NLP)**.

Smart Composition: AI algorithms can now predict your next words (predictive typing) and generate entire paragraphs based on brief prompts using Generative AI.

Contextual Refinement: Advanced grammar checkers analyze sentence context to suggest stylistic improvements (e.g., formal vs. casual tone) rather than just correcting spelling errors.

Automated Summarization: Large Language Models (LLMs) integrated into office suites can scan lengthy documents to generate concise summaries or extract key action items instantly.

Intelligent Formatting: AI agents can recognize unstructured data (like a list of items) and automatically convert it into structured tables or charts without manual formatting.

This transformation turns the word processor from a passive tool into an active collaborator in the documentation process.

2.2.1 What is LibreOffice Writer?

LibreOffice Writer is a free, open-source word processor contained in the LibreOffice suite developed by The Document Foundation. It





enables you to create letters, essays, research papers, newsletters, reports and much more. Unlike paid alternatives, Writer is compatible with almost every operating system - Windows, Linux and MacOS.

2.2.2 Exploring the Interface

To open LibreOffice Writer, click on **Start > All Programs > LibreOffice > LibreOffice Writer** (on Windows), **Applications > Office > LibreOffice Writer** (on Ubuntu), or search for it in your applications menu. When you first open LibreOffice Writer, the window displays following components:

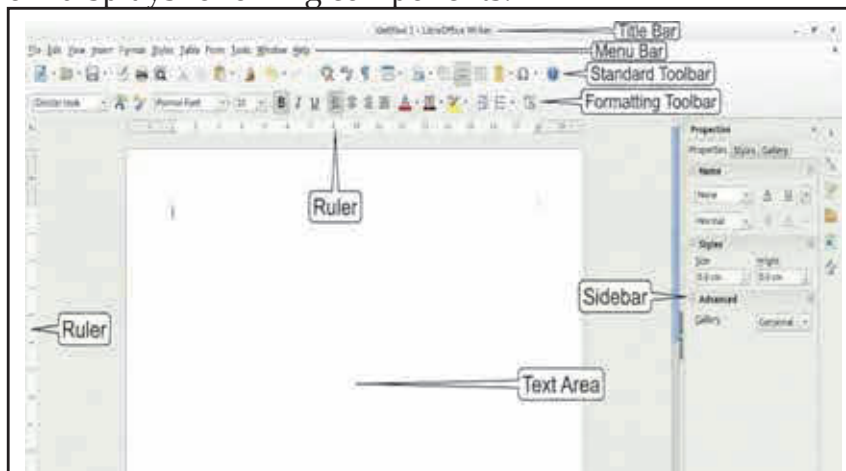


Figure 2.1 - LibreOffice Writer interface

Title bar: Located at the top of the Writer window. It shows the file name of the current document. When the document is not yet named, the document name will appear as Untitled X, where X is a number. Untitled documents are numbered in the order in which they are created.

Menu bar: Appears just below the Title bar and provides access to all major functions of Libreoffice Writer. Each menu contains a list of commands that help you perform different tasks.

- **File Menu:** Contains options like New, Open, Save and Close for managing documents.
- **Edit Menu:** Includes tools like Cut, Copy, Paste and Find & Replace ... (the three dots mean a dialog box will open).
- **View Menu:** Lets you adjust how your document looks, such as showing or hiding Toolbars and changing Zoom levels (a right arrow means more options are available).
- **Insert, Format, Styles, Table, Form, Tools, Window, Help:** These menus provide access to document formatting, style

management, table creation, form design, spell check, window management and help topics.

The Menu bar is essential for navigating and controlling all of Writer's main features easily.

Sidebar: The Sidebar is on the right side of the Writer window and it is open by default. If it is not visible, choose **View > Sidebar** or click the Hide/Show button on the right edge. It helps you change settings quickly without opening many dialog boxes. The following options can do it.

- **Properties** : font, alignment, spacing of text
- **Styles** : apply and manage styles
- **Gallery** : insert images and shapes into the document
- **Navigator** : jump to pages, headings and objects
- Page, Style Inspector, Manage Changes and Accessibility tools are used to review and improve the document.

Toolbars: Toolbars are used for quick access to common tools and commands. The Standard toolbar is typically positioned immediately below the Menu bar. Formatting toolbar is placed below it and its options activate based on what you are working on. For example:

- When the cursor is in text, it shows options like font, size, bold (**B**), italics (**I**) and alignment.
- When you select an image, it shows tools for cropping, borders and other picture settings.

Toolbars can be:

- *Docked*: fixed at the top, bottom, or sides of the window.
- *Floating*: free to move anywhere on the screen. You can drag a docked toolbar to make it float, or drag a floating one to the edge to dock it again. Writer also has extra toolbars that appear when needed, depending on the cursor position or the object you select.

Ruler: Rulers in LibreOffice Writer help you control the layout of your page. They show measurements so that you can quickly see and adjust margins, tab stops and indents for paragraphs and objects.

- The **horizontal ruler** appears across the top of the page by default. It is used most often to:





- Set left and right margins
- Create and move tab stops
- Change the first-line and hanging indents of paragraphs
- The vertical ruler is on the left side of the page, but it may be hidden. To turn it on, choose **View > Rulers > Vertical Ruler**. You can use the vertical ruler to:
 - Check and adjust top and bottom margins
 - Align objects, such as images or text frames, from top to bottom on the page
- To quickly show or hide both rulers, press Ctrl+Shift+R. This makes it easy to switch between a simple and a detailed workspace.

Workspace (Text Area): It is the area where you can type and edit the main document.

Status Bar: The Writer Status bar is located at the bottom of the workspace. It displays information such as page number, word count and language. You can hide it by deselecting it in the View menu.

2.2.3 File Basics

Saving and managing files correctly is essential for the smooth work. LibreOffice Writer facilitates flexibility by supporting multiple file formats and this section outlines the fundamental operations required to manage these files, including creating, saving, opening and closing documents.

Starting a new document: You can start a new, blank document in Writer in several ways.

- Use **File > New** on the Menu bar and select the type of document in the submenu.
- When Writer is open, use the keyboard shortcut Ctrl+N to create a new Writer document.
- If a document is already open in LibreOffice, click the New icon on the Standard toolbar and a new document of the type shown on the icon is created in a new window.

Saving a document: To save a document, use any of the following commands:



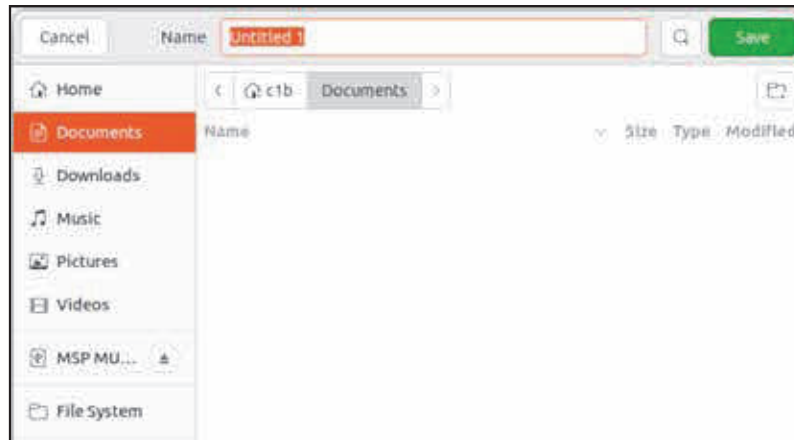


Figure 2.2 - The 'Save As' dialog box

Save: Use to update the existing file with your latest changes. It overwrites the previously stored version on your computer using the current filename, file format and folder location.

Note: When you click Save for the very first time on a new document, Libreoffice will automatically trigger the Save As dialog box because the computer does not yet have a filename or location for the file.

Save As... : use to create a new document, or change the filename and/or file format, or save the file in a different location on your computer.

Save Remote... : use if your document is already stored in a remote server or to store in a remote server.

Save a Copy...: used to save a copy of your current document and keep the current document open for more editing.

Save All : used to save all the files open in the current session.

“Save As” allows you to alter the document’s specific properties, such as its name, file format, or storage path. It focuses on establishing a new document file, whereas “Save a Copy” is strictly for generating a duplicate. It explicitly ensures the original document remains as active window for continued editing

By default, Writer saves documents automatically in a temporary file at regular intervals and creates backup copies. You can set or change the time interval, or to turn off automatic saving or backup copies.

Opening an existing document: you can open an existing document in several ways.



- When no document is open:
 - Click **Open File** or **Remote files** in the Start Center.
 - Choose **File > Open...** or **File > Open Remote...** on the Menu bar.
 - Press Ctrl+O on the keyboard.
 - Click a thumbnail in the list of recently opened documents displayed in the Start Center.
- If a document is already open:
 - Click the **Open** icon on the Standard toolbar.
 - Click the small triangle to the right of the Open icon and select from a list of recently opened documents, or select Open Remote File.
 - Use **File > Recent Documents** to make a selection from the list of recently worked files.

Closing a document: To close a document, go to **File > Close** on the Menu bar or click the X on the right or left end of the Menu bar. If the document has not been saved since the last change, a message box is displayed. Choose whether to save or discard your changes.

2.3 Editing Documents

Word processing is more than just typing words; it is about making your content clear, organized and pleasant to read. Editing focuses on what you write: correcting spelling and grammar, improving sentences and checking the meaning.

2.3.1 Basic Editing Tools

Editing is the foundation to prepare a good document. LibreOffice Writer provides different tools that help you refine your content with ease. Here is the list of basic editing tools used in LibreOffice Writer:

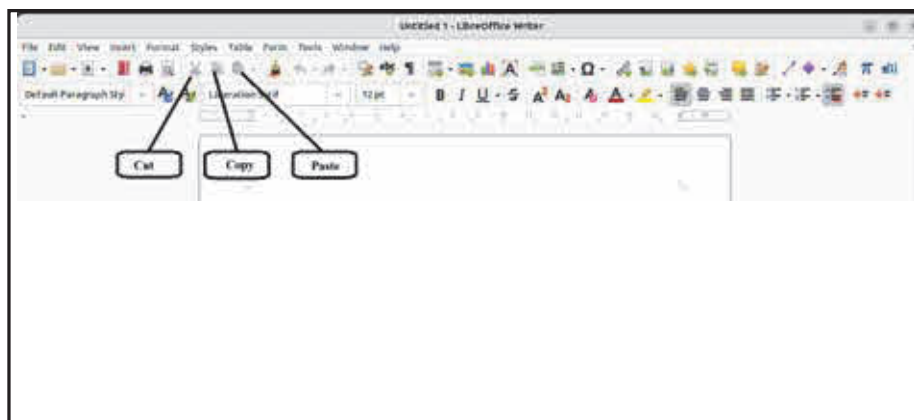


Figure 2.3 - The Standard Toolbar with the Cut, Copy and Paste icons

Select: Before editing a content, you need to select it first. You can swipe the mouse pointer over text or use multiple clicks to select a word (double-click), sentence (triple-click), or paragraph (quadruple-click). You can also click on the text, press F8 to enter Extending selection mode and then use the arrow keys on the keyboard to select a contiguous block of text. Press F8 again when finished selecting the block of text.

- **Cut** : Removes selected text or objects from the document and places them in the clipboard (a temporary storage area that holds text or objects you cut or copy) for pasting elsewhere. Use Ctrl+X or **Edit > Cut** to relocate content without retyping.
- **Copy** : Duplicates selected text or objects to the clipboard without removing them from the original location. Access via Ctrl+C or **Edit > Copy** for reusing content.
- **Paste** : Inserts content at the cursor's position in the document from clipboard. Use Ctrl+V or **Edit > Paste** to place cut or copied items efficiently.
- **Redo** : Restores the last undone action, allowing you to reverse an undo if needed. Trigger with Ctrl+Y or **Edit > Redo** to reinstate changes.
- **Undo** : Reverses the last action performed, such as deleting or formatting text, to correct mistakes. Use Ctrl+Z or **Edit > Undo** for quick error recovery.

2.3.2 Finding and Replacing Text

Large documents often require quick corrections. The Find and Replace tool helps you locate specific words and replace them instantly. Writer provides two ways to search your document. Use the Find toolbar for quick jumps and the Find and Replace dialog box when you need control, replacements, or pattern searches.

Using the Find Toolbar: Use this toolbar if you don't need to replace text. It is simple and fast.

- **How to Open:**
 - Go to **View > Toolbars > Find** or just use the shortcut Ctrl+F. The Find toolbar will usually appear at the bottom of your window.
- **How to Use:**
 - Click in the search box and type the item to be searched.
 - Press Enter to jump to the next match in the document. You can use **Find Next / Previous** buttons for navigation.





- Click **Find All** to instantly select every single match in the document.
- Check **Match case** for search to be sensitive to uppercase and lowercase letters (e.g., searching for “Writer” won’t find “writer”).
- Press on Esc key to close the toolbar.

Using the Find and Replace Dialog box: This is the more powerful tool used to change text, not just find it.

- **How to Open:**
 - Press Ctrl+H.
 - Or go to **Edit > Find and Replace....**

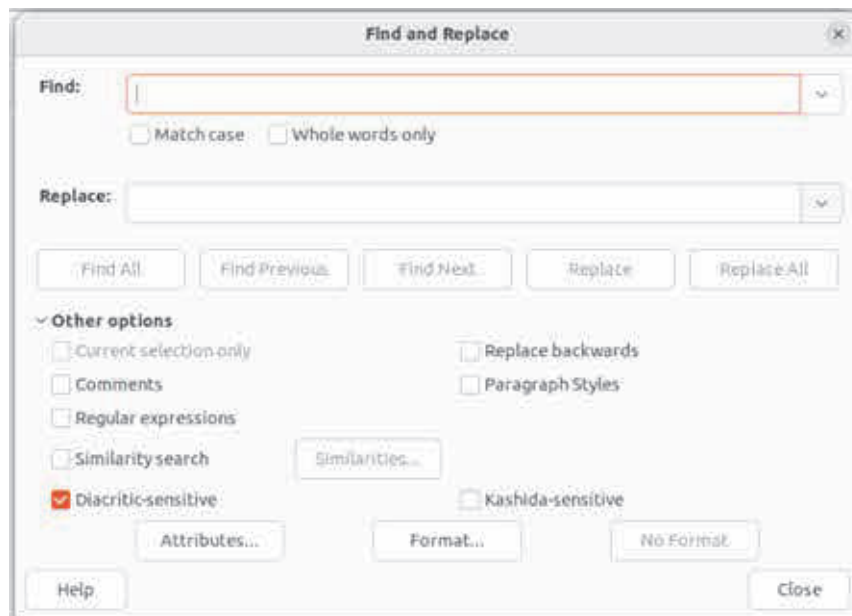


Figure 2.4 - The ‘Find and Replace’ dialog box

In the dialog box, you’ll see two main fields:

- **Find** : Type the text you’re looking for (e.g., the misspelled word).
- **Replace** : Type what you want to replace it with (e.g., word with correct spelling).

Here, you then have several choices:

- **Find Next:** Jumps to the next match.
- **Replace:** Changes the currently highlighted match and finds the next one.
- **Replace All:** Changes every single match in the entire document at once.

- **Find All:** Highlights every single occurrence of the search term throughout the entire document simultaneously. This is great for seeing how often a word is used or for selecting all instances to apply a specific format (like bolding) at once.
- **Find Previous:** Jumps back to the occurrence immediately before your current cursor position. It's the "reverse" of Find Next, useful if you accidentally skipped over the match you were looking for.



1. Open a document with at least one page of text.
2. Press Ctrl+F and find a common word like "the". Use Find All to see how many times it appears.
3. Press Ctrl+H to open the Find & Replace dialog box.
4. Find a specific word in your document (e.g., "school") and replace it with another word (e.g., "academy"). Click the Replace button several times to see how it works.
5. Challenge: Type a word in your document three times and make one of them bold. Now, try to use the advanced Find options to locate only the bold version of that word.

2.3.3 Collaboration and Review Tools

LibreOffice Writer has a powerful set of tools designed specifically for teamwork. These features can be used to track edits, leave comments and manage changes made by multiple people, making group work much more organized and efficient.

Tracking Changes: The Track Changes feature is like having a "record" button for all your edits. When it's turned on, every change made to the document—whether it's adding a word, deleting a sentence, or change in formatting—is highlighted. This allows your teammates to identify the work done by you.

- How to Use Track Changes:
 1. Go to the Edit menu on the Menu bar.
 2. Hover (act of positioning mouse cursor over an object) over Track Changes and click Record.
 3. Now, any changes that you make will be visually marked. Typically:
 - Additions are underlined and in a different color.
 - Deletions are struck through.





4. Your teammates can then right-click on each change and choose to accept or reject it.

Adding Comments: Comments are used to give a feedback or ask a question without actually changing the text. A comment is a note that appears in the margin of the document, attached to a specific piece of text.

- How to Add a Comment:
 1. Highlight the word or sentence that you want to comment on.
 2. Go to the Insert menu and select Comment (or use the shortcut Ctrl+Alt+C).
 3. A comment box will appear on the side of the page. Type your feedback or question inside it.
 4. Comments are a great way to have a conversation with your collaborators right inside the document without altering the main content.

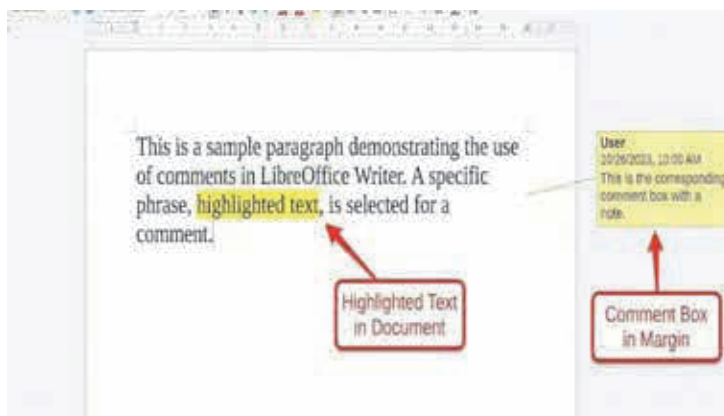


Figure 2.5 - Document showing highlighted text with a corresponding Comment box in the right margin.

Comparing Documents : Sometimes, a team member might edit a document without turning on Track Changes. Now you have two different versions of the same file and you want to see the difference. The Compare Document feature is the perfect solution. It analyzes two files and automatically creates a new document showing all the changes, just as if Track Changes had been active whole time.

- How to Compare Documents:
 1. Open your original version of the document.
 2. Go to **Edit > Track Changes > Compare Document....**
 3. A file browser will open. Select the edited version of the document that you want to compare.
 4. Writer will then show you all the differences, which you can accept or reject one by one.



1. Create a short document with two paragraphs about a recent school event.
2. Turn on Track Changes.
3. Delete one sentence from the first paragraph and add a new sentence to the second paragraph. Observe how the changes are marked.
4. Select a phrase in your document and insert a comment that says, “Is it the correct fact?”
5. Ask a friend to do the same and then practice accepting or rejecting each other’s changes.

2.4 Formatting Documents

Formatting focuses on how it looks: choosing fonts, sizes, spacing, alignment and styles. When both editing and formatting are done well, the document looks professional and creates a strong, lasting impression.

2.4.1 Text Formatting

Text formatting helps to highlight important points and improves readability. LibreOffice Writer gives users full control to the users over text appearance.

Formatting characters : Think of character formatting as changing the style of your handwriting for different purposes. You might write in big, bold letters for a heading, use a different color for notes, or write the smaller font for a footnote. In LibreOffice Writer, you have the same level of control over the typed text. Character formatting applies to individual letters, words, or phrases, allowing you to change their font, size, color etc. This helps to improve readability of the document.

Three Ways to Format Characters : you can apply character formatting from three main places, each offering a different level of control.

1. **The Formatting Toolbar:** This method is often used for common formatting requirements. The Formatting toolbar, located just above your document, gives you instant access to the most common options:
 - Font Name and Size
 - Bold (Ctrl+B), Italic (Ctrl+I) and Underline (Ctrl+U)
 - Font Color and Highlighting





Figure 2.6 - The Formatting Toolbar with labels for Font Name, Size, Bold, Italic, Underline and Font Color icons

2. **The Sidebar:** The Sidebar provides more options without opening a separate window.
 - Go to **View > Sidebar** (or press Ctrl+F5) to open it.
 - Click the Properties icon.
 - Under the Character panel, you'll find the same core controls as the toolbar, plus extras like character spacing.
3. **The Character Dialog Box:** For complete control over every possible detail, you need the Character dialog box. This is where the real power lies
 - **How to Open:** Select your text and go to **Format > Character....**

Character Dialog Box Tabs: The Character dialog box is organized into six tabs. Let's explore what each one does.

- **Font:** It is used to choose the font Family (like Libration Sans, Libration Serif), Style (Regular, Bold, Italic) and Size. A preview at the bottom shows the effect of chosen options on the text.
- **Font Effects Tabs:** This is where you can add color and flair to the document. You can set the Font Color and apply various effects like outlines, shadows, or embossing. While these effects can be fun, they are generally not suitable for formal documents like school reports.
- **Position Tab:** This tab is crucial for scientific and mathematical notation. It's divided into three sections:
 - *Position:* Here you can create superscripts (text that is raised, like in X^2 and subscripts (text that is lowered, like in H_2O).
 - *Rotation/Scaling:* You can rotate characters, stretch or compress the text width using the "Scale width" box. They are useful for creative designs in posters.

- **Spacing:** It controls the spacing between individual characters.
- **Hyperlink Tab:** This tab is used to turn the selected text into a clickable link that opens a webpage. It's a quick alternative to the main Hyperlink tool.
- **Highlighting Tab:** This tab lets you apply a background color to the text, just like using a digital highlighter pen. It's perfect for making important words or phrases stand out.
- **Borders Tab:** This tab is used to put a box around a word or phrase for special emphasis. It lets us add borders on any or all sides of the selected text and you can control the line style, thickness and color.

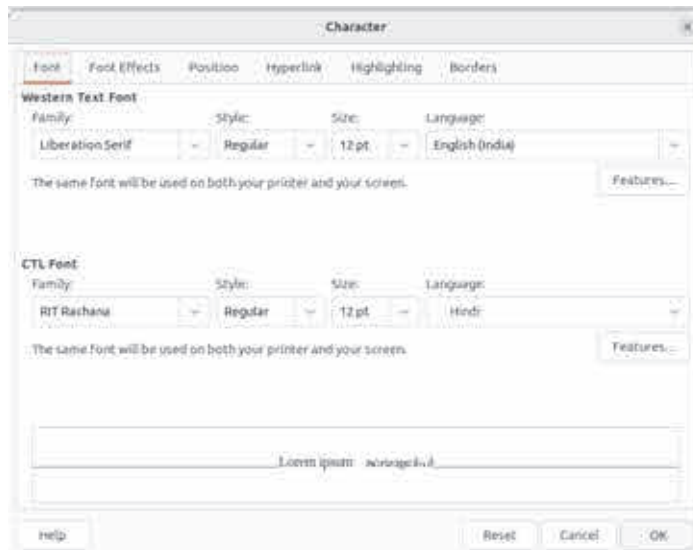


Figure 2.7 - The 'Character' dialog box



1. Type the sentence: "The chemical formula for water is H₂O and the formula for energy is E=mc².
2. Select "2" in H₂O. Go to Format > Character, open the Position tab and make it a Subscript.
3. Select "2" in mc² and make it a Superscript.
4. Type your name. Select it and use the Borders tab in the Character dialog to draw a box around it.
5. Select your name again and use the Highlighting tab to give it a light-yellow background. Avoid using too many fonts or colors in one document. Consistency improves clarity and professionalism.





2.4.2 Paragraph Formatting

While character formatting deals with individual letters and words, paragraph formatting controls the whole block of text. It manages everything from the spacing between lines to creating neat, indented lists. For creating a professional-looking document paragraph formatting is very essential.

These settings can be found in three main places:

- **The Formatting Toolbar:** For quick, common adjustments.
- **The Sidebar:** Choose **View > Sidebar** (Ctrl+F5) and then click Properties to access a useful set of formatting options.
- **The Paragraph Dialog:** Go to **Format > Paragraph...** for complete control over every detail.

Let's dive into the most important paragraph settings.

Line Spacing Line spacing is the vertical distance between lines of text. Proper spacing makes your document much easier to read.

- **Where to find it:** The quickest way is the **Line Spacing** icon on the Formatting toolbar. For more options, go to **Format > Paragraph > Indents & Spacing**.
- **Common Options:**
 - *Single/1.15/1.5 / Double:* These are standard presets. For most reports, 1.15 or 1.5 spacing is perfect for readability.
 - *Proportional:* It is used to set spacing as a percentage (e.g., 120%) for fine-tuned control.
 - *At least:* Sets a minimum space, which is useful in case of large characters or inline formulas that shouldn't crash into the line above.
 - *Spacing Above/Below Paragraphs:* In the same dialog box, you can add space before or after a paragraph. This is the correct way of giving space in between paragraphs, instead of pressing the Enter key twice. Using this feature keeps the spacing consistent and professional.

Indentation is the space between the paragraph and page margin. It helps to arrange the text and separates different paragraphs.

Where to find it: you can use the **Increase Indent** and **Decrease Indent** buttons on the toolbar, drag the markers on the ruler, or go to **Format > Paragraph > Indents & Spacing** for precise control.



- **Key Controls:**
 - *Before text:* Pushes the entire paragraph in from the left margin.
 - *After text:* Pushes the entire paragraph in from the right margin.
 - *First line:* Indents only the first line of the paragraph. This is very common in essays and books.
 - *Hanging indent:* Keeps the first line at the margin and indents all the following lines. This is great for bibliographies and lists of references.

Note: It is not a good practice to use the Tab key or the spacebar to create indents. They will cause major alignment problems if you ever change your font or margins. Always use the proper indent tools.

Alignment: Alignment determines how the text is positioned between the left and right margins. It plays a key role in the document's visual structure.

- **Where to find it:** Use the alignment buttons on the Formatting toolbar (Left, Center, Right, Justified) or go to **Format > Paragraph...** and select the **Alignment** tab.
- **Options:**
 - **Left:** Aligns text to the left margin (standard for body text).
 - **Center:** Centers text between margins (ideal for titles).
 - **Right:** Aligns text to the right margin (useful for dates or signatures).
 - **Justified:** Aligns text to both margins, creating clean edges on both sides (common in formal reports and books).

Drop Caps : Drop Caps (short for “Dropped Capitals”) are a decorative element used to make the first letter of a paragraph larger than the rest of the text, often spanning multiple lines. This is commonly seen in newspapers, magazines and storybooks to signify the start of a new chapter or section.

- **Where to find it:** Go to **Format > Paragraph...** and select the Drop Caps tab.
- **Settings:**
 - **Display drop caps:** Check this box to enable the feature.
 - **Number of characters:** Usually 1, but you can drop the first word or more.





- **Lines:** Determines how tall the letter will be (e.g., spanning 3 lines of text).

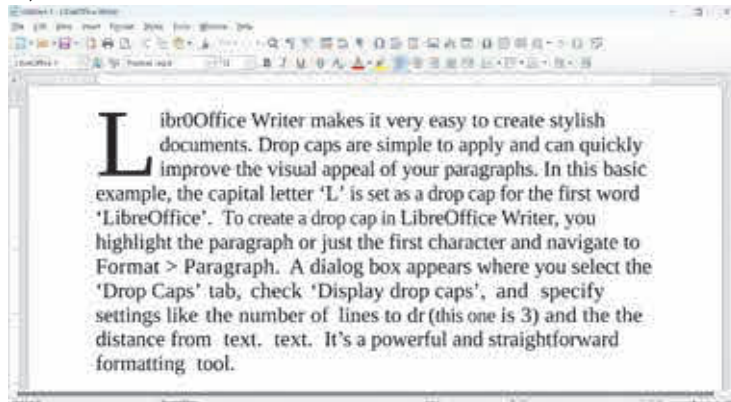


Figure 2.8 - Drop Cap

Area (Paragraph Background): Adding a background “Area” to a paragraph helps separate it from the rest of the text, making it look like a card or a highlighted box. This is perfect for side notes, warnings, or important definitions.

Where to find it: Go to **Format > Paragraph...** and select the Area tab.

- **Options:**

- **Color:** Choose a solid color fill.
- **Gradient:** Apply a smooth transition between colors.
- **Bitmap/Pattern:** Use a texture or image as the background.

Tip: When using a dark background, remember to change your font color to white or yellow so that the text remains readable.

Borders (Paragraph Borders): Just like you can place a border around a picture, you can put borders around a paragraph. You may choose to have lines on all four sides, or just a single line (like a bottom border) to act as a separator.

- **Where to find it:** Go to **Format > Paragraph...** and select the Borders tab.

Key Controls:

- **Line Arrangement:** Choose a preset like “Set all four borders” or click the specific lines in the preview box to toggle them on/off.
- **Line:** Select the Style (solid, dotted, double), Width (thickness) and Color.
- **Padding:** Padding adds space between text and border line so the text doesn’t look cramped.

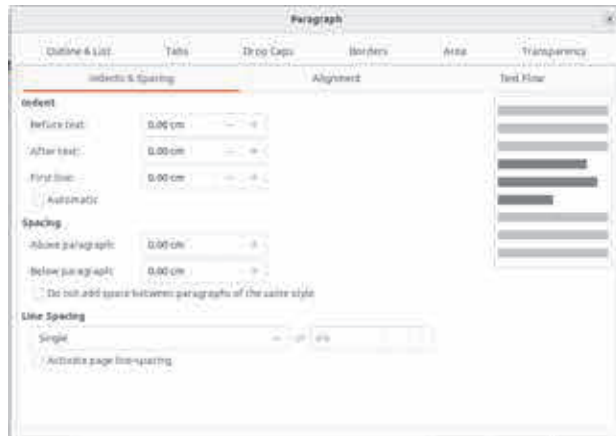


Figure 2.9 - The Paragraph dialog box

2.4.3 Bullets and Numbering

Lists are perfect for breaking down information into clear, easy-to-digest points. Use bullets (•) for items without a specific order and numbers (1, 2, 3) for steps in a sequence.

How to create lists:

- Click the **Toggle Unordered List** or **Toggle Ordered List** buttons on the Formatting toolbar.
- To create sub-levels in your list, press the Tab key
- To move an item back up a level, press Shift+Tab
- **For more control:** Go to **Format > Bullets and Numbering...** to change the style of your bullets (e.g., from circles to squares) or the numbering format (e.g., from 1, 2, 3 to a, b, c).

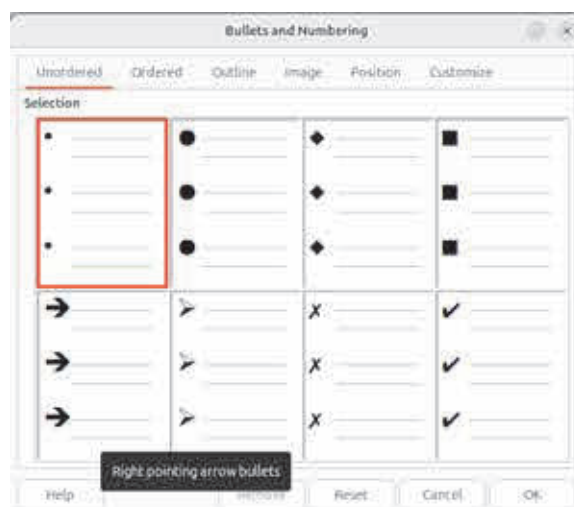


Figure 2.10 - The 'Bullets and Numbering' dialog box showing various bullet styles



1. Open a new document and type two paragraphs about your favorite subject.
2. Select both paragraphs. Use the Line Spacing ↑ icon on the Formatting toolbar to change the spacing to 1.5.
3. With the paragraphs still selected, go to Format > Paragraph > Indents & Spacing. Set the First line indent to 0.5 cm. Notice the change of first line of each paragraph.
4. Try Drop Caps: Select the first paragraph. Go to Format > Paragraph > Drop Caps. Check "Display drop caps" and set it to span 3 lines. Click OK.
5. Add a Border: Select the second paragraph. Go to Format > Paragraph > Borders. Set all four borders, choose a blue color and set Padding to 0.20 cm.
6. Add a Background: With the second paragraph still selected, go to the Area tab and choose a light grey color.
7. Below the paragraphs, create a numbered list containing three of your hobbies.

2.4.4 Inserting Special Characters and Equations

Sometimes, you need to type characters that aren't on the keyboard, like the copyright symbol (©), currency symbols (€, £), or Greek letters used in science (μ , Δ). Sometimes you need to write complex mathematical equations. LibreOffice Writer has powerful built-in tools for both of these tasks.

Inserting Special Characters Special characters dialog box is used to place single symbol or character at the cursor position.

Steps:

1. Place your cursor where you want to insert the symbol.
2. Go to the Insert menu on the Menu bar.
3. Select Special Character... (Ω).
4. The Special Characters dialog box will appear. Choose the required symbol from the sorted list by category (like Currency, Arrows, Punctuation, etc.).
5. Click on Insert.



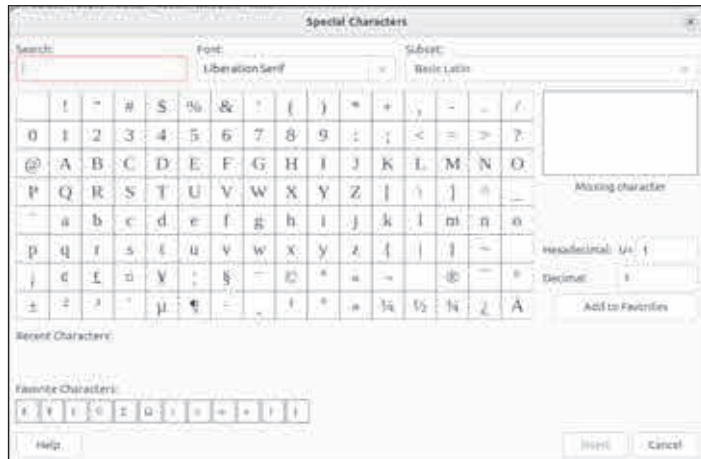


Figure 2.11 - The 'Special Characters' dialog box



1. Type the sentence: "SCERT copyrighted 2026." Then, use the Special Character tool (Ω) to insert the copyright symbol after the word "copyrighted".

2.5 Working with Tables and Objects

A text-only document may look plain and uninspiring. Adding visuals, shapes and links makes the work interactive, creative and easier to understand. LibreOffice Writer provides several options to enhance the pages.

2.5.1 Creating and Modifying Tables

Tables make information clear, structured and easy to compare. Whether you're listing marks, attendance, or budgets, tables help to present the data efficiently. LibreOffice Writer provides flexible options to create, format and calculate data inside the table.

Creating a Table : LibreOffice Writer gives two simple methods to insert a new table into the document.

- **Method 1: Using the Menu Bar** This method is useful if you know exactly how many rows and columns you need in advance.
 1. Go to the Table menu on the Menu bar.
 2. Select Insert Table.... or use the shortcut Ctrl+F12.
 3. The Insert Table dialog box will appear.
 4. Enter the number of columns and rows you need.
 5. Click Insert. An empty table will now appear in the document, ready to add your data.





- **Method 2: Using the Standard Toolbar** This is a faster and visual method to create a table, especially for smaller tables.
 1. Find the Table icon on the Standard Toolbar (it looks like a small grid).
 2. Click on the small arrow next to it to open a grid.
 3. Drag your mouse pointer across the grid to select the number of rows and columns you want. The table will be inserted into your document when you release the mouse after selecting. For example, dragging to select a 4x5 grid will create a table with 4 columns and 5 rows.



Figure 2.12 - The 'Insert Table' dropdown grid on the Standard Toolbar

Modifying the Table : Once you've created a table, it's very easy to change its structure. You can add more rows or columns for extra data, delete data/columns if you don't need, or merge cells to create headings.

- **To add or delete rows and columns:**
 1. Right-click inside a cell in the table.
 2. A context menu will pop up. Hover over Insert or Delete.
- 3. From here, you can choose to insert Rows Above, Rows Below, Columns Before, or Columns After. Similarly, you can delete the current row or column.
- **Merging and Splitting Cells:**
 - **Merging Cells:** Sometimes you need a single large cell that spans across several columns, perhaps for the main title. To do this:
 1. Select the adjacent cells you want to combine.
 2. Go to the Table menu and select Merge Cells, or right-click and choose Merge Cells from the context menu.
 - **Splitting Cells:** you can also do the opposite. To divide a single cell into multiple smaller cells:

1. Click inside the cell you want to split.
2. Go to the Table menu and select Split Cells.
3. A dialog box will appear from where you can choose to split it into more rows or columns.

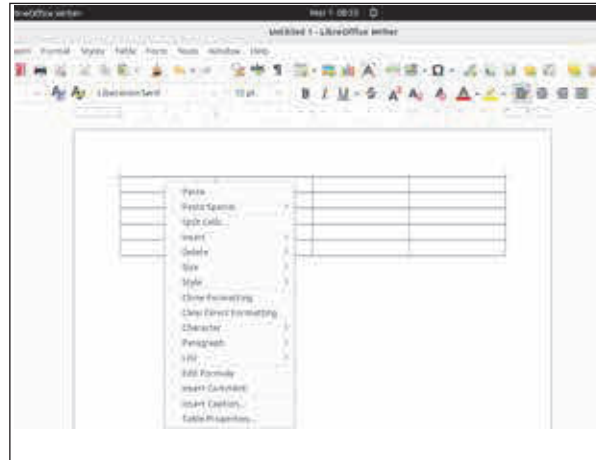


Figure 2.13 - The right-click context menu inside a table



1. Create a new document.
2. Insert a table with 3 columns and 4 rows.
3. In the second row, enter the headings: "Subject", "Name of Teacher" and "Period".
4. Merge the three cells in the first row and type the title "My Weekly Timetable". Center this title.
5. Add a new row at the bottom of the table.
6. Fill the table with details of three subjects.
7. Delete the last, empty row that you don't need.

2.5.2 Inserting Images

Let's learn the simple way to insert and manage images in the documents.

Steps:

1. Place the cursor at the exact spot in the document where you want the image to appear.
2. Go to the Insert menu on the Menu bar.
3. Select Image... . This will open the Insert Image file browser.
4. Navigate through the computer's folder to find the image file.
5. Select the image file and click on Open button. The image will now be placed at the cursor position.





Resizing and Positioning Your Image: Once an image is placed in the document, it's unlikely to be of perfect size or at the perfect spot. You may do it as directed below.

- **To resize an image:**
 1. Click on the image to select it. You will see small green squares, called handles, around its border.
 2. To change the size, click and drag one of the corner handles. Dragging a corner handle ensures that the image's height and width change proportionally, so it doesn't get stretched or distorted.
- **To move an image:**
 1. Click and hold anywhere in the image.
 2. Drag it to a new location in the document.

Positioning Images: Anchoring and Wrapping

Anchoring: An image needs to be 'anchored' to a specific point so that it stays in place.

- To Character: The image moves with the text.
- To Paragraph: The image stays with the paragraph.
- To Page: The image stays at a fixed position on the page. Right-click the image and select **Anchor** to choose.

Text Wrapping: This determines how text flows around the image.

- None: Text stops above and starts below (good for large charts).
- Parallel/Page Wrap: Text flows around the image box.
- Optimal: Text flows on the side with more space. Right-click the image and select **Wrap** to choose.

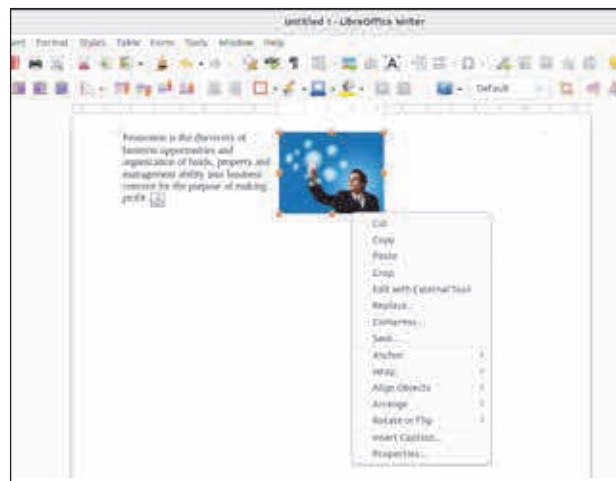


Figure 2.14 - An image inserted into a paragraph showing the right-click context menu with 'Anchor' and 'Wrap' options visible.



1. Open a new document in LibreOffice Writer.
2. Type a paragraph about your favorite hobby or subject.
3. Find a relevant image in the computer (or download one from a copyright-free source).
4. Insert the image at the middle of the paragraph.
5. Resize the image by dragging one of its corner handles to make it smaller.
6. Try wrapping the text around the image so that the paragraph flows neatly beside it.

2.5.3 Adding Shapes

Writer includes a wide variety of ready-to-use shapes, including rectangles, circles, arrows, stars, callouts (speech bubbles) and flowchart symbols.

Steps:

1. Go to the Insert menu on the Menu bar.
2. Hover over Shape to see a menu of categories (Lines, Basic Shapes, Block Arrows, Flowchart, etc.).
3. Select the desired shape (e.g., **Basic Shapes > Rectangle**).
4. The mouse cursor will change to a crosshair symbol. Click and drag on the page to draw the shape. The longer you drag, the bigger the shape will be.

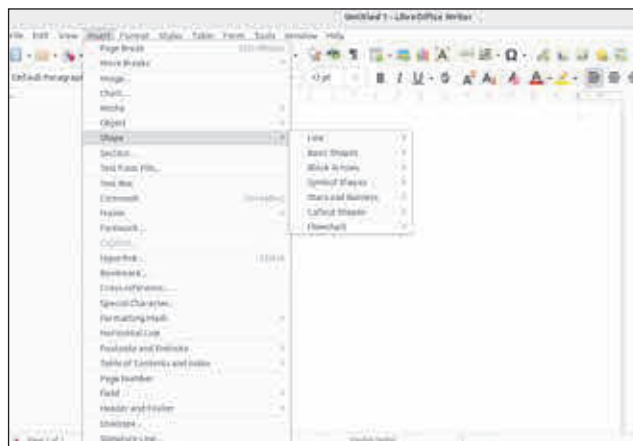


Figure 2.15 - The 'Insert > Shape' menu showing the different categories like Basic Shapes and Block Arrows.



Customizing and Formatting Shapes : Once you have drawn a shape, you can customize it completely.

1. Click on the shape to select it. You will see green handles appear around it, which you can use to resize or stretch it.
2. When a shape is selected, the Drawing Object Properties toolbar appears automatically, usually at the bottom of the screen. This toolbar gives us quick access to the most common formatting options.
3. you can change:
 - **Fill Color** : The main color inside the shape. You can choose solid colors, gradients, or even patterns.
 - **Line (Border) Color and Style**: The color, thickness and style (dashed, dotted) of the shape's outline.



1. Open a new document.
2. Create a simple flowchart to show the process of adding two numbers.
3. Use a Flowchart: Terminator shape (the one with rounded sides) for "Start" and "End".
4. Use Rectangle shapes for the steps in between (e.g., "Boil water," "Add tea leaves").
5. Use Block Arrows to connect the shapes and show the flow of the process.
6. Change the fill color of the "Start" and "End" shapes to green.
7. Add text inside each shape to label the steps.

2.5.4 Hyperlinks and Cross-References

In the digital world, documents are rarely static. They can be interactive, allowing readers to jump to a website for more information or navigate to another section within the same document with a single click. This is made possible by hyperlinks. A hyperlink (or simply a "link") is a clickable piece of text or an image that acts as a gateway to another location. A cross-reference is a special type of hyperlink that points to another part of the same document, which is extremely useful for navigating long reports or projects.

Adding a Hyperlink to a website :This is the most common type of hyperlink. You can turn any piece of text into a clickable link that opens a web page in a browser on clicking on it.



Steps:

1. Type the text that is to be converted as a link (e.g., “Visit the Official LibreOffice Website”).
2. Highlight this text.
3. Go to the Insert menu and select Hyperlink (or use the keyboard shortcut Ctrl+K).
4. The Hyperlink dialog box will open.
5. In the URL field, type or paste the full website address that you want to link to (e.g., <https://www.libreoffice.org>).
6. Click Apply and then Close. The text you have highlighted will now be colored (usually blue) and underlined, indicating it’s a clickable link.

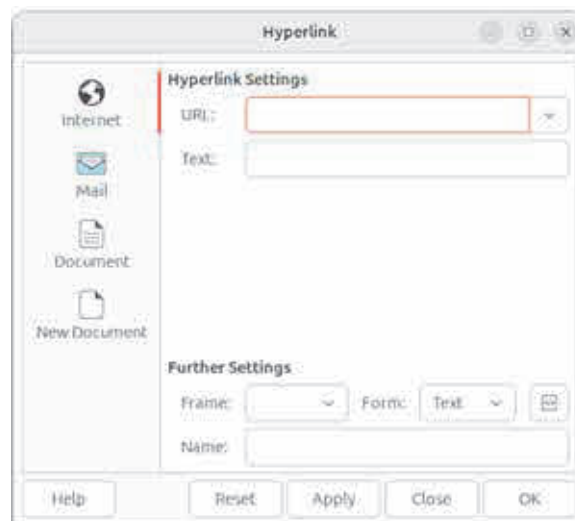


Figure 2.16 - The 'Hyperlink' dialog box

Adding an Internal Link (Cross-Reference): For a long document, like a project report with many chapters, you can create links that jump the reader from one section to another (e.g., from the introduction to a specific chart on page 10). This is a two-step process: first, you mark the destination and then you create the link.

Step 1: Create a Bookmark at the Destination A bookmark is like a signpost that gives a name to a specific spot in the document.

- Go to the place in the document that you want to link to (e.g., the title of “Chapter 5”).
- Place the cursor there.
- Go to **Insert > Bookmark**.



- In the dialog box, type a descriptive name for the bookmark (e.g., "Chapter5_Start"). The name cannot have spaces.
- Click Insert.

Step 2: Create the Hyperlink to the Bookmark Now you have to create a link to the bookmark.

- Go to the text where you want the reader to click on (e.g., the phrase "see Chapter 5 for more details" in the introduction).
- Highlight this text and open the Hyperlink dialog box (Ctrl+K).
- On the left side of the dialog, click on Document.
- Click the target icon next to the Target field. This opens the Navigator.
- Expand the Bookmarks list and select the bookmark you created earlier (e.g., "Chapter5_Start").
- Click Apply and Close. Now, when you click on the hyper linked text, the cursor will instantly jump to the location of the bookmark.



1. Create the Structure: Open a new document. Type the title "Computer Hardware" on Page 1. Press Ctrl+Enter twice to create two new pages. Type "Input Devices" at the top of Page 2 and "Output Devices" at the top of Page 3.
2. Add an External Hyperlink: Go back to Page 1. Select the title "Computer Hardware". Press Ctrl+K, enter a website URL (e.g., www.wikipedia.org) and click Apply. This links your title to the web.
3. Set the Destinations (Bookmarks): Go to Page 2, click before the text "Input Devices," and insert a Bookmark named "Input Section" (Insert > Bookmark). Repeat this on Page 3 for "Output Devices," naming the bookmark "Output Section".
4. Create a Navigation Menu: On Page 1, below your title, type a list:
Jump to Input Devices
Jump to Output Devices
5. Link to the First Section: Highlight the text "Jump to Input Devices" on Page 1. Press Ctrl+K, select Document on the left, open the Target list, select the "Input Section" bookmark and click Apply.
6. Link to the Second Section: Repeat the previous step for the text "Jump to Output Devices", but this time select the "Output Section" bookmark as your target.
7. Test Your Interactive Document: Hold the Ctrl key and click your title to see if the browser opens. Then, click your "Jump to..." links to ensure they instantly move your cursor to Page 2 and Page 3.



2.6 Page Layout and Design

A well-structured document is easy to read and looks professional. Page setup determines how your text fits on the paper, how margins appear and how readers navigate multiple pages.

2.6.1 Page Layout Essentials

When preparing a project report, the Layout defines how content is displayed on each page. LibreOffice Writer provides several options for this **Format > Page Style**.

Accessing the Page Style Options: To begin customizing the page Layout, you need to open the Page Style window.

How to get there: Go to the Menu bar and click on **Format > Page Style....**

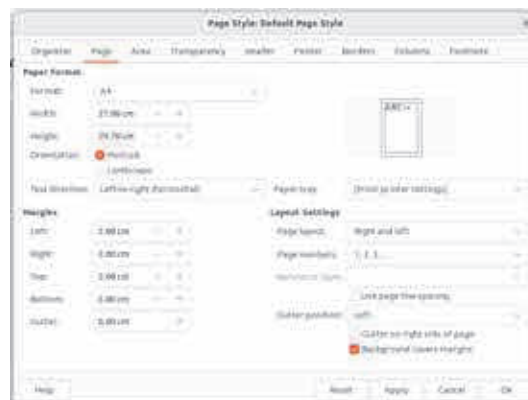


Figure 2.17 - The 'Page Style' dialog box

Key Page Layout Features

1. **Margins:** To set the margins, in the "Page" tab of the Page Style window, enter new values in the "Top," "Bottom," "Left," and "Right" fields under the "Margins" section.
2. **Orientation:** Orientation refers to the direction in which the page is displayed or printed. There are two options to choose from.
 - **Portrait (Vertical):** This is the standard orientation for most documents, like letters, reports and books. The page is taller than it is wide.
 - **Landscape (Horizontal):** This orientation is used when you need more horizontal space. The page is wider than it is tall. It's ideal for tables with many columns, wide charts, or brochures.



How to change: In the “Page” tab, select either “Portrait” or “Landscape” under “Orientation” section.

3. Paper Size: Paper size is different for different tasks and in different countries. The most common standard is A4, but you might need to adjust this for specific projects like legal documents or invitations.

- Purpose: To match the dimensions of digital document’s dimensions with the physical paper you will print on.
- How to change: In the “Page” tab, you can select a predefined size from the “Format” dropdown list. You can also set custom dimensions using the “Width” and “Height” fields.

4. Columns: Dividing the page into columns can make the document look more like a newspaper or a magazine. This format is especially useful for newsletters, brochures and flyers, as it breaks up long lines of text, making them easier to read.

To organize content into vertical sections for better readability and a professional Layout.

How to create:

1. Go to the **Format > Page Style...** menu.
2. Click on “Columns” tab of the Page Style window
3. In the “Settings” section, choose the number of columns you want. You may select one of the predefined Layouts or enter a number in “Columns” box. You can also adjust the spacing between columns and add a separator line if needed. Imagine you are creating a school newsletter. You need the page to be horizontal, with narrow margins and three columns. Follow these steps:



1. Open a new document in LibreOffice Writer.
2. Go to Format > Page Style....
3. In the “Page” tab:
 - Change all Margins (Top, Bottom, Left, Right) to 1.5 cm.
 - Under Orientation, select Landscape.
4. Switch to the “Columns” tab:
 - In the “Settings” area, click the icon that shows three columns.
 - Set the Spacing between columns to 0.50 cm.
5. Click OK.

2.6.2 Headers, Footers and Page Numbers

Have you ever noticed that the text at the top or bottom of each page in a book, like the chapter title or page number? These are called headers (at the top) and footers (at the bottom). They make documents look professional and are incredibly helpful for organizing and navigating longer works like essays, or project reports.

Using headers and footers, you can automatically display information such as the document title, author's name, date and page numbers on every page without having to type them manually. Let's learn how to use this powerful feature in LibreOffice Writer.

Adding a Standard Header or Footer The quickest way to get started is by activating the default header and footer areas.

Steps:

1. Navigate to the Insert menu on the Menu bar.
2. Hover over Header and Footer.
3. From the context menu, select Header and then choose the Default Page Style. This will activate the header area at the top of your page.
4. To add a footer, repeat the process: Go to **Insert > Header and Footer > Footer > Default Page Style**.
5. You will now see a designated area at the top (header) or bottom (footer) of your page, marked by a light blue outline. You can click inside this area and start typing.

What can you put in a header or footer?

- Document Title (e.g., "Physics Project Report")
- Chapter or Section Name (e.g., "Chapter 3: Laws of Motion")
- Author's Name
- Date and Time

Inserting Page Numbers and Other Fields Page number is essential for any multi-page document. Manually adding them is a hassle and can lead to errors. LibreOffice Writer can do it for us automatically.

Steps:

1. Click inside the header or footer area where you want the page number to appear.
2. Go to the Insert menu.
3. Select Page Number (#)
4. The correct page number will now appear on every page. It will





automatically update if you add or remove pages. you can also add other useful information using **Insert > Field** option. This allows us to add things like:

- Page Count: To show the total number of pages (e.g., “Page 2 of 15”).
- Date: To insert the current date.
- Title: To insert the title from the document’s properties.

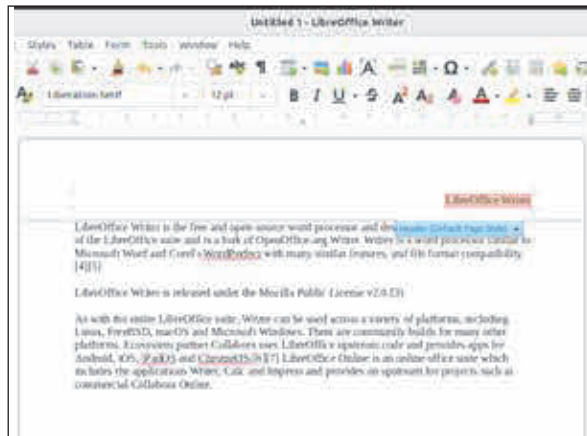


Figure 2.18 - A document in edit mode showing an active Header area with a blue boundary

Once you’ve added text or a page number, you can align it just like any other text.

- To center align the text, use the **Center Align** button in the Formatting toolbar or press Ctrl+E.
- To right-align it, use the **Right Align** button or press Ctrl+R.

For example, it’s common to place the document title on the left and the page number on the right. You Can do this by typing the title, pressing the Tab key twice and then inserting the page. number.



1. Create a new document in LibreOffice Writer.
2. Add a header. In the header, type your name on the left and insert the current date on the right.
3. Add a footer. In the footer, insert the page number # in the center.
4. Add a thin black line under your header to separate it from the main text.
5. Type enough text to create a second page and see if your header, footer and page number appear automatically in that page.

2.6.3 Watermarks and Page Borders



Figure 2.19 - watermark

A watermark is a faded text or image that appears behind the primary content of the document. It's a good method to show the status of a document (like a draft), add branding (like school logo), or indicate that the information is confidential. Let's learn how to add it in a document.

How to Add a Text Watermark: Adding a text watermark, such as your school's name or the words "School Project," is very easy.

Steps:

1. Go to Format menu on the Menu bar.
2. Select Watermark.... It will open the Watermark dialog box.
3. In the Text field, type the word or phrase to be used as watermark (e.g., "SCHOOL PROJECT", "CONFIDENTIAL", or your name).
4. You'll now see the text appears faintly in the background of the pages.

How to Add an Image Watermark: Sometimes, instead of text, you may want to use an image as the background. Let's learn how to add it in a document

Steps:

- Go to **Format** menu on the Menu bar.
- Select **Page Style**.... It will open the Page Style dialog box.
- In the dialog box, go to the **Area** tab and click on the **Image** button. Click Add/Import to choose the desired picture.
- You can now adjust the position or transparency of the image to ensure the text in front of it remains readable.

Adding Page Borders: In order to add a border, follow these steps:

- Open the Page Style Menu:
 1. Go to the Menu bar and select **Format > Page Style...**
 2. Navigate to the Borders Tab:
 3. In the dialog box that appears, click on the Borders tab.
 4. Choose the Line Arrangement:



5. Under the “Line Arrangement” section, click the Set All Four. Borders icon (the box icon) to quickly surround the page.
- Customize the Look:
 1. Line: Pick your preferred style (solid, dashed, etc.), color, and width (thickness).
 2. Padding: Adjust the “Padding” values if you want more space between the border and your text.
 3. Shadow: (Optional) Add a shadow effect to the bottom or side for a 3D look.
 - Apply:
 1. Click OK.
 2. The border will now appear on all pages using that specific style.



1. Open a new document in LibreOffice Writer.
2. Add a text watermark that says “DRAFT”.
3. Change the font to “Libration Serif” and the color to a light blue.
4. Adjust the transparency so that it’s visible but doesn’t make the main text hard to read.
5. Try changing the angle to 90°.
6. Once it is done, remove the watermark by going back to **Format > Watermark...** and clearing the text field.

2.7 Output and Security

Digital documents often contain sensitive or important information. Learning how to protect, preview and share them responsibly is an essential skill for every student and professional. LibreOffice Writer provides built-in tools for safe and efficient document handling.

2.7.1 Print and Print Preview

After preparing document and completed the formatting, you may take the printout of the document. But before you do, you may check exactly how it will appear on paper. Have you ever printed a document containing a table split awkwardly across the two pages or the margins were wrong? The Print Preview feature may be used in this situation and thereby avoid wasting paper, ink and time. It shows you a perfect replica of what your printed pages will look like, allowing you to notice any Layout problems beforehand.



Step 1: Always Use Print Preview This is an important step before printing any document. It helps in ensuring that everything is aligned correctly.

- **How to Access Print Preview:**

1. Go to the File menu on the Menu bar.
2. Select Print Preview.

Step 2: Printing Your Document Once you are satisfied with the preview, you may take the print.

Steps:

1. Go to the File menu and select Print...  or use the universal shortcut Ctrl+P.
2. This will open the Print dialog box. Now you have to set the following options:
 - *Printer:* Choose the printer from the dropdown list, especially where multiple printers are available.
 - *Range and Copies:* Here specify the pages to be printed. You can choose:
 - *All Pages:* To print the entire document.
 - *Pages:* To print a specific range (e.g., 2-5 for pages 2 through 5) or individual pages (e.g., 1, 7, 10).
 - *Selection:* To print only the selected text in the document.
 - *Include:* Use the dropdown to select All pages, Odd pages, or Even pages.
 - *Paper Sides:* Choose Print on one side or Print on both sides (Duplex) if the printer supports it.
 - *Number of copies:* Specify the number of copies to be printed.
3. Once you've configured the settings, click Print to get printout.

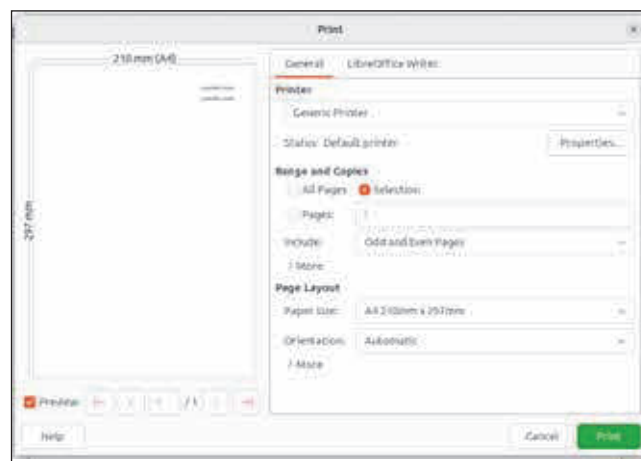


Figure 2.20 - The 'Print' dialog box with Printer, Range and Copies and Page Layout tabs visible



1. Create a document containing three pages. Add a title on page 1, a table on page 2 and some text on page 3.
2. Open Print Preview to see how all three pages look. Check if your table fits nicely on page 2.
3. Close the preview and press Ctrl+P to open the Print dialog.
4. Configure the settings to print only pages 1 and 3.
5. Change the number of copies to 2.
6. If you have a PDF printer installed, select it and save the file to your desktop. If not, just click Cancel to close the dialog without printing.

2.7.2 Exporting Documents

Exporting allows you to save a copy of the document in a different file format. This will allow other users to access the document even if they don't have writer in their system. The most common and important format for sharing is the Portable Document Format (PDF).

Exporting as a PDF: A PDF is a universal file format that preserves all your fonts, images and Layout, creating a digital snapshot of the document. It's the standard for sharing final reports, assignments and resumes because it looks professional and can't be easily edited by others.

Steps:

1. Open the document you want to export.
2. Go to the File menu, hover over Export As and select Export as PDF... .
3. The PDF Options dialog box will appear, giving you several useful settings:
 - Range: you may choose to export all pages or just a specific range (e.g., pages 2-4).
 - Images: you can reduce the image quality (e.g., JPEG compression at 90%) to make the file size smaller.
 - Security: Click on the Security tab to set a password! you can set a password to open the file or a password that restricts others from printing or editing it.
4. After choosing the options, click on Export button.

5. A save window will open. Choose a location in the computer, give the file a name and click Save. You now have a high-quality, professional PDF version of the document ready to be shared.

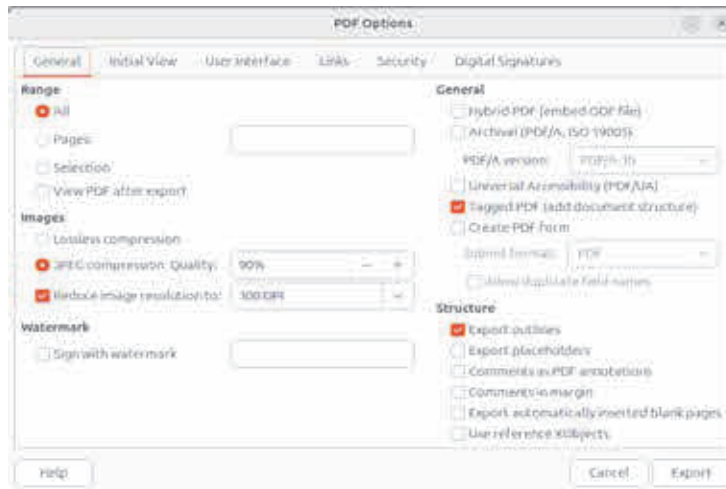


Figure 2.21 - The 'PDF Options' dialog box.

Other Useful Export Formats : While PDF is the most common, Writer can export to other formats too:

- **HTML (Hypertext Markup Language):** If you want to publish your document as a simple webpage, you can export it as an HTML file. It will open in any web browser.
- **Plain Text (.txt):** This format saves only the text, stripping away all formatting, images and tables. It creates the smallest possible file and is readable on virtually any device.



1. Open an existing document.
2. Use the File > Export As > Export as PDF... option to save it as a PDF.
3. Open the PDF file you just created to see how it preserves the Layout perfectly.

2.7.3 File Protection and Passwords

Some documents contain information that you need to keep private. Think about personal diary entries, confidential project data, or a question paper you are setting for an exam. To prevent unauthorized people from opening and viewing your work, you can protect the document with a password. LibreOffice Writer has a simple, built-in feature to encrypt the file, making it unreadable to anyone who doesn't have the correct password.



How to Save a Document with a Password Protecting your file is done during the saving process. It's a simple but very effective security measure.

Steps:

1. Go to the File menu and select Save As.... (Even if you have saved the file before, you need to use "Save As" to access the password option).
2. "Save As" dialog box will appear. Before clicking save, look for the checkbox Save with password at the bottom corner.
3. Check this box.
4. Click the Save button.
5. A new dialog box, "Set Password," will pop up. You need to:
 - Enter the desired password in "Enter password to open" field.
 - Enter the same password again in the "Confirm password" field. This is to make sure that you didn't make a mistake.
6. Click OK. Your document is now saved and encrypted. The next time anyone (including you) tries to open this file, LibreOffice Writer will prompt them to enter the password first. If you forget the password for a document, there is no way to recover it. The file will be permanently locked and you will not be able to open it again. Always choose a password that is strong but memorable for you and consider storing it in a safe, private place.



Figure 2.22 - The 'Set Password' dialog box showing fields for entering and confirming the password.



1. Create a new document and type the message: "This is a test document."
2. Go to File > Save As....
3. Check the Save with password box.
4. Save the file to the desktop with the name "My Secret File".
5. When prompted, set a password like "Test1234" and confirm it.
6. Close the document.
7. Now, try to open the file "My Secret File". Writer asks for the password to open it.

2.8 Keyboard Shortcuts

Table 2.1: Keyboard shortcuts

Action	Shortcut
Save	Ctrl+S
Open File	Ctrl+O
Copy	Ctrl+C
Paste	Ctrl+V
Undo	Ctrl+Z
Redo	Ctrl+Y
Bold	Ctrl+B
Italic	Ctrl+I
Underline	Ctrl+U
Insert Page Break	Ctrl+Enter
Spell Check	F7
Find & Replace	Ctrl+H
Print	Ctrl+P



◆————◆ Summary ◆————◆

In this chapter, we have learned about the comprehensive features and functionalities of LibreOffice Writer to master digital documentation:

- We explored LibreOffice Writer as a powerful, open-source word processor that facilitates the creation of professional documents through an intuitive interface comprising the Menu bar, Sidebar, and various toolbars.
- We examined fundamental file management operations, including the ability to create, save, and open documents in universal formats to ensure data accessibility and safe storage.
- The chapter detailed essential editing tools such as Cut, Copy, Paste, and Find and Replace, which are crucial for efficiently refining content and correcting errors within a text.
- We learned to apply comprehensive formatting techniques to both characters and paragraphs, utilizing tools for font adjustment, alignment, indentation, and line spacing to enhance visual clarity and readability.
- The integration of visual elements was covered, demonstrating how to insert and manipulate tables for structured data representation, as well as images and shapes to create interactive and engaging pages.
- We discussed the critical aspects of page layout and design, learning to configure margins, orientation, and columns, alongside the addition of headers, footers, and page numbers for better organization.
- The chapter provided instructions on using specialized tools, such as the Formula Editor and special characters, to support the creation of complex scientific and technical documentation.
- Finally, we addressed the necessary steps for finalizing a document, including the use of Print Preview to verify layout, exporting files as PDFs for distribution, and implementing password protection for data security.



1. What is a word processor? Name two examples of such software mentioned in the text.
2. What is line spacing and why is the “At least” option useful?
3. Briefly explain the difference between anchoring an image “To Character” versus “To Page.”
4. What is a “Bookmark” in the context of LibreOffice Writer and why is it used?

5. Define a watermark and list two purposes for using one in a document.
6. Why is it recommended to always use “Print Preview” before printing a document?
7. Why is the PDF format considered as the standard for sharing final reports and assignments?
8. Explain the purpose and function of the following LibreOffice Writer components: The Menu Bar, the Sidebar and the Rulers.
9. Differentiate between the “Find Toolbar” (Quick Search) and the “Find & Replace Dialog box.” When would you use one over the other?
10. Explain the four types of text alignment available in LibreOffice Writer. Provide a specific use case for each type (e.g., where would you typically use “Center” vs. “Justified?”).
11. You have created a table but need to modify it. Explain the steps to:
 - a. Insert a new row below the current one.
 - b. Merge three adjacent cells into one.
 - c. Split a single cell into multiple parts.
12. Discuss the importance of “Margins” and “Orientation” in page layout. How do you access these settings and what is the difference between Portrait and Landscape orientation?



3

Designing Presentation

“The success of your presentation will be judged not by the knowledge you send but by what the listener receives” –

Lilly Walters

3.1 Introduction

In today's world, whether in a classroom or a business meeting, the ability to effectively share ideas is a crucial skill. A presentation is a structured process of communicating information to an audience, with the primary goal to inform, persuade, or inspire. Every presentation relies on four key components: a Presenter to deliver the message, the Audience for whom it is intended, the Content or information being shared, and a Medium through which it is delivered. While you could use a physical chart or a simple speech, the most powerful and versatile medium today is a digital one – **presentation software**. Using such software, you can design slides that integrate text, images, charts, audio, video, and animations, allowing you to communicate your message with greater clarity and impact.

In the previous chapter, you learned about LibreOffice Writer, which is used to create and edit digital documents. In this chapter, you will learn about another important type of application software called **presentation software**. Presentation software, enables us to present information in a clear and attractive way using slides. It allows us to combine text, pictures, charts, audio, video, and simple animations to explain ideas effectively. Such software is commonly used in classrooms, seminars, meetings, and other programmes to share information with an audience.

There are many presentation software tools available, such as LibreOffice Impress, Microsoft PowerPoint, Google Slides, Apple Keynote, Canva etc. This chapter focuses on **LibreOffice Impress**, which is a free and open-source presentation software. It provides all the essential features needed to create good-quality presentations without any cost. You will also learn how to create slides, format content, add multimedia, and present your ideas confidently and effectively.

3.2 Advantages of digital presentation

When using a digital medium for presentation, it is far more effective to use dedicated presentation software like LibreOffice Impress rather than a basic tool like a word processor or a simple image viewer. The advantages of using presentation software are:

1. **Improves Clarity and Simplifies Complex Ideas :** Digital media supports embedding audio, video, and interactive charts, and thereby enhance the depth of information. So, it is easily understandable to the audience.
2. **Flexibility and Ease of Editing:** Digital presentations can be edited in real time, allowing presenters to update content quickly. For instance, last-minute data updates or corrections can be made seamlessly.
3. **Cost Effective:** Digital media eliminates cost for paper, ink, and binding, which can add up for large or frequent presentations.
4. **Portability and Storage:** Digital files are stored on devices or cloud platforms, making them easy to carry and access anywhere. A USB drive or laptop can hold thousands of presentations, unlike bulky paper handouts.
5. **Collaboration and File Sharing :** Multiple people can work on the same presentation, but not simultaneously in real-time. Instead, users can share the file via email or a link, take turns editing, and use features like version history or comments to track changes. The final file can be easily distributed for viewing or further editing.

3.2.1 Features of LibreOffice Impress

LibreOffice Impress is a powerful and free presentation software that is part of the LibreOffice suite. It is widely used for creating professional slide shows for educational, business, and personal purposes. A slide is an individual page or frame within a presentation that serves as a visual aid for conveying information. It is the fundamental building block that collectively forms the





complete presentation Below are some of its key features:

1. User-Friendly Interface:

- Impress provides a clean and intuitive interface with three main panes:
- Slides Pane: Displays thumbnails of all slides for easy navigation.
- Workspace: The main area for designing and editing slides.
- Side bar: Offers quick access to layouts, animations, transitions, and more.

2. Multiple Views:

- Normal View: For designing individual slides.
- Outline View: For organising and editing text content in outline format.
- Slide Sorter: For rearranging slides and managing the slide sequence.
- Notes View: For adding speaker notes to slides.
- Master Handout View: To prepare handouts for printing.

3. Slide Masters and Templates:

- Impress allows the use of Slide Masters to maintain a consistent design across all slides.
- Predefined templates and backgrounds are available for quick and professional-looking presentations.
- Users can also create and save their own templates.

4. Text Formatting and Styles:

- Supports advanced text formatting, including fonts, colours, alignment, and spacing.
- Bulleted and numbered lists can be easily created and customised.
- Text styles (both presentation and graphic styles) help to maintain consistency.

5. Graphics and Drawing Tools:

- Includes a wide range of drawing tools for creating shapes, lines, arrows, and flowcharts.
- Supports basic 3D shapes and Font work for creative text effects.
- Tools for grouping, aligning, and arranging objects are available.

6. Inserting Multimedia and Objects:

- Users can insert images, audio, and video clips into slides.
- Supports OLE (Object Linking and Embedding) for embedding spreadsheets, charts, and other documents.
- Charts and tables can be inserted and customised directly within Impress.

7. Animations and Transitions:

- A variety of slide transitions and custom animations are available to make presentations dynamic.
- Effects can be applied to text, images, and other objects.

8. Hyperlinks and Interaction:

- Hyperlinks can be added to text or objects to link to slides, documents, or web pages.
- Interactions and action settings can be used for non-linear navigation.

9. Export and Sharing Options:

- Presentations can be exported to PDF, HTML or various picture formats.
- Supports printing handouts, notes, and slides in various layouts.

10. Compatibility:

- Impress is compatible with Microsoft PowerPoint files (.ppt, .pptx), allowing easy sharing and collaboration.

11. Extensible with Add-ons:

- Users can enhance functionality by installing extensions from the LibreOffice repository.

12. Cross-Platform Availability

- It is available for all major computer Operating Systems (OS), including Windows, macOS, and Linux. This allows users to create and edit presentations on almost any laptop or PC.

13. Strong Community Support

- The LibreOffice community is a global network of volunteers who develop, support, and translate the software, providing free assistance to users worldwide. This community not only creates the program but also writes documentation, answers questions on forums, and welcomes contributions from anyone, not just programmers.





1. Name any two popular presentation software.
2. Which view in Impress is used to rearrange the order of slides quickly?
3. State one environmental advantage of using digital presentations over physical handouts.
5. List any three advantages of using presentation software over a simple word processor for creating a digital presentation.
6. How does 'Slide Masters' help in creating a consistent and professional-looking presentation?
7. How does the 'Outline View' in Impress assist in organising content?
8. Describe any five advantages of using dedicated presentation software for creating and delivering content in a classroom setting

3.3 Familiarizing with Interface and Views

To effectively create presentations in LibreOffice Impress, it is essential to first understand its workspace. The main window is strategically divided into three key areas: the Slides Pane on the left for easy navigation and management of your slide sequence, the central workspace where you design the content of individual slides, and the Sidebar on the right which provides quick access to layouts, animations, and formatting tools.

3.3.1 Opening LibreOffice Impress

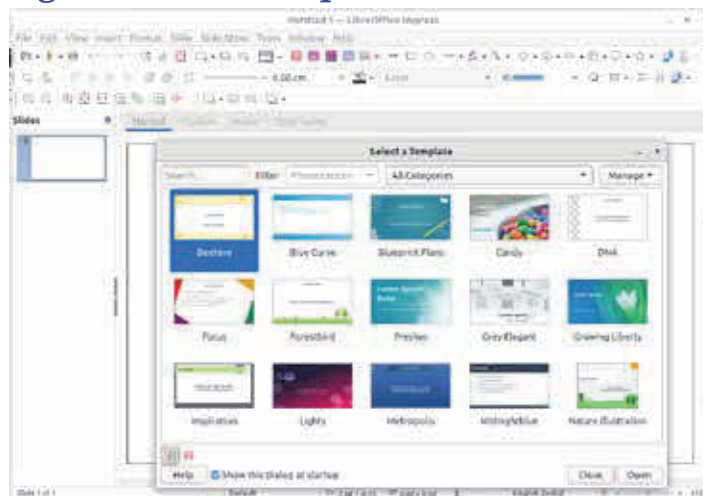


Figure 3.1 - LibreOffice Impress interface displaying the "Select a Template" dialogue box with various slide design options

Click on the Application menu > **Office> LibreOffice** Impress. A window as shown on Fig 3.1 will be displayed on the screen

When you open, it shows a dialogue box (select a Template).

3.3.2 Template in LibreOffice Impress

A template in Impress is a pre-designed document used as a starting point for creating new presentations. It can contain predefined elements such as backgrounds, graphics, text formatting, styles, slide layouts, and user-specific settings like measurement units and default printer settings. They are of two types, default and custom templates.

- **Default Templates:** Impress comes with a set of predefined templates that provide various backgrounds and design elements. These are available via the Select a Template dialogue when starting a new presentation. The Fig 3.2 shows some of them.
- **Custom Templates:** You can create and save your own templates (e.g., for business presentations) via **File > Templates > Save As Template**. These are stored in the My Templates category.

If you click the Close button, an empty presentation will open. To open your selected slide, choose a template and then click the Open button.

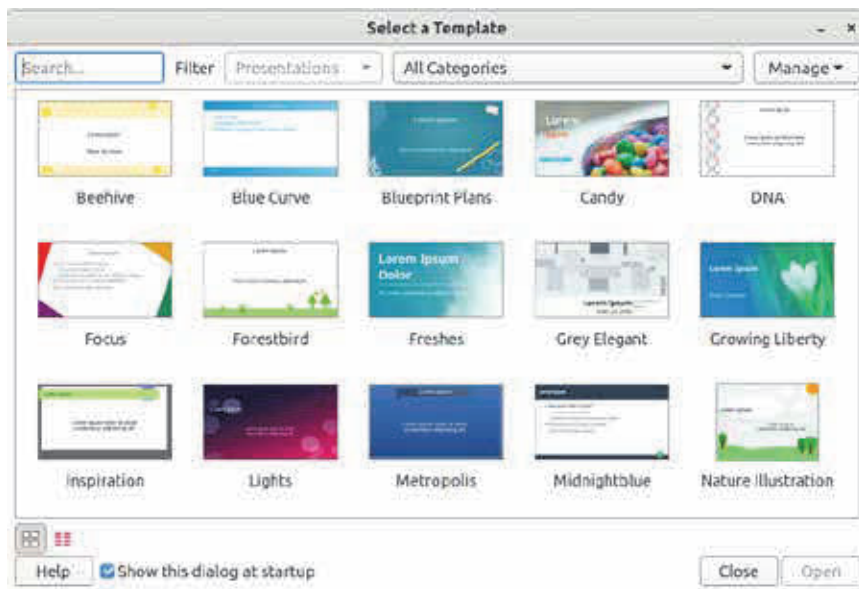


Figure 3.2 - Select a Template dialogue box in a presentation software.



3.3.3 Main Impress window

The main Impress window has three main sections such as Slides pane, Workspace, and Sidebar (Fig 3.5). At the top of the main window is the Menu bar and toolbars.

Menu Bar

The Menu bar, at the top of the main window provides several menus like File, Edit, View, Insert, Format, Slide, Slide Show, Tools, Window, and Help. When a menu is selected, a submenu opens to show the available commands.

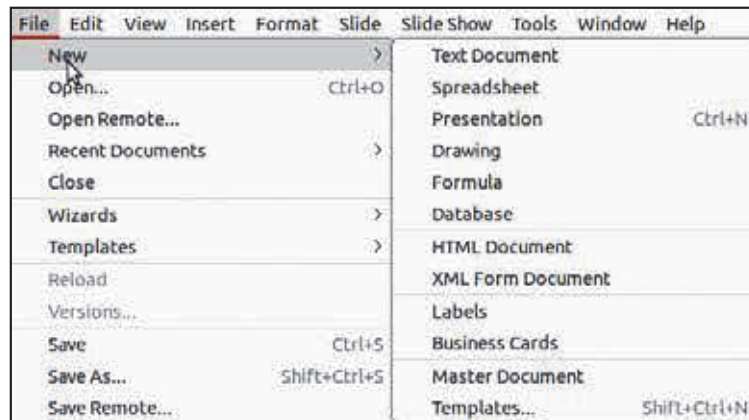


Figure 3.3 - Menu Bar

Toolbars

It is placed below the Menu Bar. A toolbar is a graphical control element in LibreOffice Impress that contains a set of icons, buttons, or tools providing quick access to frequently used commands and functions for creating and editing presentations. For example, Standard tools include common functions (New, Open, Save, Print) and Drawing toolbars contains Drawing tools for shapes, lines, and graphic objects and Text Formatting toolbars are not normally displayed and have to be selected. You can toggle toolbars on/off via **View > Toolbar** in the menu.



Figure 3.4 - Toolbar

Workspace

The Workspace is the central area of the Impress window where you actively design, create, and edit individual slides. The Impress Workspace has four standard views Normal, Outline, Notes, and

Slide Sorter. Each Workspace view is designed to make it easier to complete certain tasks.

Slide Pane

The Slide Pane is the left-hand section of the main Impress window that displays thumbnail images of all slides in your presentation in sequential order. You can easily reorder slides by simply dragging and dropping them a new sequence. Right-clicking on a slide thumbnail provides access to essential functions like adding, duplicating, hiding, or deleting slides.

SideBar

The Sidebar is a versatile, multi-panel interface element located on the right side of the main Impress window. It provides quick access to a wide range of formatting, design, and navigation tools, organised into eight collapsible decks (panels). The Sidebar puts all the important tools in one place on the screen, so you don't have to keep searching through menus.

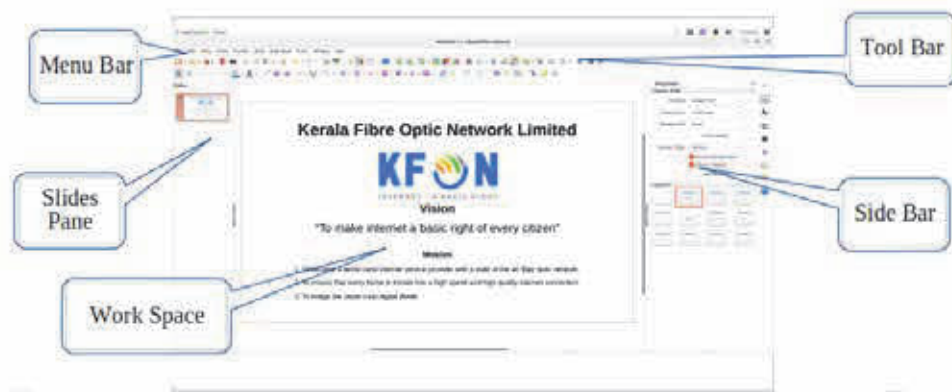


Figure 3.5 - Parts of a Libre Office Impress window

3.3.4 To create a new presentation,

1. Go to the File menu and select New.
 2. From the submenu that appears, choose Presentation.
- *Shortcut: You can also just press Ctrl + N on your keyboard.*

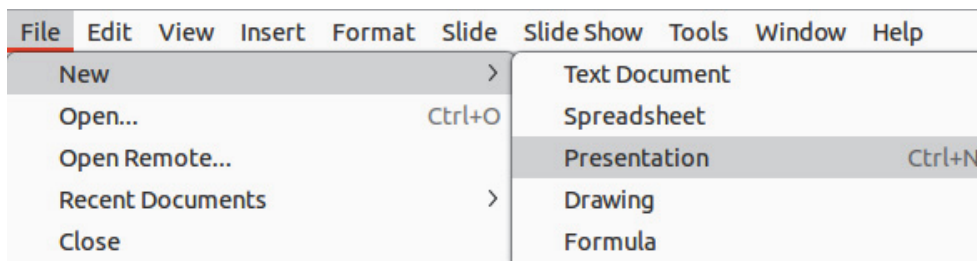


Figure 3.6 - create a new presentation



This will open a new window with a Templates dialogue box.

- If you want to use a template, select one and click Open.
- If you click Close, a new blank slide will open instead.

3.3.5 Open an existing presentation

Click on "Open" in the File menu or Press Ctrl + O

1. Navigate to the folder where your presentation is saved
2. Select the presentation file (.odp, .ppt, .pptx)
3. Click "Open"

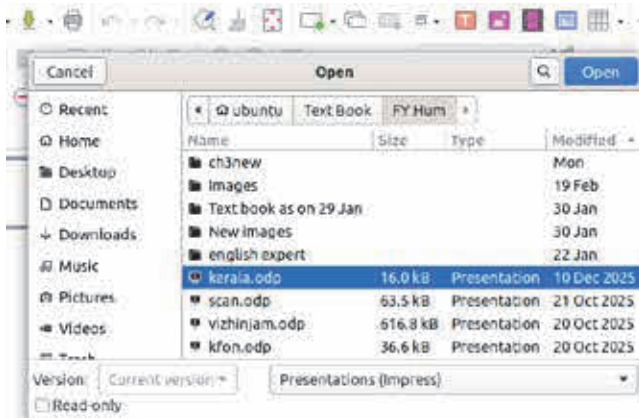


Figure 3.7 - Opening a LibreOffice Impress presentation file named "kerala.odp"

3.3.6 Save a presentation

Here are the steps to save a presentation in LibreOffice Impress:

First Time Saving (Save As)

1. Click **File > Save** on the Menu bar
 - Keyboard shortcut: Ctrl + S
 - Or click the Save icon on the Standard toolbar
2. The Save dialogue box as shown in Fig. 3.8 will open
3. Navigate to the folder where you want to save the file
4. Enter a name for your presentation in the "File name" box e.g. vgssahss
5. Choose a format from the "Save as type" drop-down
 - odp (OpenDocument Presentation) - Default, recommended format
 - pptx (Microsoft PowerPoint 2007-365)
 - pdf - For sharing that cannot be edited
6. Click Save

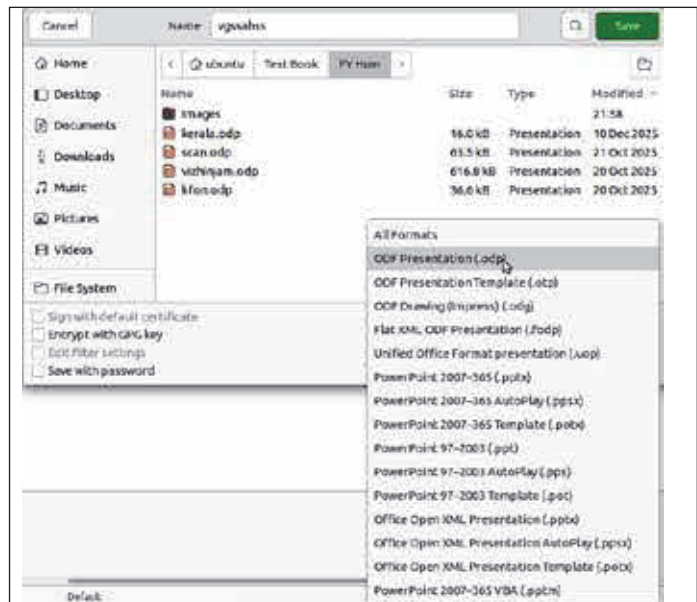


Figure 3.8 - Saving a presentation

Saving Changes to Existing File

- Click **File > Save** or press Ctrl + S
- Or click the Save icon on the Standard toolbar

3.3.7 Add slides to a presentation

There are many methods for adding/inserting slides. Some of them are

Method 1: Using the Menu

1. Go to **Slide > New Slide** on the Menu bar
2. A new slide will be added after your current slide

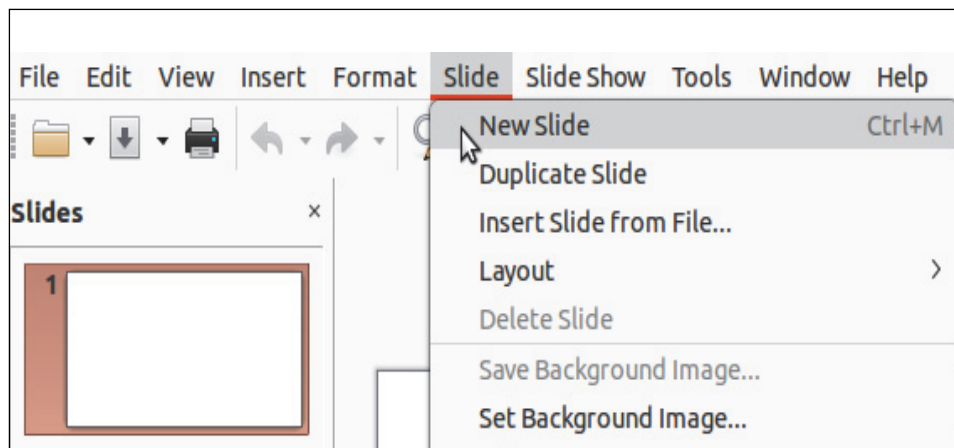


Figure 3.9 - Inserting new slide using Menu

Method 2: Using the Slides Pane

1. Right-click on any slide in the Slides Pane (left side)
2. Select New Slide from the context menu
3. The new slide appears after the selected slide

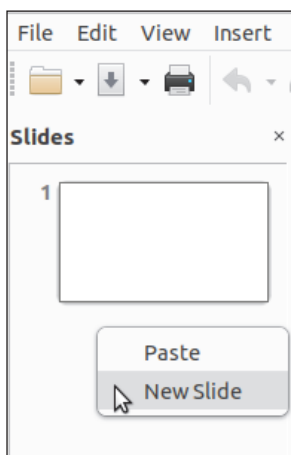


Figure 3.10 - Inserting new slide using Slides Pane

Method 3: Keyboard Shortcut

1. Press Ctrl + M to quickly insert a new slide

Method 4: Using Toolbar

1. If the Presentation Toolbar is visible, click the New Slide button
2. If the toolbar isn't visible, use View > Toolbars > Presentation to show it.

Method 5: Using Slide Sorter View

1. Switch to Slide Sorter view (tab at top of workspace)
2. Right-click on a slide and select New Slide



3.3.8 Views of Presentation

When you use LibreOffice Impress, you can see your presentation in different ways, called views. You can use Normal View, Outline View, Slide Sorter View, Notes View, and Master Slide View. Each view helps you with a different job—like designing slides, writing your words, arranging the order, writing your secret notes, or setting up the design for every slide at once.

Normal View: is the main workspace used for building and designing individual slides. In this view, the screen is divided into three functional areas: the Slides Pane on the left for navigation, the central Workspace for editing the current slide, and the Sidebar on the right. Use this view when you need to add text, insert images, or format the layout of a specific slide.

Outline View: allows you to focus purely on the structure and content of your text without the distraction of graphics. It lists the titles and bullet points of each slide in a sequential list. It is important to note that Outline View only displays text contained within default AutoLayout text boxes; manually created text boxes or images will not appear here. This view is ideal for planning the flow of your ideas and quickly rearranging topics.

Slide Sorter View: displays all the slides in your presentation as small thumbnails arranged in a grid. This "photo-album" style view makes it easy to manage the overall sequence of your presentation. From here, you can click and drag slides to change their order, delete multiple slides at once, or apply the same transition effect to a selected group of slides.

Notes View: is used to create speaker notes that assist you during a presentation. Each page shows the slide at the top with a large text area below it for your script or reminders. While these notes are hidden from the audience on the main projector, they can be displayed privately for the presenter on a second monitor using the Presenter Console.

Master Slide View: is a powerful tool used to control the global design of your entire presentation. A Master Slide acts as a template that defines the background, default font styles, and recurring elements (like a company logo or slide numbers) for every slide. Instead of editing each slide individually, you can use the Master View to ensure a consistent look across the whole presentation instantly.

The different slide views in LibreOffice Impress are important because they help users design slides, organise content, and prepare for effective presentation in an easy and systematic way. These views are used while creating, editing, arranging slides, and adding notes, making presentations clear, organised, and professional.



1. Name the view that allows you to add speaker notes in Impress.
2. Which keyboard shortcut opens a new presentation in Impress?
3. What is a template in LibreOffice Impress?
4. Where is the Menu Bar located in the Impress window?
5. Differentiate between default and custom templates in Impress.
6. Briefly explain the use of the Workspace in Impress.
7. How can you add a slide using the Slides Pane?
8. What are two methods to save a presentation in Impress?
9. Give two features of Sidebar in Impress.
10. Describe three different views available in Impress and their uses.
11. Explain the process of opening an existing presentation in Impress.
12. Compare the functions of Slides Pane and Slide Sorter view.
13. Describe the main window of LibreOffice Impress, its sections, and how each section aids in creating professional presentations.

3.4 Design and format of slides

The design and format of your slides form the visual foundation of your entire presentation, directly influencing its clarity, professionalism, and ability to engage the audience. Effective design is not merely about aesthetic appeal but about creating a clear, consistent, and coherent structure that guides the audience through your message. This involves making strategic decisions about layout, colour schemes, typography, and the use of visual elements like images and charts. By mastering the use of tools like Master Slides, styles, and templates, you can ensure a uniform and polished look across all slides. Ultimately, a well-designed presentation enhances comprehension, reinforces key points, and makes the content more memorable.

3.4.1 Slide Layout

Slide Layout in LibreOffice Impress refers to the pre-designed arrangement of content boxes and placeholders on a slide.





How to Change Slide Layout

1. Select the slide you want to modify
2. Use one of these methods:
 - Sidebar: Open Properties deck → Layouts panel → Click desired layout
 - Menu: **Slide > Layout > Choose layout**
 - Right-click: Right-click slide → Layout → Choose layout
 - Toolbar: Click Slide Layout on Presentation toolbar

3.4.2 Objects that can be included in a slide

Impress allows you to incorporate a wide variety of objects to make your content more engaging and informative. Beyond basic text boxes and pictures, you can insert structured elements like tables and charts to present the data clearly. To enhance visual storytelling, you can include graphic shapes and even video or audio clips directly onto your slide. Furthermore, interactive objects like hyperlinks and action buttons can transform a static presentation into an immersive, non-linear experience for the audience. Some of the object types are listed below

1. Text Objects

- Title Text - Main heading text boxes
- Content Text - Body text and bullet points
- Text Boxes - Custom text containers
- Text Callouts - Annotations with connector lines

2. Graphic Objects

- Lines and Arrows - Straight lines with/without arrowheads
- Shapes - Rectangles, circles, polygons, stars, banners
- 3D Objects - Cubes, spheres, cylinders, cones
- Flowchart Elements - Process boxes, decision diamonds, connectors
- Callout Shapes - Speech bubbles and annotation boxes
- Freeform Drawings - Hand-drawn curves and polygons

3. Media Objects

- Images - Photos, illustrations, clipart (multiple formats supported)
- Audio Files - Sound clips and music
- Video Files - Movie clips and animations



4. Data Objects

- Tables - For structured data presentation
- Charts - Bar charts, pie charts, line graphs, etc.
- Spreadsheets - Embedded Calc spreadsheets
- Formulas - Mathematical equations using Math component

5. Interactive Objects

- Hyperlinks - Clickable links to web pages, documents, or other slides
- Image Maps - Clickable areas within images
- Action Buttons - For navigation and interactions
- Animated Objects - Elements with movement effects

6. Structural Objects

- Headers and Footers - Slide numbers, dates, copyright text
- Fields - Automatic content (date, time, author, slide count)
- Background Objects - Logos, watermarks, decorative elements

7. Special Objects

- OLE Objects - Embedded documents from other applications
- Connectors - Smart lines that stay attached between shapes
- Fontwork - Stylized text with special effects
- Grouped Objects - Multiple objects combined into one

3.4.3 Master Slide

A Master Slide is a template or blueprint that controls the basic design, layout, and formatting of all slides based on it in a presentation. Every new slide automatically copies these features without manual setup. Some other advantages of using Master Slide are

- The Master Slide provides predefined backgrounds for all slides.
- It sets standard text styles like fonts, sizes, and colours.
- Logos and branding elements are added once and appear on every slide.
- Recurring items like slide numbers or dates are placed on the Master Slide.





- Using a Master Slide saves time by eliminating repetitive formatting.
- It allows quick global design changes by editing just one slide.
- Master Slides help to create professional and uniform presentations.

1. Open Master View:

- Go to the View menu
- Choose Master Slide

2. Create New Master Slide:

- In the Master View, right-click in the slides panel
- Select New Master Slide from the context menu
- Alternatively, use **Slide > New Master** from the menu bar

3. Customise the Master Slide:

- Modify background designs
- Set default fonts and colours
- Add logos or other repeating elements
- Create consistent layout placeholders

4. Apply to Presentation:

If you want to change the design of your entire presentation at once:

- Go to the **Slide> Change Slide Master** (This will open a dialogue box showing available Master Pages).
- Select the desired master design from the list.
- Click **OK**.

3.4.4 Backgrounds

The background is the base layer of your slide that appears behind all text, images, and other objects.

Types of Backgrounds

1. None - Transparent background
2. Colour - Solid colour fill
3. Gradient - Smooth colour transitions
4. Image - Picture or photograph
5. Pattern - Repeated geometric designs
6. Hatch - Cross-hatched line patterns

How to Apply Backgrounds:

Method 1: Using Slide Properties

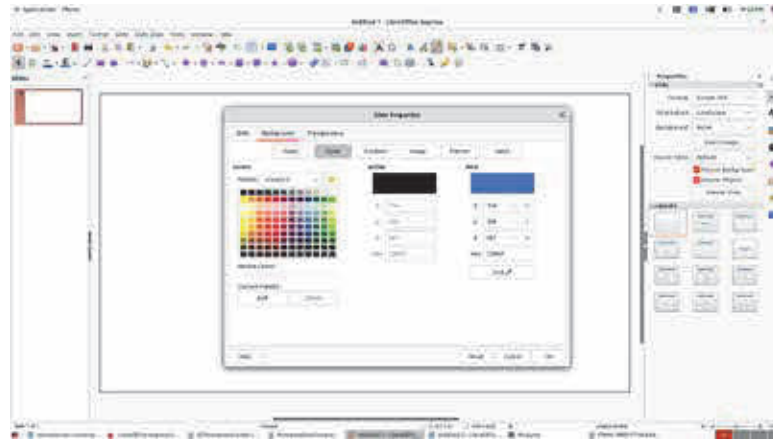


Figure 3.11 - Applying background to Master Slide

1. Right-click on a slide → slide Properties
2. Click the Background tab
3. Select background type (colour, Gradient, Image, etc.)
4. customise the settings
5. Click OK

Method 2: Using Master Slides

1. Go to **View > Master Slide**
2. Select your Master Slide
3. Right-click → Slide Properties
4. Set background in the Background tab
5. This applies to all slides using that master

Method 3: Using Styles

1. Open Styles deck in Sidebar
2. Right Click Background → Edit Style....
3. Set background in the Area tab

3.4.5 Themes in Impress

Theme is the concept of bundling colour, font and format settings. The colours, fonts and format settings names are fixed in the document. When switching themes in the document, the elements containing the fixed names switch colours, fonts and format settings accordingly to the new theme.

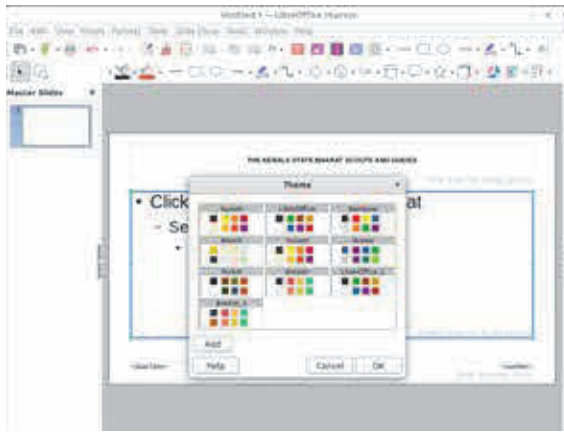


Figure 3.12 - Applying themes in Impress

To Use a Document Theme

1. Format the document using the fixed theme attribute name such as colours, fonts and other format settings.
2. Apply the theme to the document.

To Apply a Theme to the Document

1. Choose **Format > Themes**.
2. Double-click on the theme desired or select the theme and click OK

All document elements with the fixed theme attribute name set will change to the new theme attribute. For example, a heading with font colour set as "Dark 2" changes to the new theme "Dark 2" colour.

To Add a New Theme

1. Choose Format - Theme and click on Add.
2. Enter a name for the new theme in the Name text box.
3. On the colour area, choose the base colour for each of the 12 fixed colour names of the theme.

Theme colours consist of a set of twelve base colours, each with five internally calculated variations. These colours are defined solely by their RGB values, and saved to the document file. An object's colour can be assigned by referencing a colour from the Theme colours set, either by keyword or index, depending on the context. The base colour names are

- Dark 1, Light 1, Dark 2, Light 2,
- Accent 1, Accent 2, Accent 3, Accent 4, Accent 5, Accent 6,
- Hyperlink, Followed Hyperlink

4. Click OK to close the colour dialogue.
5. Click OK or double click the new theme to apply the theme to the document.

3.4.6 Character Formatting

Text formatting is important in a presentation. In a slide, there may be different types of text like Heading, Sub heading, Explanation etc. So, we have to format each of them according to our need. It can be done in different methods. The easiest method is through Sidebar located at the right side.

Character formatting consists of following options

1. **Font Selection:** Chooses different fonts (e.g., Arial, Times New Roman) to style text.
2. **Font Size:** Adjusts the size of text (e.g., 12pt, 24pt) for emphasis or readability.
3. **Bold:** Makes text bold to highlight important points.
4. **Italic:** Applies italic style for emphasis or stylistic variation.
5. **Underline:** Underlines text to draw attention or indicate links.
6. **Text colour:** Changes the colour of text to match the presentation theme.
7. **Alignment:** Aligns text to the left, center, right, or justify it across the slide.
8. **Line Spacing:** Sets spacing between lines (e.g., 1.0, 1.5, 2.0) for better readability.
9. **Indentation:** Increases or decrease indents to organise text hierarchically.
10. **Bulleted Lists:** Creates lists with bullets (e.g., dots, arrows) for key points.
11. **Numbered Lists:** Uses numbering (e.g., 1, 2, 3) for sequential information.
12. **Paragraph Spacing:** Adjusts space before and after paragraphs for layout control.

You may apply the above formatting to the whole object by selecting the control or format specific text by selecting it.





1. Which panel in the Sidebar is used to change the font of selected text?
2. What is the purpose of using a Master Slide?
3. List one type of background available in Impress.
4. What are Themes used to set in a Master Slide?
5. Explain the advantage of using a Master Slide.
6. List any four different types of objects that can be included in an Impress slide.
7. Describe the steps to change the background of all slides in a presentation to a specific image using the Master Slide method.
8. Compare and contrast 'Slide Layout' and 'Master Slide'.

3.5 Inserting Multimedia Elements, Charts, Tables

In this section, we will see that a good presentation sometimes requires videos, audio, graph, chart etc. In LibreOffice Impress, multimedia specifically refers to audio and video content that can be embedded and played directly within presentations to create richer, more interactive viewing experiences. The commonly used multimedia elements and its characteristics are listed in table 3.1.

Table 3.1 Multimedia Elements

Multimedia Element	Description
Images	Add pictures or graphics to enhance visual appeal
Audio	Include sound files for narration or background music
Video	Embed video clips to make presentations dynamic
Using Spreadsheets	Insert Calc spreadsheets for data display and analysis
Charts	Add charts to visually represent data
Formulas	Insert mathematical or scientific formulas using the Math module
Drawings	Include drawings or graphic objects created with the Drawing toolbar

HTML Files	Insert web page content or HTML files as static objects
Other Objects (OLE)	Add OLE (Object Linking and Embedding) objects like documents or media from other applications

3.5.1 Inserting Images

We can insert images into a slide using any of the four methods listed below

Method to add images

Via Menu Bar

- Go to **Insert > Image** on the Menu bar
- File browser opens (Insert Image file browser)
- Navigate to directory containing the image
- Select Preview to see thumbnail of selected file
- Click Open to place image in center of slide
- Selection handles appear around image border

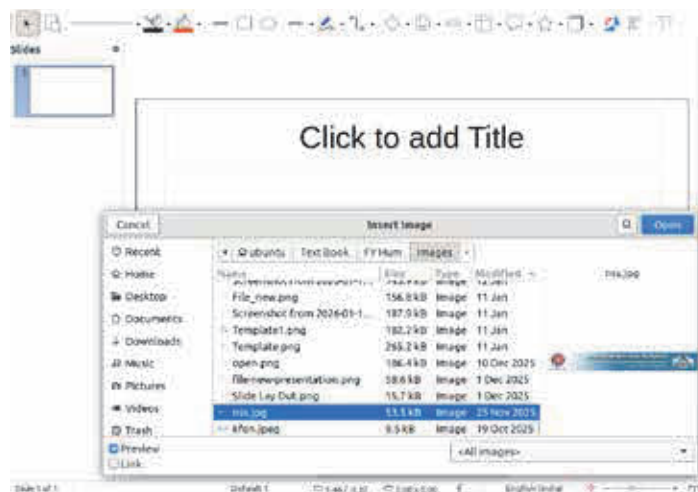


Figure 3.13 - Inserting Images - using Menu Bar

3.5.2 Inserting a Chart into a Slide

Charts can be inserted into slides to visually represent data. There are different methods to include a chart.

Basic Insertion Methods

1. Select the slide: Open your presentation and select the slide where you want to add the chart.



2. Insert via Menu or Toolbar:
 - Go to **Insert > Chart** on the Menu bar. This inserts an example chart at the center of the slide in editing mode.
 - Alternatively, click the Insert Chart icon on the Standard toolbar. (icon resembles a bar chart – not always visible by default).
 - For advanced embedding, go to **Insert > Object > OLE Object** and select "LibreOffice Chart" to insert it as an OLE object.
3. Exit Editing Mode: Click outside the chart area to deselect and view the chart normally.

When inserted, Impress places a default column chart with sample data. The chart enters editing mode automatically, opening the Chart Formatting toolbar and a specialized Standard toolbar for the charts. The Chart Type panel also appears in the Properties deck on the Sidebar for customization.

3.5.3 Inserting Audio and Video

This feature allows you to add sound or video to your presentation. You can insert audio files like background music, a recorded narration, or sound effects (like a clap or a bell). When you play your slide show, the sound will play at the point you choose, making your presentation more dynamic and engaging for the audience.

How to insert it:

1. Go to the **Insert** menu.
2. Select **Audio or Video**.
3. In the window that opens, find your audio or video file (like an MP3 or MP4) and click **Open**.

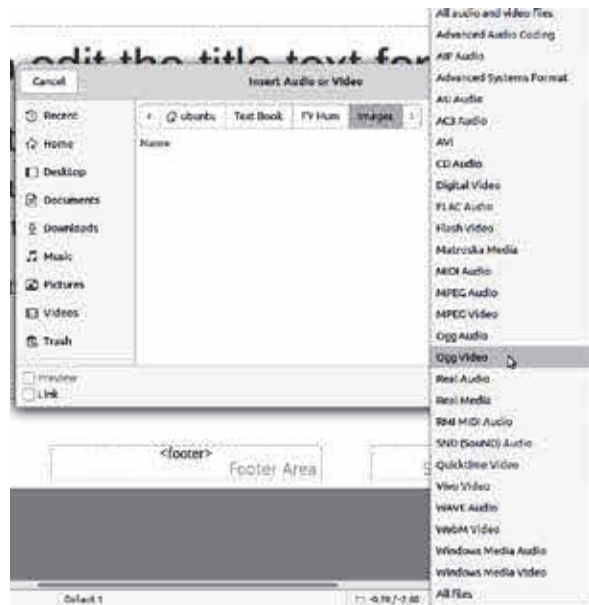


Figure 3.14 Inserting Video

3.5.4 Drawings

Impress has simple tools that let you create your own shapes, diagrams, and illustrations directly on a slide. You can draw lines, circles, arrows, and flowchart symbols to explain a concept visually. This is very helpful for creating custom diagrams, like explaining a process or labeling the parts of a plant, without the need of another

program.

- **How to insert it:**

1. Look for **Drawing** toolbar at the bottom of the Impress window.
2. Click on a tool (like the Rectangle, Ellipse, or Arrow).
3. Click and drag on your slide to draw the shape.

3.5.5 Other Objects

OLE (Object Linking and Embedding) is a technical way of saying that you can put a file from another program (like a Calc chart or a Writer document) into your slide and still edit it. If you double-click the object, Impress will temporarily open the tools from the other program so that you can make changes. It's like having a mini-version of Calc or Writer living inside your presentation.

- How to insert it:

1. Go to the Insert menu and select **Object > OLE Object**.
2. To create a new object, choose Create new and pick the type (e.g., Text Document).
3. To insert an existing file, choose Create from file, click Search, find your file, and click OK.

3.5.6 Hyperlinks

A hyperlink is an interactive element in a presentation that, when clicked, redirects the user to another location. This location can be a different slide within the same presentation, an external webpage, an email address, or even a file.

Hyperlinks make your presentation non-linear and interactive. They allow you to navigate freely between slides, access external resources during a talk, or provide additional information without cluttering your slides.

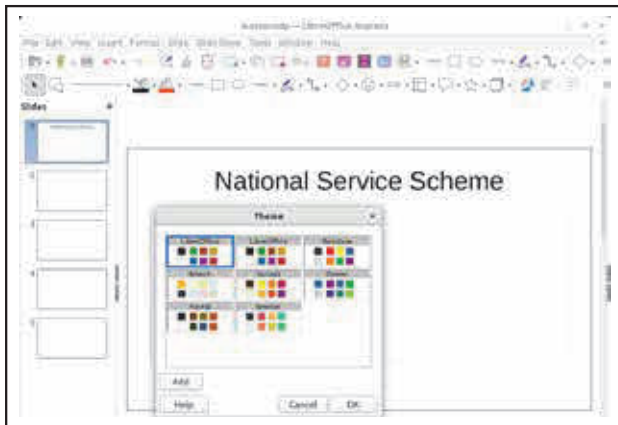


Figure 3.15 Inserting Hyperlink

How to Use Hyperlinks

1. Select the text, image, or object you want to turn into a hyperlink.
2. Choose **insert >Hyperlink** or use the keyboard shortcut **Ctrl + K**.



3. In the dialogue box, choose the destination:

- **Internet:** To link to a website or a file on your computer.
- **Document:** To open to another document.
- **mail:** To open the user's default email client with a pre-filled recipient address.

3.5.7. Action Buttons

An Action Button is an interactive element that can be added to a slide in LibreOffice Impress. It is typically a graphical shape that, when clicked during a slide show, triggers a specific action—such as navigating to another slide, playing a sound, opening a document, or launching a web page. Action buttons enhance the interactivity of a presentation, allowing the presenter or viewer to control the flow of content in a non-linear manner.

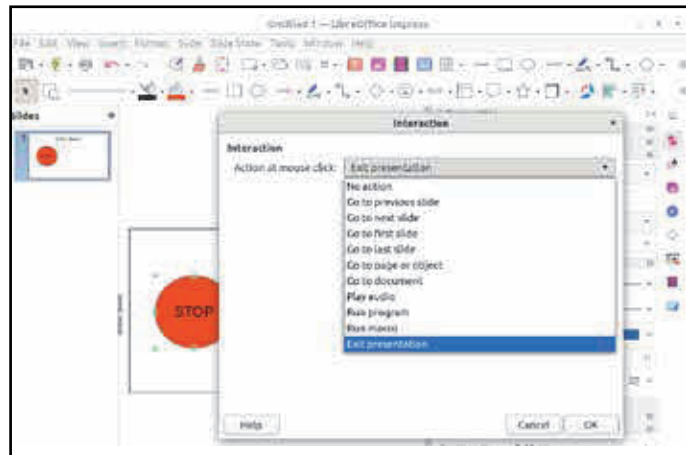


Figure 3.16 Inserting Action Button

Creating an Action Button

To insert and configure an action button, follow these steps:

1. Insert a Shape:

Select a shape from the **Drawing Tools** toolbar (e.g., rectangle, rounded rectangle, arrow, or any custom shape). Click and drag on the slide to draw the shape, which will serve as the button.

2. Open the Interaction Dialog:

Right-click on the shape and select **Interaction...** from the context menu.

3. Assign an Action:

In the **Interaction** dialog box, click the drop-down menu under **Action at mouse click** and choose the desired function.



1. What is the purpose of inserting a video into a presentation?
2. What is the main advantage of inserting a spreadsheet (OLE Object) instead of a table's image?
3. Explain the steps to insert a chart using a content box.
4. Describe a situation where a Line chart would be more effective than a Pie chart. Justify your answer.

3.6 Animation in Slides

Animation is the illusion of movement. It's the process of making static objects change over time. In the context of presentations, animation is a feature that allows you to control how the elements on your slides appear, move, emphasize points, or disappear. Instead of showing all the content on a slide at once, you can reveal it piece by piece, making your presentation more dynamic and engaging. Animations can be classified into Object Animations and Slide Transition.

3.6.1 Animating Objects on a Slide

How to Apply an Animation to an Object:

1. In **Normal** view, select the object (text, image, shape, etc.) you want to animate on your slide.
2. Open the **Animation Deck** in the Sidebar.
3. In the deck, you will find the following controls to build your animation:

Animation Category: Choose a category of effects, such as "Entrance", "Exit", "Emphasis", or "Motion Paths".

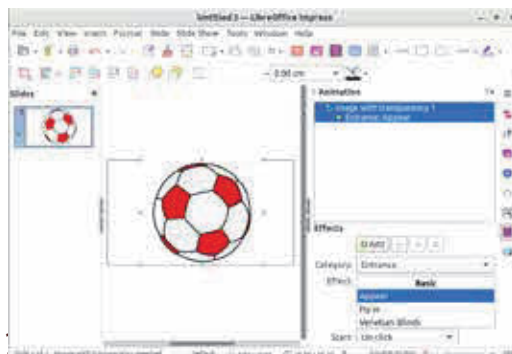


Figure 3.17 Applying animations to an object

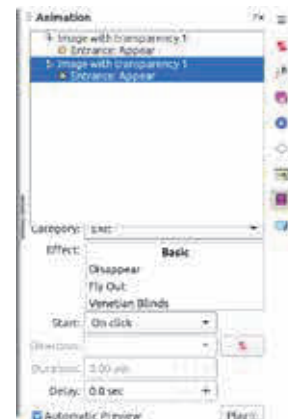


Figure 3.18
Applying animations
categories

These effects are used when you want something to come onto the slide. Instead of just being there, a picture or text can "fade in" softly or "fly in" to the side. This helps you show your points one by one, so your friends don't get distracted and can focus on what you are saying right now.

2. Emphasis Effects

Use these when you want to make something already on the screen



stand out. If you have an important word or number, you can make it "pulse" or "spin" a little. This is like raising your voice to say "listen carefully to this part!" but in a visual way.

3. Exit Effects

These effects control how an object leaves the slide. When you are done talking about a point, you can make it "fade out" or "fly away." This keeps your slide neat and clean, making space for the next matter you want to show.

4. Motion Paths

This is the most attractive animation effect. It lets you move an object on a specific path. For example, you can make a car graphic drive across the slide from left to right, or make a planet move in a circle to show its orbit. It helps you explain how things move from one place to another.

Animation Effect: Select a specific effect from the list (e.g., "Fade In", "Fly In", "Spin"). There are many types of animation effects, each creating a different visual impact. For example, the "Fade In" effect makes an object gradually appear, which is useful for a subtle and professional introduction. The "Fly In" effect brings an object onto the slide from a chosen direction, which is effective for showing a sequence or a list of points. The "Spin" effect rotates an object, making it ideal for drawing focus to a key logo, icon, or piece of data.

- **Start:** Choose how the animation is triggered.
 - **On Click:** The animation plays when you click the mouse.
 - **With Previous:** The animation plays along with the previous one.
 - **After Previous:** The animation plays immediately after the previous one finishes.
- **Duration:** Adjust how long the animation effect lasts.
- **Delay (automatic only):** Set a pause before the animation starts (if the slide show is set to advance automatically).

4. The **Automatic Preview** option will show you a preview of the effect as you apply it.

Animating Text

Text within text boxes can also be animated. The options are found in the Text dialogue.

To access Text Animation:

1. Right-click on a text box and select Text Attributes.
2. In the Text dialogue, go to the Text Animation tab.
3. Here you can apply effects that specifically control how the text appears, one character, word, or line at a time.

3.6.2 Slide Transition

A **slide transition** is the visual effect that plays when you move from one slide to the next during a presentation.

How to Apply a Slide Transition:

1. Select the slide(s) you want to apply the transition to. You can do this in the **Slides Pane** or in **Slide Sorter** view.
2. Open the **Slide Transition Deck** in the Sidebar.
3. In the deck, you can customise the transition:
 - **Transition Type:** Choose from a list of effects, each creating a distinct visual experience. The "Fade" transition gently dissolves one slide into another, ideal for formal presentations and creating subtle, elegant movement. "Push" slides the new content in from a specified direction, effectively showing progression or sequence. "Wipe" reveals the new slide with a sweeping motion, useful for emphasizing transitions between related concepts. "Random Bars" creates a dynamic pattern of horizontal or vertical bars during the transition, suitable for more casual or creative presentations.
 - **Modify Transition:** Adjust the speed of the transition (Slow, Medium, Fast).
 - **Advance Slide:** Choose how to move to the next slide.
 - **On Mouse Click:** Manually advance by clicking.
 - **Automatically after:** Set a specific time for the slide to advance on its own.
4. Use **Apply to All Slides** to use the same transition throughout your presentation.

Animation in LibreOffice Impress is a powerful tool that transforms static slides into dynamic and engaging narratives. By mastering the use of **Entrance, Emphasis, and Exit effects**, presenters can control the flow of information, revealing key points sequentially to maintain audience focus. Furthermore, **Motion Paths** allow for the illustration of movement and processes, enhancing explanatory power. When combined with purposeful **Slide Transitions**, these elements create a seamless and professional visual experience. Used





judiciously, animation is not merely decorative but a fundamental feature for emphasizing content, guiding the audience's attention, and delivering a more impactful and memorable presentation.



1. Name one destination you can link to using a hyperlink.
2. Which tab in the menu is used to insert an Action Button?
3. What is the special name for the view that allows a presenter to see their notes during a slideshow?
4. What is the keyboard shortcut to insert a hyperlink?
5. Differentiate between a hyperlink and an Action Button.
6. Explain how does Speaker Notes help a presenter.
7. Describe one practical use of a hyperlink in a classroom presentation.
8. Why should a presenter use Action Buttons instead of only keyboard shortcuts?

3.7 AI in Presentation Software

Presentation software is getting a major upgrade thanks to Artificial Intelligence (AI). In the future, AI will do most of the hard work, turning these programs from simple tools into smart assistants.

1. AI will Build Presentations for You

Instead of starting with a blank slide, you will just tell the AI program to create a presentation on a topic. It will write the text, choose the right layouts, pick good colours and fonts, and even find suitable pictures. If you have data, the AI will analyse it and create the best charts, also writing short explanations for them.

2. Presentations will Become Interactive and Adaptive

Future presentations will not be a fixed sequence of slides. They will be able to change in real-time. For example, during a talk, the software could shorten the presentation if time is running out, or show more details on a topic as the audience finds interesting. It will also make adding 3D models and interactive elements very easy. You can use free slide designs from Slidesgo.com in LibreOffice Impress by opening the downloaded templates in the program. To make your presentation interactive, use AhaSlides.com in your web browser while showing your slides—it lets your audience answer polls and quizzes live on their phones. This way, you get nice-looking slides and keep everyone engaged.

3. AI will Help You to Be a Better Presenter

The software will also act as a personal coach. It will listen to you practice and give tips on your speaking speed, tone, and use of filler words. It will also make presentations accessible for all type of people by adding features like audio descriptions for the blind and captions for the deaf. In short, AI will handle the design and formatting work, allowing you to focus on what really matters: delivering a clear and powerful message.

You can use Artificial Intelligence (AI) tools to help create better presentations in LibreOffice Impress. Since Impress does not have AI built in, you work with external AI applications and bring their results into your presentation.

Here is a simple way to do it:

1. For Text and Ideas: Use a free AI tool like ChatGPT or Google Gemini. Ask it to "write three clear points about solar energy" or "suggest a title for a presentation on healthy eating." Then, copy the text from the AI and paste it into your Impress slides.

2. For Pictures and Designs: Use an AI image generator. Tell the AI what you need, like "a simple icon for teamwork" or "a background for a science project." Download the image it creates. Then, in Impress, go to Insert → Image to add it to your slide.

3. For Practice: Some AI tools can listen to you practice your presentation. They can tell you if you are speaking too fast or using too many filler words like "um." You practice separately with the AI, and then use the feedback to improve before you present with Impress.



Applying your skills : Subject specific uses for LibreOffice Impress

For Sociology Students:

In Sociology, you study society, which can involve complicated ideas and a lot of numbers. This chapter helps you to:

- Show data clearly: Use charts and graphs to make statistics about people or social trends easy to understand.
- Explain complex ideas: Break down big ideas into simple points on different slides.
- Tell a story: Use photos and video clips to show real-life examples of the social issues you are discussing.





For Journalism Students:

Journalism is about telling true stories in a way that grabs people's attention. This chapter helps you learn how to:

- Pitch a story: Create a short, visual presentation to convince your editor to run a story.
- Organise a news report: Use slides to lay out the key facts of a story in a logical order.
- Make stories engaging: Add short audio clips from an interview or video from a scene to make your report more powerful and believable.

Making Presentations in Many Languages with Impress

A multilingual presentation is a slide show made for people who speak different languages. LibreOffice Impress helps you create such presentations easily. You can write and check spelling in many languages like English, Hindi, or Spanish right inside your slides. To do this, go to Tools → Options → Language Settings to choose a language, or select any text box and pick a language from the formatting menu. When designing your slides, keep the layout simple and leave enough space because translated words can be longer or shorter. Use common fonts and avoid putting text inside pictures so that translating is easier. With these steps, you can make one presentation that everyone in your class, community, or online audience can understand, no matter what language they speak.

For Communicative English Students:

This subject is all about communicating well. Presentation software is a perfect tool for this because it helps you:

- Speak with confidence: Use the "speaker notes" to remember your key points without reading from the slide.
- Use visuals wisely: Learn how to use images to support your words, not just repeat them.
- Create digital stories: Build a presentation that uses a mix of words, sound, and pictures to tell a story in a modern and engaging way.

In short, learning to use **LibreOffice Impress** will give you a powerful voice. No matter if you are explaining social data, reporting a story, or giving a speech, these skills will help you share your ideas with confidence and clarity.



◆————◆ Summary ————◆

This chapter introduces presentation software as a vital digital tool for organizing and sharing ideas visually through slides. It focuses on LibreOffice Impress, a free, open-source application that allows you to combine text, images, charts, audio, and video to create clear and engaging presentations for classrooms, meetings, and seminars. You will become familiar with the Impress workspace, including its interface, different views (Normal, Outline, Slide Sorter, Notes, and Master), and basic operations like creating, saving, and adding slides. The chapter then guides you through designing professional slides using layouts, Master Slides, backgrounds, and themes, and enriching your presentation by inserting multimedia elements, charts, and tables. To make your presentation dynamic, you will learn to apply animations, transitions, and interactive tools like hyperlinks and action buttons. The chapter also explores the growing influence of Artificial Intelligence (AI) in automating design and improving delivery, and demonstrates how these skills apply to subjects like Sociology, Journalism, and Communicative English. Supported by exercises and lab work, this chapter builds the essential digital literacy and communication skills needed for academic and professional success.



1. Which feature of LibreOffice Impress allows a user to maintain a consistent design, including backgrounds and font styles, across all slides?
A) Slide Sorter B) Slide Masters C) Animation Deck D) Outline View
2. What is the default file format used for saving presentations in LibreOffice Impress?
A) .ppt B) .odp C) .docx D) .pdf
3. Which view displays all slides as small thumbnails in a grid, making it the best tool for managing the overall sequence of a presentation?
A) Normal View B) Outline View C) Slide Sorter View D) Notes View
4. Which component of the main Impress window provides quick access to layouts, animations, transitions, and slide properties?
A) Slides Pane B) Menu Bar C) Workspace D) Sidebar
5. Which animation category is used to move an object along a specific line or custom path on the slide?
A) Entrance Effects B) Emphasis Effects C) Exit Effects D) Motion Paths





6. Which of the following is a capability of LibreOffice Impress regarding file compatibility?
 - A) It can only open Open Document formats.
 - B) It can open and save Microsoft PowerPoint files (.ppt, .pptx).
 - C) It cannot export to PDF format.
 - D) It is only available for the Windows Operating System.
7. What happens if you click the “Close” button on the “Select a Template” dialogue box when starting the application?
 - A) The application exits.
 - B) A file browser opens to find existing files.
 - C) The help menu appears.
 - D) An empty/blank presentation opens.
8. To enable a “Presenter Console” where the speaker sees their notes and the next slide while the audience only sees the current slide, which view must the presenter prepare?
 - A) Slide Sorter View
 - B) Master Slide View
 - C) Notes View
 - D) Outline View
9. Why might a student prefer “Outline View” over “Normal View” when starting a complex presentation?
 - A) It allows for better image placement.
 - B) It allows the user to focus on the structure and flow of ideas without graphical distractions.
 - C) It shows all manually created text boxes and images.
 - D) It is used to apply 3D effects to text.
10. The ----- is the left-hand section of the main window that displays thumbnail images of all slides in your presentation in sequential order.
11. The central area of the Impress window where you actively design, create, and edit individual slides is known as the -----.
12. A ----- in Impress is a pre-designed document used as a starting point that can contain backgrounds, styles, and slide layouts.
13. The ----- allows a presenter to create speaker notes that are hidden from the audience but assist the presenter during a talk.
14. An ----- is a graphical shape that triggers a specific function, such as navigating to a different slide or playing a sound, when clicked during a slideshow.
15. The illusion of movement applied to specific elements like text, images, or shapes on a single slide is called -----.



16. A ----- is the visual effect that plays specifically when moving from one slide to the next during a presentation.
17. Define a “Slide” as a visual aid within a presentation.
18. Name the pane that displays thumbnails of all slides for easy navigation.
19. State the keyboard shortcut used to quickly insert a new slide.
20. Which feature is used to maintain a consistent design across all slides in a presentation?
21. Identify the view used to organize and edit text content in an outline format without graphics.
22. Name the specific view used for adding speaker notes to slides.
23. List and briefly explain any two advantages of digital presentations over paper handouts .
24. Describe the function of the Workspace area in the Impress window.
25. Mention two different methods used to add a new slide to a presentation .
26. Name four types of objects that can be included in an Impress slide .
27. What is an Action Button, and how is it used during a slide show ?
28. List any four character formatting options available in the Sidebar (e.g., Bold, Font Size) .
29. Distinguish between a Slide Transition and an Object Animation.
30. Briefly explain the purpose of using OLE (Object Linking and Embedding) in a slide.
31. Explain the specific tasks performed in Normal View, Slide Sorter View, and Notes View.
32. Describe the purpose of Entrance, Emphasis, and Exit animation effects.
33. “The Master Slide acts as a blueprint for a professional presentation.” Justify this statement with three reasons.
34. Describe the steps to insert a Chart into a slide using the Menu bar .
35. Describe the main sections of the LibreOffice Impress window (Slides Pane, Workspace, and Sidebar) and how each aids in creating a presentation .
36. Explain the step-by-step process to change the background of all slides in a presentation using the Master Slide method .
37. List the five “Standard Views” available in the Impress Workspace and explain the specific task each view is most useful for.



4

Electronic Spreadsheet



“Without data, you’re just another person with an opinion.”

W. Edwards Deming

4.1 Introduction

In today’s digital world, data is used across almost every field, from tracking daily expenses to analysing scientific results. Spreadsheet software helps users to organise data in rows and columns and perform calculations accurately. It is widely used in schools, offices and homes to manage information such as marks, schedules and inventories.

Electronic Spreadsheets allow users to enter numbers, text and formulas to analyse and present data effectively. Features such as formulas, functions and charts help to simplify calculations and identify trends and patterns. Some popular spreadsheet software include LibreOffice Calc, MS Excel, Google Sheets, Apple Numbers, Gnumeric and Zoho Sheet. In this chapter, we will learn about the features and practical uses of LibreOffice Calc.

4.1.1 Features of a Spreadsheet

Spreadsheet software provides a wide range of features that make data entry, calculation and analysis simple and efficient. Some of the important features are given below.

a. Grid Structure

Spreadsheets are organised in the form of rows and columns. The intersection of a row and a column forms a cell, which is the basic unit of data entry. Each cell is identified by a unique address.

b. Data Entry and Editing

Users can easily enter different types of data such as numbers, text, dates and formulas in a spreadsheet. Editing options such as Cut, Copy, Paste, Delete and Undo/Redo make data entry and correction more convenient.

c. AutoFill and AutoComplete

The AutoFill feature allows users to quickly fill a series of numbers, dates, or patterns in adjacent cells. AutoComplete helps to reduce typing by suggesting entries based on previous data.

d. Data Formatting

To improve the readability and presentation of data, spreadsheets provide various formatting options. Features such as font style, size, colour, alignment, borders and background shading can be applied to cells or a range of cells to make the data clearer and more attractive.

e. Formulas and Functions

Spreadsheets allow users to perform calculations using formulas (user-defined expressions) and built-in functions such as SUM, AVERAGE, MAX, MIN, IF, etc. The functions help in performing mathematical, statistical, logical and financial operations quickly and accurately.

f. Charts

Data can be represented visually using charts such as bar charts, line charts, pie charts, etc. Charts make data analysis easier and clearer by highlighting trends and comparisons.

g. Data Sorting and Filtering

Spreadsheets allow users to sort data in ascending or descending order to organise information more effectively. The filter feature is used to display only those records that meet specific conditions, making it easier to focus on relevant data.

h. Data Analysis Tools

Spreadsheets provide tools such as Pivot Tables and What-if Analysis to analyse large sets of data and study different outcomes by changing input values. Analysis tools help users to summarise information, identify patterns and make predictions effectively.





i. Data Validation and Security

Spreadsheets allow users to set rules and restrictions on the type of data entered into a cell, ensuring accuracy and preventing invalid inputs. Features such as password protection, sheet protection, and cell locking help to protect important information from unauthorised changes.

j. Collaboration

Modern cloud-based spreadsheets such as Google Sheets and Office 365 support real-time collaboration, allowing multiple users to work on the same file simultaneously. These tools make teamwork easier by enabling shared editing, comments, and instant updates across devices.

Did you know?

Modern spreadsheet tools are increasingly integrating Artificial Intelligence (AI) to make data handling easier and smarter. AI can assist users by enabling direct data entry from different file types, suggesting formulas, detecting patterns, automatically creating charts, and highlighting important insights.

Most AI features are not native to LibreOffice Calc, which focuses mainly on core spreadsheet functions. However, learning about AI-assisted spreadsheets helps students understand advanced tools used in real-world data analysis and decision-making.

Zoho Sheet is a web-based spreadsheet application that includes an AI assistant called Zia, which helps users analyse data more quickly.

4.1.2 LibreOffice Calc

LibreOffice Calc is the spreadsheet component of the LibreOffice suite. It allows users to enter numerical and other types of data, and manipulate this data to obtain meaningful results.

Spreadsheets, Sheets, and Cells

Calc works with documents called spreadsheets (workbooks). A spreadsheet contains multiple sheets (worksheets) and each sheet is made up of cells arranged in rows and columns. Every cell is identified by a unique cell address, formed by combining its column letter and row number. The number of available rows, columns and sheets may vary depending on the software version.

Calc Interface

When Calc is started, the main window opens (Figure 4.1).

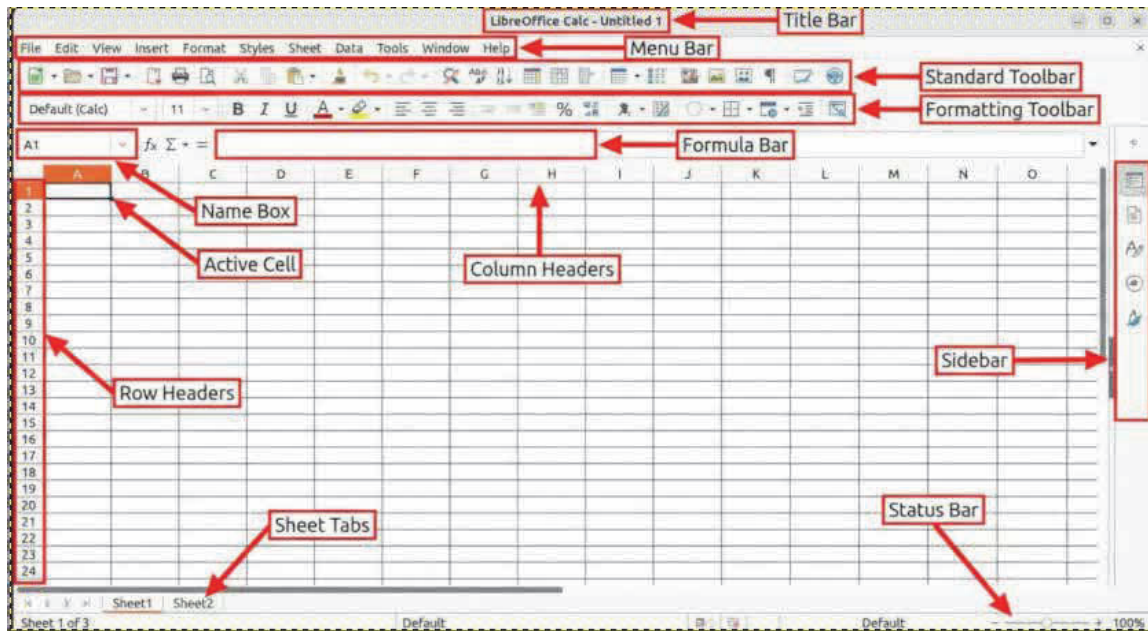


Figure 4.1 - Calc Main Window

The main components of the spreadsheet window are given below.

Title Bar

The Title bar, located at the top, shows the name of the current spreadsheet and three control buttons - minimise, maximise and close.

Menu Bar

The Menu Bar is located below the Title Bar and provides drop-down menus such as File, Edit, View, Insert, Format, Styles, Sheet, Data, Tools, Window and Help, which are used to perform various functions of Calc.

Standard Toolbar

It provides quick access to commonly used options such as Save, Open, Copy, Paste and Print.

Formatting Toolbar

It contains shortcut icons for applying text and cell formatting options such as font style, font size, alignment and number formats.

Active Cell

The active cell is the currently selected cell in a spreadsheet where data can be entered or edited.

Formula Bar

The Formula Bar shows the contents of the active cell and is used to enter or edit data and formulas. It has three main parts: the Name



Box - which displays the address of the active cell; the Input Line - used to enter or edit data; and the Function Wizard icon - which helps to insert functions.

Window (Cell Grid)

This is the central area of the screen, organised into a grid of numbered rows and lettered columns where we enter and view the data.

Column Headers

The column headers start at letter A and go on to the right. The letters (A, B, C...) at the top of the columns identify each column.

Row Headers

The row headers start at 1 and go down. The numbers (1, 2, 3...) on the left side of the worksheet identify each row.

Sheet Tabs

Tabs at the bottom of the window allow us to switch between different worksheets within the same workbook. It indicates the name of the worksheet currently in use. Users can also edit the name of any worksheet.

Status Bar

It is located at the very bottom of the window. It displays information about the current spreadsheet, such as zoom level, sheet number, language, the sum and average of selected numeric data in the range, etc.

Side Bar

A panel on the right side of the window that provides quick access to properties, styles, gallery and navigator.

4.1.3 Calc Terminology

Cell address: The location of each cell in the worksheet is unique and it is identified with an address consisting of column letter followed by a row number. For example, B4 is the cell in the second column and the fourth row (figure 4.2).

Cell reference: In calculations using functions and formulas, when cells are referred by their cell addresses, it is called cell referencing. This topic is explained in later sections.

Cell range: A set of selected adjacent cells is called cell range. It is useful in referring to multiple values at once. The range indicator



symbol in Calc is ':' (colon). For example, the range A1:B4 includes cells A1, B1, A2, B2, A3, B3, A4 and B4.

Data, Labels, Functions and Formulas: The values representing the details about any entity or event are called data. Label is the text that identifies the data. Functions are built-in features of Calc to perform calculations. Formulas are created by the user to perform calculations according to specific requirements.

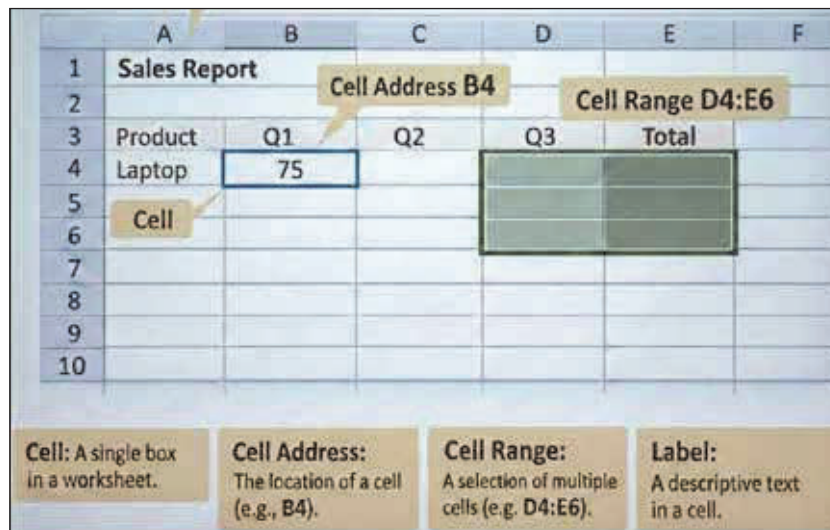


Figure 4.2 - Spreadsheet Basics

4.1.4 Creating and Opening Spreadsheets

Creating and opening spreadsheets are similar to creating and opening different types of files in other LibreOffice modules.

Creating: Choose **File > New** on the Menu Bar, Click the **New** button from the toolbar or press **Ctrl+N** to create a spreadsheet.

Opening: Choose **File > Open** on the Menu Bar, Click the **Open** button from the toolbar or press **Ctrl+O**, select the file and click Open to open an existing file.

4.1.5 Saving Spreadsheets

Calc can save spreadsheets in a variety of formats and also export spreadsheets to several file formats. To save a spreadsheet and store the changes made to the file, we can use any one of the following methods.

Choose **File > Save** on the Menu Bar, Click the Save button from the toolbar or press **Ctrl+S** to save the spreadsheet.

Common File Formats

When we save a spreadsheet, we can choose from several file formats.



ODS (Open Document spreadsheet): This is the default, native format for Calc(e.g., class.ods).

XLSX (Microsoft Excel Open XML Spreadsheet): This is the default file format for modern versions of Microsoft Excel 2007 and newer (e.g., class.xlsx)

XLS (Microsoft Excel 97-2003 Spreadsheet): This is the older file format for Microsoft Excel(e.g., class.xls).

CSV (Comma Separated Values): This is a plain text file format in which values are separated by commas (e.g., class.csv). CSV files do not preserve formatting or formulas.

PDF (Portable Document Format): This format creates a 'snapshot' of your document(e.g., class.pdf).



1. Fill in the blanks

- A spreadsheet is an application software used to arrange data in rows and _____
- The _____ displays the active cell address and allows users to enter or edit data and formulas.
- The default native file format of Calc is _____.
- A group of adjacent selected cells is called _____.

2. Match the following

i. Title Bar	a. Displays the active cell address and allows editing of formulas
ii. Menu Bar	b. Shows the name of spreadsheet and control buttons
iii. Formula Bar	c. Displays information such as zoom level and sum of selected cells
iv. Sheet Tabs	d. Contains drop-down menus such as File, Edit, and View
v. Status Bar	e. Used to switch between different worksheets

- List any two popular spreadsheet software.
- Write any two features of a spreadsheet.
- What is a cell address? Give an example.
- What is cell range? Give an example.
- What is a CSV file format?
- List and explain the components of Calc window.

4.2 Entering and Editing Data

Entering and editing data in Calc is simple. Users can click in a cell and enter the data using the keyboard. We can move between cells using the mouse or arrow keys. We can edit the data directly inside the cell or use the Input Line (Formula Bar) at the top.

To explain spreadsheet concepts clearly, a simple and practical worksheet named the Student Progress Tracker is used (Figure 4.3). At this stage, it contains basic information such as student names and marks in three subjects. As the section progresses, the remaining fields are completed gradually, demonstrating the step-by-step addition of data, formulas and calculations.

	A	B	C	D	E	F	G
1	Name	English	Maths	Science	Total	Percentage	Result
2	Anu	78	85	72			
3	Binu	54	42	38			
4	Charu	90	88	95			
5	Dinu	45	53	48			
6	Esha	82	79	85			
7	Maximum Mark	100	100	100			

Figure 4.3 - Student Progress Tracker data sheet

4.2.1 Basic Data Entry

- Select a cell by clicking on it with the mouse.
- Enter text, numbers, dates directly or start with an equal sign (=) to enter a formula.
- Press Enter to save the data and move to the next cell down or Tab to move right.

Different Types of Data

In a spreadsheet, we deal with different types of data.

- **Text:** Any combination of letters, numbers or symbols not recognised as a number, date or formula. Text is displayed as entered and is often used for labels or names.
- **Number:** Integer or decimal values. Numbers allow mathematical operations and can be formatted for currency, percentages or scientific notation.
- **Date:** Calc recognises various date formats ('DD/MM/YYYY', 'MM/DD/YYYY'). Date values allow calculations such as the difference between days and chronological sorting.



- **Formula:** Begins with the '=' sign. Formulas can compute sums, averages or reference other cells, updating automatically when cell data changes.

4.2.2 Data Editing Tools

The data entered in a worksheet can be edited at any time.

- **Direct Editing:** We can use any one of the following methods for direct editing
 - Double-click in a cell to edit the data in it.
 - Click in the cell and Press F2 (function key) to edit the data.
 - Select the cell and edit the data in the Input Line.
- **Cut, Copy, Paste, Paste Special:** Enables moving or duplicating values, formulas or formats between cells. Paste Special gives options to paste values, formulas or both.
- **Find and Replace:** Allows for quick searching and updating of data.
- **Delete:** Remove unwanted entries by selecting cells and pressing the Delete key.

AutoFill

AutoFill automates the entry of repeating series or patterns (numbers, dates, text - like days of the week).

It is useful for quickly generating lists or copying formulas across rows/columns.

Steps

- Enter a value (number, date, text) in a cell, select it, then drag the fill handle at the cell's bottom-right to auto-complete series or duplicate data.
- For custom series, select **Sheet > Fill Cells > Series** from the Menu Bar and specify the Start Value, End Value, Increment, Direction, etc. in the Fill Series dialog box (Figure 4.4).

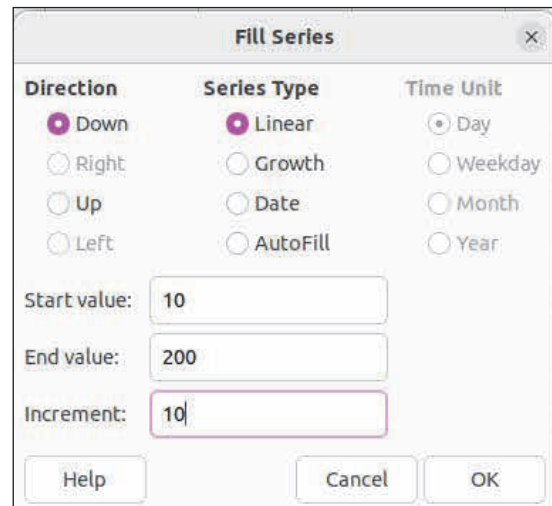


Figure 4.4 - Fill Series dialog box

4.2.3 Inserting Cells

Inserting cells is used to add new cells in a worksheet so that additional data can be entered. When new cells are inserted, the existing cells shift to create space.

Steps:

- Select the cell or range of cells where you want to insert new cells.
- Choose **Sheet > Insert Cells...** from the Menu Bar or right-click the selected cells and choose **Insert Cells** from the context menu.
- Select the required option and click **OK**.

4.2.4 Inserting Columns and Rows

Inserting columns and rows is used to add new columns or rows in a worksheet to enter additional data. When a column or row is inserted, the existing data shifts to make space.

Steps:

- Select the column header or row header where you want to insert a new column or row.
- Choose **Sheet > Insert Columns** or **Sheet > Insert Rows** from the Menu Bar or right-click the selected column or row header and choose **Insert Columns** or **Insert Rows** from the context menu.



Tip: To delete cells, rows, or columns, select them and use the appropriate Delete option from the Sheet menu or the right-click (context) menu.

4.2.5 Freezing Rows and Columns

Freezing is used to lock rows across the top of a spreadsheet or to lock columns on the left of a spreadsheet. Then, when moving around within a sheet, the cells in frozen rows and columns always remain in view. This is useful when working with large amounts of data.

Steps:

- Click on the row header below the rows you want to freeze or click on the column header to the right of the columns where you want to freeze.
- Go to View on the Menu Bar and select **Freeze Rows and Columns**.
- To unfreeze rows or columns, go to View on the Menu Bar and click Freeze Rows and Columns to clear the freeze option.





1. Fill in the blanks
 - a. _____ key is used to edit the cell content.
 - b. _____ tool helps in searching and updating the data quickly.
 - c. To enter a formula in Calc, it must begin with _____ sign.
 - d. We can move between cells using the _____ keys.
 - e. _____ allows pasting only values, formulas, or formats.
2. Name any two types of data that can be entered in a spreadsheet.
3. What is the use of the F2 key in Calc?
4. Differentiate Paste and Paste Special.
5. What is the function of Find and Replace?
6. What is AutoFill in Calc?

4.3. Formatting Cell

Cell formatting is an important feature of any modern spreadsheet software, including Calc. In this section, we learn about manual and style formatting as well as conditional formatting. The Format Cells dialog box in Calc provides various options to control the appearance and display of data in a cell. It can be opened by right-clicking a cell and choosing Format Cells from the context menu, by selecting **Format > Cells** from the Menu Bar or by pressing **Ctrl + 1**. The Format Cells dialog box contains several tabs, each used for a specific type of formatting. The tabs in the dialog box include Numbers, Font, Font Effects, Alignment, Borders, Background and Cell Protection.

a. Alignment

Multiple lines of Text

Sometimes we may want more than one line of text inside the same cell (for example, an address). Multiple lines of text can be entered into a single cell using automatic wrapping or manual line breaks. Wrap text allows long sentences to fit into multiple lines within a single cell without changing the column width.

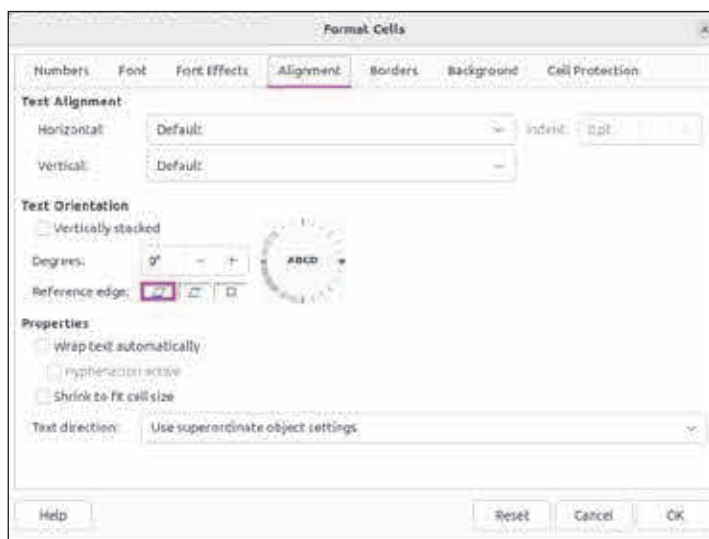


Figure 4.5 - Format Cells dialog box

Steps to Wrap Text Automatically:

- 1) Select a cell or cell range.
- 2) Open the **Format Cells** dialog box. (Figure 4.5)
- 3) Click the Alignment tab.
- 4) Check '**Wrap text automatically**'.
- 5) Click **OK**.

Manual Line Break:

A manual line break is used to start a new line within the same cell without moving to another cell.

How to Insert a Manual Line Break

- While typing inside a cell: → Press **Ctrl + Enter**.
- In the input line (Formula Bar): → Press **Shift + Enter**.

Text Alignment and Orientation

Alignment helps to place the text at different positions inside a cell.

Horizontal Alignment: Left, Center or Right

Vertical Alignment: Top, Middle or Bottom

Orientation: Rotate text vertically or diagonally.

Example: Rotate the text 'TOTAL' vertically for a narrow column.

b. Formatting Numbers

Numbers in Calc can be displayed in different formats, such as currency, percentage or with a fixed number of decimal places. For example, to display the value 120 in currency format as ₹ 120.00, follow these steps:

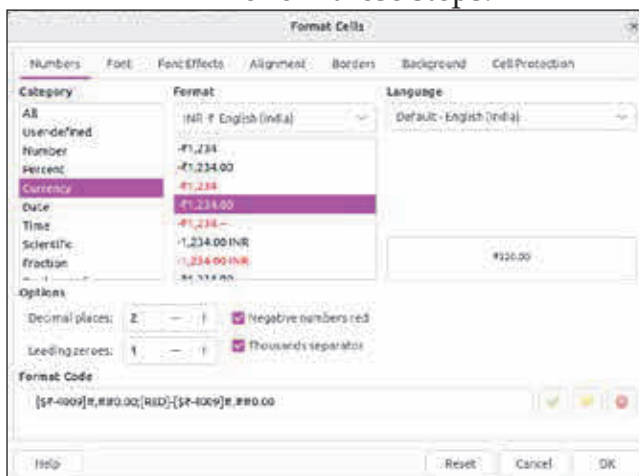


Figure 4.6 - Formatting numbers

1. Select the required cell.
2. Open the **Format Cells** dialog box.
3. Click the **Numbers** tab (Figure 4.6).
4. Select the **Currency** category.
5. Specify the number of decimal places and other required options.
6. Click **OK** to apply the format.



c. Formatting Fonts

The appearance of data in Calc can be changed using the Formatting toolbar or the Format Cells dialog box. Font formatting allows users to modify how text appears in a worksheet.

Common font formatting options include:

- Changing the font style (Regular, Bold, Italic, Bold Italic)
- Changing the font size
- Changing the font family, etc.

Steps:

1. Select the required cell or range of cells.
2. Open the **Format Cells** dialog box.
3. Click the **Font** tab.
4. Choose the required font family, style and size from the available options.
5. Click **OK** to apply the formatting.

Example: In Student Progress Tracker, Make the headings bold and larger.

d. Font Effects

Font effects are used to apply special styles to text, such as font colour, underlining, overlining, strike-through, shadow, etc.

Steps:

1. Select the required cell or range of cells.
2. Open the **Format Cells** dialog box.
3. Click the **Font Effects** tab.
4. Choose the required font effect from the available options.
5. Click **OK** to apply the font effects.

Example: Underline the title “Student Progress Tracker”.

e. Formatting Cell Borders

Cell borders help maintain a clean and organised appearance of a table. Borders improve readability of data.

Steps:

1. Select the required cells.
2. Open the **Format Cells** dialog box.

3. Click the **Borders** tab.
4. Choose the required line style and border type.
5. Click **OK** to apply the borders.

Example:

Add borders to the Student Progress Tracker data table.

f. Formatting Cell Backgrounds

Background colours are used to distinguish headings and highlight relevant data.

Steps:

1. Select the required cells.
2. Open the **Format Cells** dialog box.
3. Click the **Background** tab.
4. Select a colour from the palette.
5. Click **OK** to apply the background colour.

Example: Give a light yellow background colour to the header row.

g. Setting Row Height and Column Width

Steps:

- Select the required row or column.
- From the Menu Bar, choose **Format > Row > Height** to set row height or **Format > Column > Width** to set column width.
- Enter the required value and click **OK**.

h. Hiding and Showing Rows and Columns

Steps to Hide Rows or Columns:

- Select the required row or column.
- Choose **Format > Row > Hide** or **Format > Column > Hide** from the Menu Bar

Steps to Show Rows or Columns:

- Select the entire worksheet or the rows/columns around the hidden ones.
- Choose **Format > Row > Show** or **Format > Column > Show** from the Menu Bar





i. Merging Cells

Merging of cells is the process of combining two or more adjacent cells into a single cell. It is commonly used to create headings or labels in a worksheet.

Steps:

- Select the cells you want to merge.
- Choose **Format > Merge Cells** from the Menu Bar, or click the Merge Cells icon on the toolbar.
- Confirm the action to merge the selected cells.

j. Conditional Formatting

Conditional formatting modifies the appearance of cells - such as colour, font or borders - according to specific conditions.

Why Use It:

- Highlight data like 'low marks'.
- Identify highest/lowest values.
- Automatically apply different colours to data or cells based on given conditions.

Steps:

1. Select the required range of cells.
2. Go to **Format > Conditional > Condition...**
3. Choose the type of condition.
4. Set the rule (for example, Marks < 40).
5. Choose a style and click **OK**.

Example: Highlight marks below 40 in red.

- **Condition type:** Cell Value
- **Condition:** Less than 40
- **Style:** Red font colour

Formatting helps improve the clarity and appearance of spreadsheet data. In this section, we have learned to format text, numbers and cells, apply borders and background colours, align content and use conditional formatting to highlight important values automatically.



1. Fill in the blanks

- a. The different horizontal alignment options are _____, _____ and _____.
- b. To format numbers, we use _____ tab in the Format Cells dialog box.



- c. Conditional formatting is applied using the _____ menu.
- d. Font formatting can be done using _____ toolbar.
- e. The common font styles are _____.

2. Match the following

i. Horizontal alignment	a. Top, Middle, Bottom
ii. Vertical alignment	b. Rotates text vertically or diagonally
iii. Orientation	d. Positions text inside a cell
iv. Alignment	e. Left, Center, Right

3. What is horizontal alignment? Name any two types.
4. Name any two font styles used in Calc.
5. How do you apply font effects to text?
6. What is conditional formatting?
7. Name any two number formats available in Calc.

4.4 Formulas and Functions

Formulas and functions help users perform calculations automatically in Calc. This section explains how to calculate each student's Total marks, Percentage of marks and Result in the Student Progress Tracker worksheet.

4.4.1 What is a Formula?

A formula is an equation written in a cell to perform a calculation. It can use numbers, cell references or both.

Writing formulas

- Every formula must start with an equal '=' sign.
- There must be an operator(s) to operate on the data.
- The data can be a value or a cell address or range of cells.
- If a cell value changes, the formula result updates automatically.

For example, in the Student Progress Tracker, the total mark of each student is calculated by adding the marks obtained in all subjects. This is done using a formula in the Total column, as shown in Figure 4.7.

In the Student Progress Tracker:

To calculate the **Total** in cell **E2**, type **=B2+C2+D2** and press Enter.



	A	B	C	D	E	F	G
1	Name	English	Maths	Science	Total	Percentage	Result
2	Anu	78	85	72	=B2+C2+D2		
3	Binu	54	42	38			
4	Charu	90	88	95			
5	Dinu	45	53	48			
6	Esha	82	79	85			
7	Maximum Mark	100	100	100			

Figure 4.7 - Formula to find Total

Copy (drag the fill handle) down to calculate totals for all students. As the formula is copied, the cell addresses in the formula change automatically according to the row. For example, the formula =B2+C2+D2 becomes =B3+C3+D3 when copied to the next row. The updated table is shown in Figure 4.8. The total can also be calculated using the built-in SUM function or by using the AutoSum tool.

Tip: While creating a formula using cell references, you can use the mouse to select a cell and automatically insert its address instead of typing it manually.

	A	B	C	D	E	F	G
1	Name	English	Maths	Science	Total	Percentage	Result
2	Anu	78	85	72	235		
3	Binu	54	42	38	134		
4	Charu	90	88	95	273		
5	Dinu	45	53	48	146		
6	Esha	82	79	85	246		
7	Maximum Mark	100	100	100	300		

Figure 4.8 - Student Progress Tracker Table after Calculating Total

4.4.2 Operators

Calc supports different types of operators that are used to build formulas and perform various calculations (Table 4.1).

Table 4.1 Operators

Arithmetic Operators			
Operator	Operation	Example	Description
+	Addition	=B2 + C2 + D2	Adds the values stored in cells B2, C2, and D2

-	Subtraction	=B2 - C2	Subtracts the value in cell C2 from the value in cell B2
*	Multiplication	=C2 * 2	Multiplies the value in cell C2 by 2
/	Division	=E2 / 3	Divides the value in cell E2 by 3
^	Exponent	=B2 ^ 2	Calculates the square of the value in cell B2
%	Percentage	=B2*10%	Calculates 10% of the value in cell B2
Comparison Operators			
=	Equal to	=E2 = 200	Returns TRUE if the value in cell E2 is equal to 200.
>	Greater than	=E2 > 150	Returns TRUE if the value in cell E2 is greater than 150.
<	Less than	=E2 < 120	Returns TRUE if the value in cell E2 is less than 120.
>=	Greater than or equal to	=E2 >= 150	Returns TRUE if the value in cell E2 is greater than or equal to 150.
<=	Less than or equal to	=E2 <= 180	Returns TRUE if the value in cell E2 is less than or equal to 180
<>	Not equal to	=E2 <> 150	Returns TRUE if the value in cell E2 is not equal to 150
Text operator			
&	Concatenation	=A2&"scored"&E2	Joins the text in cell A2, the word 'scored' and the value in cell E2
Range operator			
:	Range of cells	E2:E6	Represents a range of cells that includes all the cells from E2 to E6

Precedence of basic mathematical operators

1. () Parentheses. Evaluates items in the parentheses
2. % Percentage
3. ^ Exponent
4. *, / Multiplication, Division
5. +, - Addition, Subtraction
6. =, <>, >=, <= Comparison operators



Operators with higher precedence are evaluated first. If two or more operators have the same precedence, they are evaluated from left-to-right.

Example showing order of calculation

The expression $=5 + 4 * 4$ is evaluated in the following order:

1. Multiplication: $4 * 4 = 16$, so the expression becomes $5 + 16$
2. Addition: $5 + 16 = 21$

Answer: 21

4.4.3 Types of Cell References

As mentioned earlier, cell reference identifies a specific cell in a spreadsheet using a combination of a column letter and a row number, such as A1 or B5. Cell references are essential for creating formulas and functions because they allow us to use or manipulate data from different cells. In the Student Progress Tracker, we use references such as **B2**, **C2** and **D2** to calculate totals.

References are the way that we refer to the location of a particular cell in Calc and can be either relative (to the current cell) or absolute (a fixed cell).

1. Relative references: Cell address change automatically when a formula is copied to another cell. For example, A1 becomes A2 if copied one row down.

Example in Student Progress Tracker:

Formula in **E2** is $=B2 + C2 + D2$

When this formula is copied down:

- In **E3**, it becomes $=B3 + C3 + D3$
- In **E4**, it becomes $=B4 + C4 + D4$

Here, the cell references change according to the row position. This is called relative reference. It is useful when performing the same calculation for different students.

2. Absolute references: An absolute reference is a cell reference that does not change when a formula is copied to other cells. It is written using the dollar sign '\$' before the column letter and the row number.

Format: $\$A\1 . It means that the cell A1 is fixed.

To calculate the percentage of marks for each student in the Student Progress Tracker, first store the maximum total marks in cell **E7**

(for example, 300). Then, enter the following formula in cell F2:

$$=(E2/\$E\$7)*100$$
 (Figure 4.9).

	A	B	C	D	E	F	G
1	Name	English	Maths	Science	Total	Percentage	Result
2	Anu	78	85	72	235	$=(E2/\$E\$7)*100$	
3	Binu	54	42	38	134		
4	Charu	90	88	95	273		
5	Dipu	45	53	48	146		
6	Esha	82	79	85	246		
7	Maximum Mark	100	100	100	300		

Figure 4.9 - Absolute Reference

Here, $\$E\7 remains fixed even when the formula is copied to other cells, ensuring correct percentage calculation for all students. i.e., the formula, $=(E2/\$E\$7)*100$ in cell F2 becomes $=(E3/\$E\$7)*100$ in cell F3 and $=(E4/\$E\$7)*100$ in cell F4, while the reference $\$E\7 does not change. This type of reference is called absolute reference. It is used when the same value (maximum marks - 300) is needed for all students.

4.4.4 What is a Function?

A function is a predefined formula in Calc that performs a specific task automatically such as adding many numbers, finding an average or identifying the highest score. Functions make calculations faster and easier.

Key Points

- A function always has a name such as SUM, AVERAGE, MAX, or MIN.
- A function uses arguments (values, cell references, or ranges) written inside the parentheses.
- A function must begin with an equal sign '='.

Example: $=\text{AVERAGE}(\text{B1:B10})$

Here, AVERAGE is the function name and B1:B10 is the argument (range of cells).

This function calculates the average of the values in cells B1 to B10.

For example, in the Student Progress Tracker, the average marks of a student in English, Maths and Science can be calculated using the following function.

$=\text{AVERAGE}(\text{B2:D2})$



Function name: AVERAGE

Argument: B2:D2 (Marks of English, Maths and Science)

Meaning: Finds the average marks of Anu in 3 subjects (Row 2)

Using the Function Wizard

The Function Wizard is the easiest way to insert functions in Calc. It guides us in choosing a function, selecting the required cells, and viewing the result instantly.

We can open the Function Wizard in three ways:

- Select **Insert > Function**.
- Click the **Function Wizard icon** on the Formula Bar.
- Press **Ctrl + F2** on the keyboard.

The Function Wizard (Figure 4.10) shows different categories of functions such as Mathematical, Statistical and Logical. A function such as SUM, AVERAGE or IF can be selected and applied to cells in the worksheet.

Example using the Student Progress Tracker - Finding the Result

In our Student Progress Tracker, the Result column is used to show whether a student has Passed or Failed based on the marks obtained.

Conditions:

If Total ≥ 150 , then Pass.

If Total < 150 , then Fail.

Steps to Find Result Using Function Wizard

1. Click on **cell G2** (Result of Anu).
2. Open the Function Wizard.
3. In the Function Wizard:
 - Select **Category:** Logical.
 - Select **Function:** IF.
4. Enter the arguments:
 - **Logical test:** $E2 \geq 150$.
 - **Value_if_true:** "PASS".
 - **Value_if_false:** "FAIL".
5. Click OK.

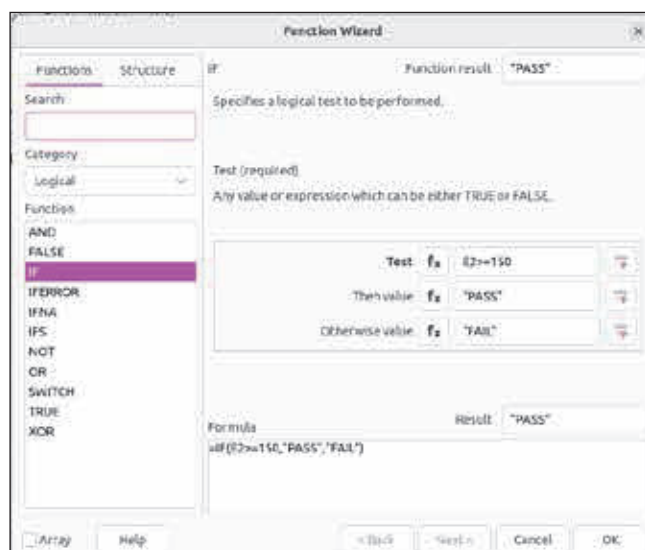


Figure 4.10 - Function Wizard

The result 'PASS' will appear in cell G2.

Copying the Formula

- Drag the fill handle from G2 down to G6.
- The result for all students will be displayed automatically.

After calculating the Total marks, Percentage and Result for each student using appropriate formulas and the Function Wizard, the Student Progress Tracker now presents a complete overview of student performance. The final table clearly summarises the academic progress of all students at a glance (Figure 4.11).

	A	B	C	D	E	F	G
1	Name	English	Maths	Science	Total	Percentage	Result
2	Anu	78	85	72	235	78.33	PASS
3	Binu	54	42	38	134	44.67	FAIL
4	Charu	90	88	95	273	91.00	PASS
5	Dinu	45	53	48	146	48.67	FAIL
6	Esha	82	79	85	246	82.00	PASS
7	Maximum Mark	100	100	100	300		

Figure 4.11 - Final Student Progress Tracker Table

Commonly Used Functions

There are many functions available in Calc. These functions are grouped into different categories such as Text, Mathematical, Statistical, Financial, Date and Time and others. Some commonly used functions are shown in Table 4.2.

Table 4.2: Commonly used functions

Function	Purpose	General Syntax
SUM	Adds all numeric values in selected cells or range.	=SUM (Value1, Value2,...) =SUM(Range)
AVERAGE	Finds the arithmetic mean of given values.	=AVERAGE (Value1, Value2...) =AVERAGE(Range)
MAX	Returns the highest value in a list or range.	=MAX (Value1, Value2...) =MAX(Range)
MIN	Returns the smallest value in a list or range.	=MIN (Value1, Value2...) =MIN(Range)
COUNT	Counts cells containing numbers or dates. It will not count text.	=COUNT (Value1, Value2, ...) =COUNT (Range)
COUNTA	Counts all non-empty cells (numbers, text, dates).	=COUNTA (Value1, Value2...) =COUNTA (Range)



ROUND	Rounds a number to a specific number of decimal places.	=ROUND(Number, Digits)
TODAY	Displays the current system date.	=TODAY ()
CONCAT	Joins text from one or more cells into a single text string.	=CONCAT(Text1, Text2,...) =CONCAT(Range)
IF	Performs a logical test and gives two possible results.	=IF(Test,True value,False value)

Formulas and functions are used to perform calculations automatically in Calc. In this section, we have learned to write formulas using operators and cell references to use relative and absolute references, and apply built-in functions such as SUM, AVERAGE, COUNT and IF with the help of the Function Wizard for accurate and efficient data analysis.



1. Fill in the blanks

- The values passed to a function are called _____.
- Comparison operators return either _____ or _____.
- Operators with the same precedence are evaluated from ____ to ____.
- An absolute reference uses _____ symbol.
- _____ function is used to find average of values.

2. Match the following

1. Function	a. Changes when copied
2. Relative reference	b. Predefined formula
3. Absolute reference	d. Used to copy formulas
4. Fill handle	e. Does not change when copied

3. What is a formula in Calc?

4. What is the use of text operator '&' ?

5. Define absolute cell reference with an example.

6. List any two functions used in Calc.

7. Write the syntax of COUNT function.

8. Enter the scores of a group of students in a worksheet, then

- Find the highest score (MAX), lowest score (MIN) and average score (AVERAGE).
- Write a formula using IF to determine if a student is "Eligible" or "Not Eligible" based on a given condition.

4.5. Sheet Management

Calc manages data in spreadsheets composed of multiple sheets. Effective sheet management helps to organise data in a clear and efficient manner. A Calc file (workbook) can contain many sheets. Using multiple sheets helps organise data effectively; for example, Class A, Class B and Charts can be stored in separate sheets of the Student Progress Tracker.

The main sheet management tasks are given below.

4.5.1 Inserting Sheets

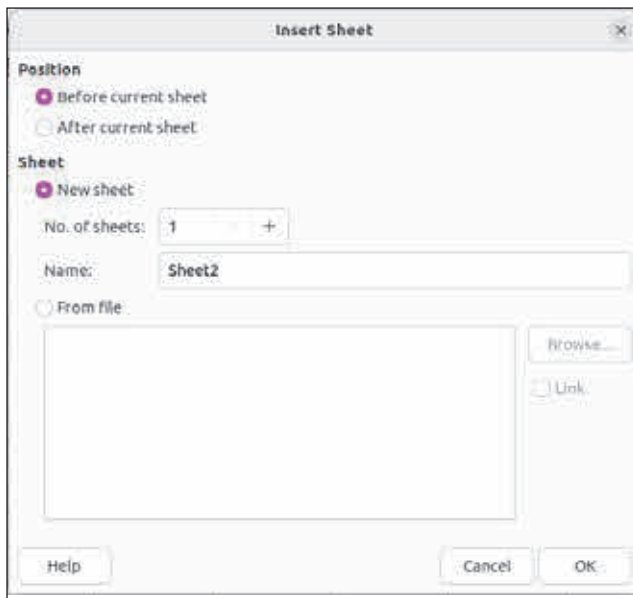


Figure 4.12 - Insert Sheet dialog box

We can insert a new sheet whenever we need to organise or store additional related information separately within the same workbook.

Steps:

- Select **Sheet > Insert Sheet...** from the Menu Bar (Figure 4.12).
- Alternatively, click the + (Insert Sheet) icon next to the Sheet Tabs to add a new sheet.

4.5.2 Renaming Sheets

Renaming sheets helps us to identify the purpose of each sheet.

Steps:

- Select **Sheet > Rename Sheet...** from the Menu Bar
- Alternatively, right-click the sheet tab and choose Rename Sheet from the context menu.
- Type the new name and press Enter to apply it.

Example: Rename Sheet1 to 'Class A Tracker'. This sheet displays the marks obtained by students in Class A.

4.5.3 Deleting Sheets

A worksheet can be deleted when it is no longer required.

**Steps:**

- Select **Sheet > Delete Sheet...** from the Menu Bar
- Alternatively, right-click the sheet tab and choose Delete Sheet from the context menu.
- Click **Yes** in the confirmation dialog box to permanently remove the sheet.

4.5.4 Navigating and Selecting Sheets

Navigating and selecting sheets enable us to move between different worksheets in a workbook and select the required sheet for viewing or working with data.

- In the **sheet tab**, click on a sheet to switch to it.
- To select multiple contiguous sheets, click the first tab, hold Shift key and click the last tab in the group.
- To select multiple non-contiguous sheets, hold Ctrl key and click each desired tab.

4.5.5 Moving or Copying Sheets

Worksheets can be rearranged to change their order or can be duplicated to create copies.

Steps:

- Select **Sheet > Move or Copy Sheet...** from the Menu Bar
- Alternatively, right-click the sheet tab and choose **Move/Copy Sheet...** from the context menu.
- In the dialog box, choose the desired position and specify whether to move or copy the sheet, then click **OK**.

Example: Copy “Class A Tracker” to create a new sheet named ‘Class A - Final Report’.

4.5.6 Protecting a Sheet

Protecting a sheet means preventing unauthorised changes to the data in a worksheet. To protect the entire sheet, perform the following steps.

1. Click **Tools > Protect Sheet** or right-click the sheet tab and select Protect Sheet.
2. Enter and confirm a password (optional).
3. Click **OK** to apply the protection.

To unprotect a sheet, do the following steps.

1. Go to **Tools > Protect Sheet**.
2. Enter the password (if set).
3. Click OK to remove the protection.



Tip: You can hide a sheet using the Hide Sheet option from the sheet tab or Sheet menu, and show it again by selecting Sheet > Show Sheet and choosing the required sheet.



1. How do you insert a new worksheet in Calc?
2. Write the steps to delete a worksheet.
3. How can you create a duplicate copy of a worksheet?
4. What is sheet protection?
5. Write the steps to rename a worksheet.

4.6 Creating Charts

Charts provide a visual representation of data, making it easier to identify trends and patterns. Follow these steps to create a Column Chart for the Student Progress Tracker:

1. Select the Data Highlight the specific data you want to visualise. To select non-adjacent columns:

- Select the Name column (A1:A6).
- Hold down the Ctrl key and select the Total column (E1:E6).
- Note: This tells Calc to use Names for labels and Totals for the data bars.

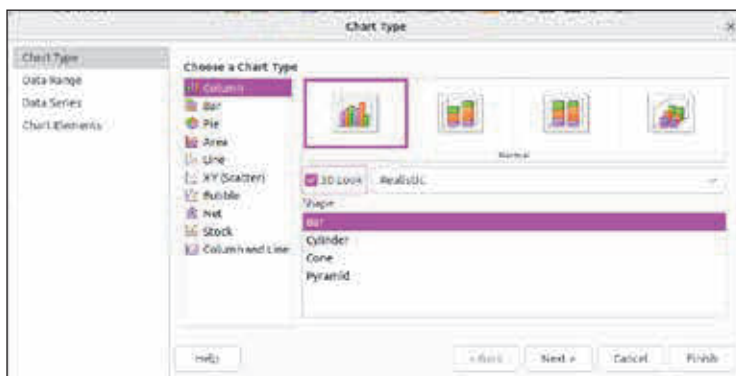


Figure 4.13 - Chart Wizard

2. Open the Chart Wizard You can launch the Chart Wizard using either of these methods:

- Menu Bar: Go to **Insert > Chart...**
- Standard Toolbar: Click the Insert Chart icon. The Chart Wizard dialog box will appear (Figure 4.13).



3. Choose the Chart Type In the “Chart Type” step, select Column from the list of options. This is best for comparing individual values. Click **Next**.

4. Confirm the Data Range The wizard will show the range you selected earlier. Ensure ‘Data series in columns’ and ‘First row as label’ are checked if your selection included headers. Click **Next**.

5. Adjust Data Series (Optional) This step allows you to fine-tune which data appears on which axis. If your selection was correct in Step 1, the preview will already show Names on the X-axis and Marks on the Y-axis. Click **Next**.

6. Add Chart Elements Enter descriptive labels to make the chart professional and easy to interpret:

- **Title:** Total Marks of Students
- **Subtitle:** (Optional, e.g., Class XI - Section A)
- **X-axis:** Students
- **Y-axis:** Marks.
- Click Finish to generate the chart and place it on your worksheet.

7. Chart Insertion and Customization The chart will now appear as an object on your sheet (Figure 4.14). Once inserted, you can:

- **Move or Resize:** Click and drag the chart to a new location, or use the corner handles to change its size.
- **Modify Elements:** Double-click the chart to enter “Edit Mode.” From here, you can right-click any element (like a bar or the background) to change colours, modify text, or add Data Labels to display the exact marks on top of each bar.

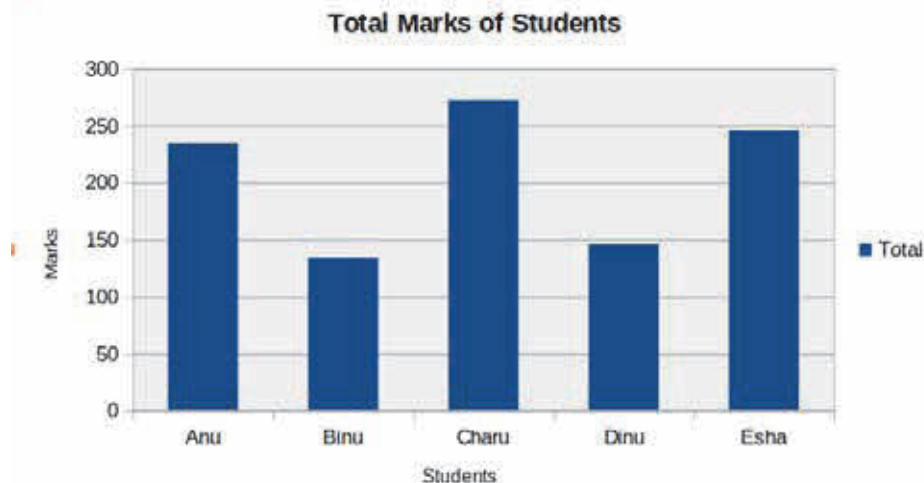


Figure 4.14 - Column Chart

Types of Charts

Calc provides several types of charts for visual presentation of data, each designed for specific purposes such as comparing values, showing proportions or analysing trends over time. The different types of charts are given in the Table 4.3.

Table 4.3 Types of Charts

Chart Type	Description
Column Chart	Vertical bars, best for comparing values.
Bar Chart	Horizontal bars, good for comparing long category names.
Pie Chart	Displays data as slices of a circle; shows proportions.
Line Chart	Shows changes or trends over time using a line.
Area Chart	Similar to the line chart, but with the area under the line filled.
XY (Scatter)	Plots points using X and Y coordinates; used in scientific data.

Chart Elements

Chart elements are the different parts of a chart, such as the chart title, legend, axes, data series and grid lines, that help in understanding and interpreting the displayed data. The Table 4.4 shows the standard elements of a chart.

Table 4.4 Elements of a Chart

Element	Description
Chart Title	Shows what the chart is about.
Legend	Identifies colours or patterns corresponding to the data used in the chart.
Chart Area	The area where the chart is drawn.
Data Series	Actual data represented in the chart.
Axis Titles	Labels for X-axis (horizontal) and Y-axis (vertical).
Grid lines	Lines that help to read the values easily.





1. Fill in the blanks

- Charts are created step by step using the _____.
- A chart that displays data as slices of a circle is _____.
- _____ chart is used to show changes over time.

2. Match the following

i. Column Chart	a. Compares data using horizontal bars
ii. Bar Chart	b. Compares values using vertical bars
iii. Pie Chart	d. Shows proportions of each component
iv. Line Chart	e. Shows trends over time

- Write any two types of charts available in Calc.
- What are chart elements?
- What is the use of a pie chart?
- What is Chart Wizard?
- How can you open the Chart Wizard in Calc?
- Describe the step-by-step procedure to create a chart using Chart Wizard.
- Describe the uses of Column Chart, Pie Chart, and Line Chart with examples.
- The following table shows the final result of students from a Student Progress Tracker.

Result	Number of Students
Pass	40
Fail	10

Enter the data given above and create a pie chart to show the distribution of students based on their result (Pass/Fail).

- Give a suitable title to the pie chart.
- Identify which category occupies the larger portion of the pie chart.
- What percentage of students passed in the examination?

4.7 Data Sorting

Sorting rearranges data in ascending or descending order based on the selected column(s).

For example, the data in the Student Progress Tracker can be sorted in different ways:

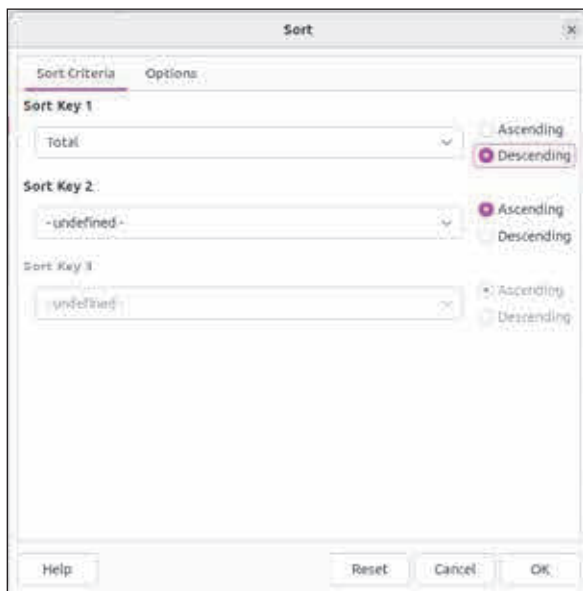


Figure 4.15 - Sort dialog box

- Alphabetically by Name (A - Z)
- By **Total Marks** (from highest to lowest)
- By **Result** (PASS first, then FAIL)

Steps to Sort Data based on Total Marks

1. Select the entire data table (cells A1:G6).
2. From the Menu Bar, choose **Data > Sort**.

The Sort dialog box appears (Figure 4.15).

3. Select the required column (**Total**).
4. Choose **Descending** order to display the highest marks first.
5. Click **OK** to apply the sorting.

This helps us to quickly find toppers or identify weak performers. The resultant table is shown in Figure 4.16.

	A	B	C	D	E	F	G
1	Name	English	Maths	Science	Total	Percentage	Result
2	Charu	90	88	95	273	91.00	PASS
3	Esha	82	79	85	246	82.00	PASS
4	Anu	78	85	72	235	78.33	PASS
5	Dinu	45	53	48	146	48.67	FAIL
6	Binu	54	42	38	134	44.67	FAIL

Figure 4.16 - Sorted Table based on Total marks

4.8 Data Filtering

Filtering is a feature used to display only selected data that meets specific conditions, while hiding the remaining data temporarily. It helps users to analyse large sets of data easily by focusing on required information. Filtering helps us to study only the required part of the data. For example, in a Student Progress Tracker,



filtering can be used to show only students who have passed or failed, without changing the original data. In Calc, three types of filters exist:

- AutoFilter
- Standard Filter
- Advanced Filter

AutoFilter

AutoFilter is a quick way to display only the rows that meet specific criteria while hiding the rest.

Steps to Apply AutoFilter:

1. **Select the Data:** Highlight the entire data table (including the headers).
2. **Activate AutoFilter:**
 - Go to the Menu Bar and choose **Data > AutoFilter**.
 - Or click the **AutoFilter** icon on the Standard Toolbar.
 - Or press the shortcut key **Ctrl + Shift + L**.

Drop-down arrows will now appear in the header cell of each column.

3. **Filter the Data:** Click the drop-down arrow in the Result column and select PASS from the list.

Result: Only the records of students who have passed will be displayed. The rows that do not meet the criteria are temporarily hidden, not deleted.

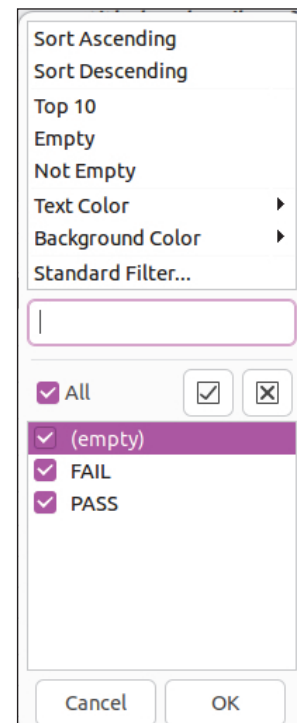


Figure 4.17 - AutoFilter Combo Box

Tip: To remove the AutoFilter arrows entirely from your table, go to **Data > AutoFilter** again, or press **Ctrl + Shift + L**.

Standard Filter

Standard Filter provides more options and conditions for filtering data. Users can apply multiple conditions using operators such as equal to, greater than and less than. Unlike AutoFilter, the Standard Filter uses a dialog box (Figure 4.18), which can be opened by selecting **Data > More Filters > Standard Filter** from the Menu Bar

Example: Show students who scored 80% or more marks.

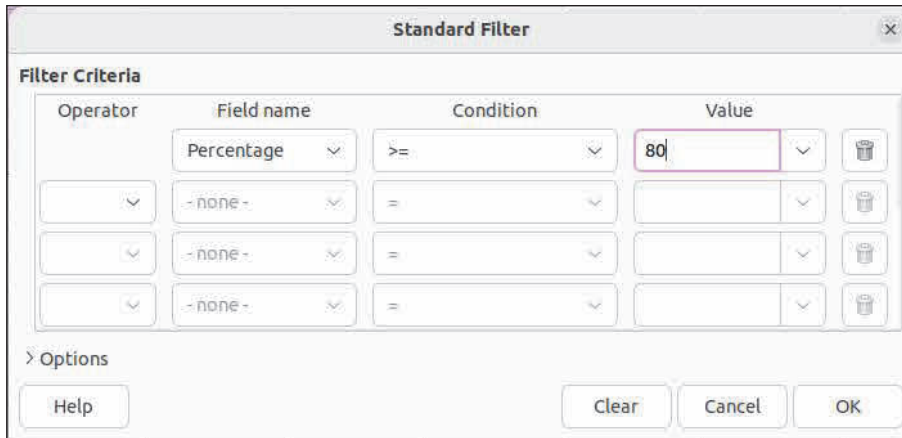


Figure 4.18 - Standard Filter dialog box

Advanced Filter

Advanced Filter is used for complex filtering by applying conditions from a separate criteria range. It allows users to filter data based on multiple conditions and also provides the option to copy the filtered results to another location. The Advanced Filter can be accessed by selecting **Data > More Filters > Advanced Filter** (Figure 4.19).

Example: Display students who have passed and scored more than 70 marks in Maths.

Criteria Range:

Result	Maths
Pass	>70

Steps:

- Select the Student Progress Tracker table.
- In an empty area of the sheet, create the criteria range by typing the field names exactly as in the table. Enter the conditions under the field names (as shown in the criteria range).

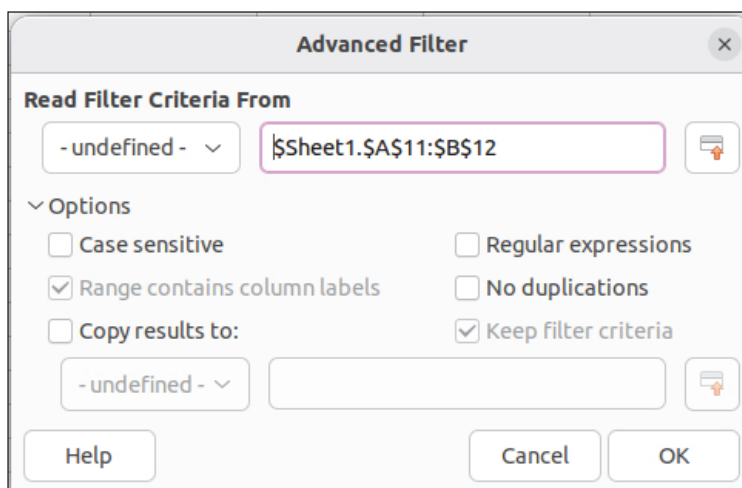


Figure 4.19 - Advanced Filter dialog box

the field names exactly as in the table. Enter the conditions under the field names (as shown in the criteria range).

- Choose **Data > More Filters > Advanced Filter**.
- In the Advanced Filter dialog box, Set **Read Filter criteria From:** Select the criteria range.
- Click **OK**.



Only students with Result = PASS and Maths marks greater than 70 are displayed.

Tip: If you want to remove any filtering applied to your database table, simply select Data > More Filters > Reset Filter on the Menu Bar



1. Fill in the blanks

- _____ option is used to arrange data in ascending or descending order.
- Filtering is used to display data based on _____.
- _____ Filter provides drop-down arrows in column headers.
- Standard Filter allows applying _____ conditions.
- Advanced Filter uses a separate _____ range.

2. List three types of filters available in Calc.

3. What is Standard Filter?

4. What is filtering? Explain three types of filters in Calc.

4.9 Preparing a Spreadsheet for Printing

Before printing or exporting a spreadsheet, we must adjust several page/print settings so that the output looks clean, clear and well organised. Calc provides controls for print range, margins, page orientation, scaling and export options.

Setting the Print Range

A print range tells Calc about the area of worksheet to be printed.

Steps

- Select the area to print (e.g. A1:G6 in the Student Progress Tracker).
- Go to **Format > Print Ranges > Define**.
- Only the selected area will be printed.

Adjusting Margins

Specify the margins on the four sides of the page.

Steps

- Go to **Format > Page Style**.
- Select the Page tab.
- Adjust Top, Bottom, Left, and Right margins.

Page Orientation

Orientation determines how the page is positioned when printed.

Two types

- Portrait (tall)
- Landscape (wide)

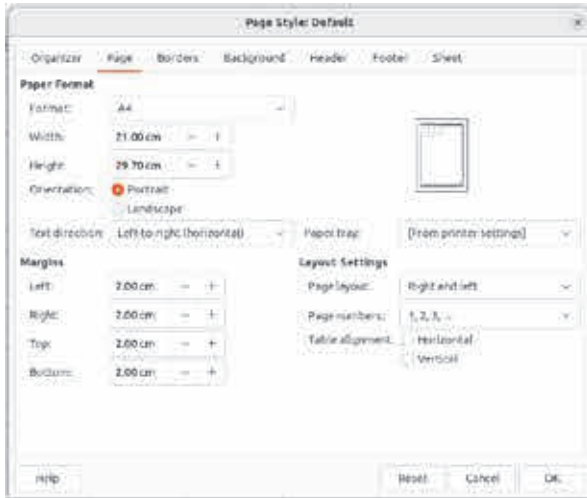


Figure 4.20 - Page Style dialog box

Steps

1. Open **Format > Page Style**.
2. Under the Page tab, choose Portrait or Landscape.

Scaling the Sheet to Fit a Page

Scaling adjusts the size of the sheet to fit onto a printed page.

Steps

1. Go to **Format > Page Style** (Figure 4.20).
2. Click on the Sheet tab.
3. Use Scaling mode:

- Reduce/enlarge printout
- Fit print range(s) on number of pages
- Fit width/height

Print Preview

Before printing, we check how the page looks.

Steps

- Go to **File > Print Preview**

We can confirm Page breaks, Margins, Orientation and Scaling. This will help us to avoid printing mistakes.

Export Options

Calc allows us to export the sheet for digital sharing.

Steps

1. Go to **File > Export As**.
2. Choose the format (PDF, JPEG, PNG, etc.).
3. Set options (e.g. quality, page range).
4. Click **Export**.



1. Fill in the blanks

- Print range specifies _____ of the worksheet to be printed.
- Two types of page orientation are _____.
- PDF stands for _____.

2. Match the following

i. Print Range	a. Fits sheet to page size
ii. Margins	b. Page layout direction
iii. Orientation	c. Blank spaces around page
iv. Scaling	d. Selected area to be printed

- What is a print range? Why is it used?
- What is Print Preview?
- What are export options in Calc?
- Differentiate between Portrait and Landscape orientation.

Emerging Trends: AI in Spreadsheets



Artificial Intelligence (AI) is now integrated into spreadsheets to make working with data faster, smarter and easier. AI tools help users to analyse data, create formulas and find patterns without advanced technical skills.

Did you know?

- AI in spreadsheets can learn from data, recognise patterns and automate repetitive tasks, reducing errors and saving time.
- Natural language formulas allow users to describe what they want (for example, calculate the average marks) and let AI suggest the correct formula.
- Intelligent data analysis highlights trends, unusual values and useful summaries, helping users understand results, not just calculate them.
- AI assistants and smart functions guide users while writing formulas. Tools like LAMBDA help create custom functions and AI helpers can explain formulas in simple language.
- Data cleaning features such as Flash Fill, Remove Duplicates and Get Data from Picture automatically organise and correct data, even converting images into editable tables.
- Forecasting tools use past data to predict future values, such as sales trends or student performance.

◆————◆ Summary ————◆

In this chapter, we have learned to use LibreOffice Calc to store, organise, calculate and analyse data. We have explored spreadsheet structure, entered and edited different types of data, and used formulas and functions for accurate calculations. We have also learned to manage worksheets, create charts, and apply data analysis tools such as sorting and filtering. Finally, we have understood how to prepare spreadsheets for printing and export. Overall, the chapter develops essential skills for effective data handling and analysis.



1. Your teacher wants to quickly identify students who scored between 60 and 75 marks. Which operation is most suitable for this task?
2. Your class teacher maintains a Student Progress Tracker containing the marks of 60 students. She wants to list the top 10 students based on their total marks.
 - a. Which data analysis tool should she use?
 - b. Explain the steps briefly.
3. Create a Line Chart in Calc using the data given below.
Monthly attendance of students

Month	Attendance
June	20
July	23
August	25
September	22
October	24
November	25

- a. Set a suitable Chart Title.
 - b. Label the X-axis as Month and Y-axis as Attendance.
4. In Calc worksheet, enter the population data of 8 villages. Calculate:
 - a.Total population
 - b.Average population
 - c.Sort villages in descending order of population.
 - d.Create a bar chart



5

Computer Network

"The Internet is becoming the town square for the global village of tomorrow."

Bill Gates

5.1 Introduction

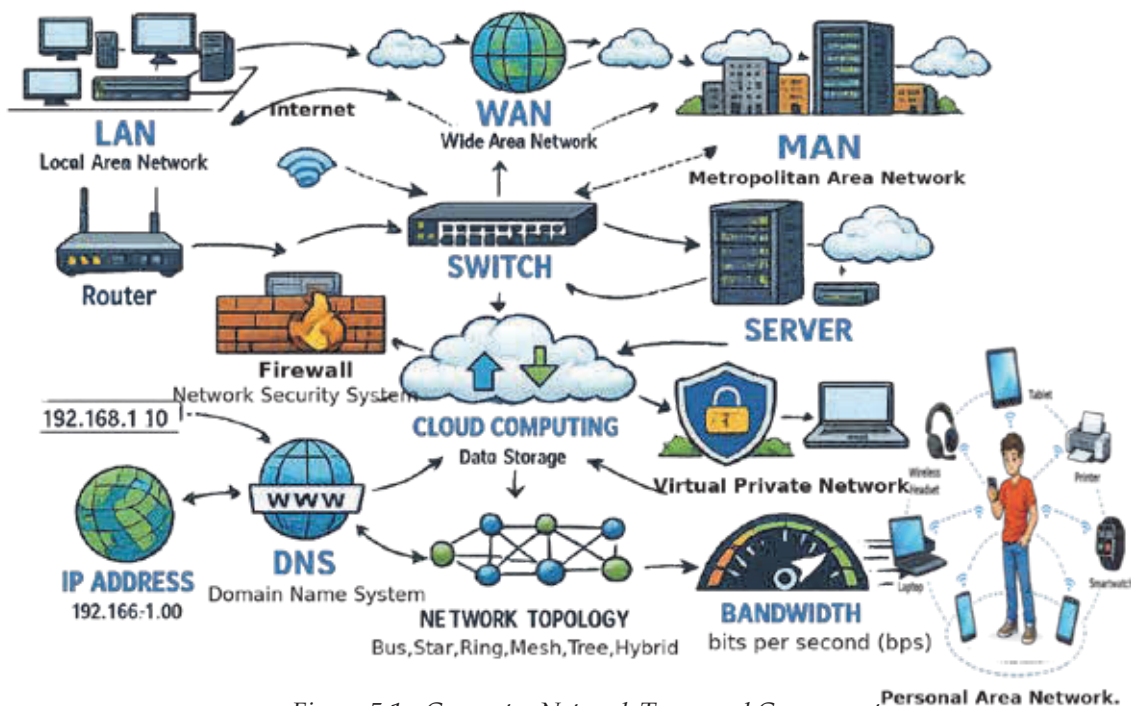


Figure 5.1 - Computer Network Types and Components

A network is created when two or more individuals or devices are connected, enabling them to communicate and share resources. Imagine sending a message to your friend in another city and receiving a reply within seconds. This is possible because of computer networks. Today's world is highly interconnected, with

information being generated, shared, and tracked globally in real time. This is possible because people, devices, and systems in the digital environment are connected in one way or another, forming a vast and continuous network. Computer networks help us to communicate, learn, work, and entertain ourselves. When we use the Internet, send emails, attend online classes, watch videos, or play online games, we are using computer networks. Even devices like mobile phones, printers, and smart TVs are connected through networks. In simple words, a computer network acts like a digital bridge that connects people and devices across the world, making communication fast, easy, and efficient.

We experience many kinds of networks in our daily life (Figure 5.2):

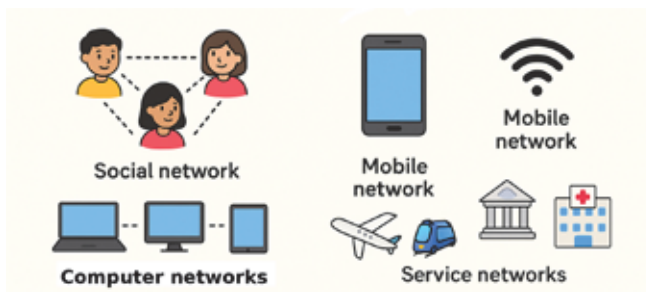


Figure 5.2 - Different Networks

- Social networks – friends and families are connected through relationships.
- Mobile networks – phones connected for calls, messages, and internet.
- Computer networks – computers sharing files, videos, and information.
- Service networks – airlines, railways, banks, and hospitals that connect people, places, and services.

A computer network is an interconnection among two or more computers or computing devices. Such interconnections allow computers to share data and resources among each other. A small network may link just a few computers in the same room, while a large network can connect thousands of devices across the world. The network size may vary from small to large depending on the number of connected computers. A computer network can include different types of hosts (also called nodes) like server, desktop, laptop, cellular phones, etc. Apart from computers, networks include networking devices like switch, router, modem, etc (Figure 6.1). Networking devices are used to connect multiple computers in different settings. The main goal of a network is to connect devices and people so that they can communicate, share resources, and work together easily.

5.2 Data Communication

Data Communication refers to the process of transmitting digital data between two or more devices through a communication medium such as cables or wireless signals. The main goal is to exchange information efficiently and accurately.



Basic Components:

1. **Sender:** The device that sends the data (Figure 5.3).
2. **Receiver:** The device that receives the data.
3. **Message:** The actual information or data to be transmitted.
4. **Medium (Transmission Channel):** The path through which data travels (e.g., cables, airwaves).
5. **Protocol:** A set of rules that governs data transmission (e.g., TCP/IP).

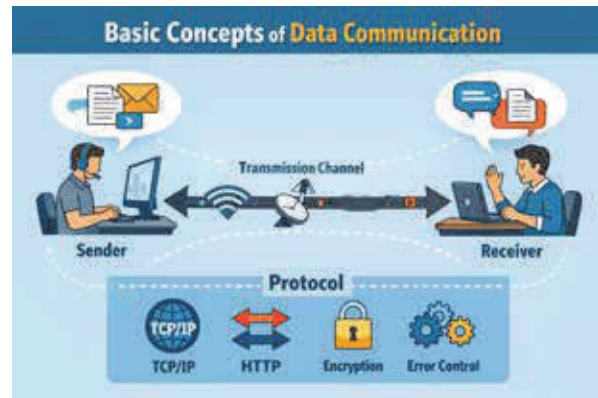


Figure 5.3 - Components of Data Communication

Key Terminologies:

- **Node:** A node in a computer network is any device that can send, receive, or process data. It serves as a connection point within the network, allowing communication between devices. A node can be a device such as computers (desktops, laptops), servers, printers, routers, switches, modems, smartphones and IoT (Internet of Things) devices. Each node has a unique network address (such as an IP address) that helps to identify it within the network. Nodes work together to share resources, transmit data, and maintain communication. In short, a node is any active device connected to a network that participates in data exchange.
- **Bandwidth:** The amount of data that can be transmitted over a network in a given time is called bandwidth. (Figure 5.4) for example: Consider a water pipe system.
- The pipe represents the communication channel.
- The water represents the data.
- The width of the pipe represents the bandwidth.

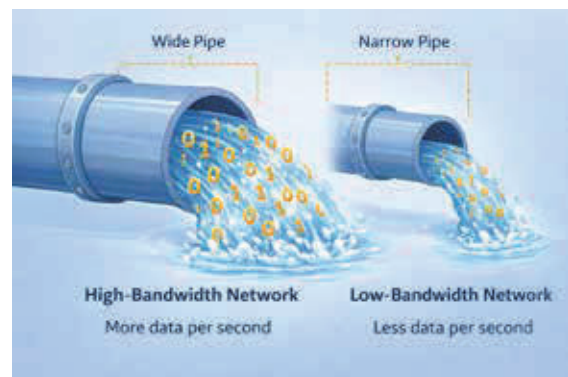


Figure 5.4 - Bandwidth

If the pipe is wide, more water can flow at the same time. This is similar to a high-bandwidth network, which can transmit more data per second. If the pipe is narrow, less water flows. This is like a low-bandwidth network, where data transfer is slower. Therefore, greater bandwidth allows more data to be transmitted in less time.



Figure 5.5 - Latency

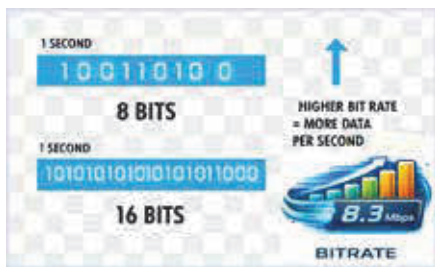


Figure 5.6 - Bit Rate

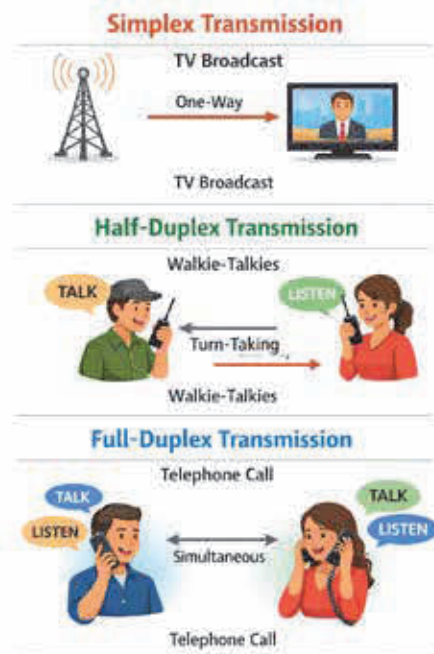


Figure 5.7 - Different Transmission Modes

- **Latency:** The time taken for data to travel from source to destination is called latency. Example: Imagine you're chatting with a friend online. You send a message, and there's a slight delay before your friend receives it. This delay is latency. In simple words, latency means delay in data transmission. (Figure 5.5)
- **Bit Rate:** It is the number of bits transmitted per second (bps). (Figure 5.6)
- **Transmission Modes:** The direction in which data flows between two communicating devices in a network. There are three main transmission modes (Figure 5.7):
 1. **Simplex:** Data flows only in one direction from sender to receiver. (one-way, e.g. Keyboard to computer, TV/ radio broadcast.)
 2. **Half Duplex:** Data can travel in both directions, but not simultaneously, one device sends while the other receives. (two-way, one at a time, e.g. Walkie-Talkies),
 3. **Full Duplex:** Data flows in both directions at the same time. (two-way simultaneously e.g. Mobile phones).

Effective data communication ensures that information is transmitted quickly, securely, and without loss or error between devices or networks. For communication, data in a network is divided into smaller packets. These packets are then carried over a network through a medium. Devices in a network can be connected using guided media such as cables/ Fiber optic cable (for wired communication) through which electrical

signals or light pulses propagate or unguided media such as free space (for wireless), through which electromagnetic (radio) waves propagate. In the context of data communication, interconnectivity of computing devices in a network allows us to exchange information simultaneously with many parties through email, websites, audio/video calls, etc. Network allows sharing of resources.



For example, Imagine you are preparing an assignment in the computer lab. All the computers in the lab are connected to one printer through a network. To take the printout of the assignment, you can directly give the print command, and the printer receives it through the network. This saves time, avoids extra work, and shows how computer networks make resources sharing simple and efficient.



1. Define a computer network.
2. What is a node in the network?
3. Give two examples for social networks.
4. Discuss how computer networks help in sharing resources efficiently.
5. Explain how computer networks connect people and devices in the modern world.
6. How does bandwidth affect data transmission speed?
7. Give an example for a real-life situation that uses different transmission modes.
8. How does a computer network improve communication and resource sharing in a school or office environment?
9. Using a diagram, explain the basic components of data communication and their functions.

5.3 Classification of Networks

Computer networks can be classified in different ways: based on the transmission media and geographical coverage.

5.3.1 Classification Based on Transmission Media

In a computer network, data is transmitted from one device to another through a channel. This channel is known as Transmission Media. It acts as a path between the sender and receiver through which data travels in the form of electrical signals, light, or electromagnetic waves. Transmission media are mainly classified into two categories.

A) Guided (Wired) Transmission Media:

Guided Transmission Media are physical paths used to transmit data signals from one device to another. In this type of media, signals

travel through cables, so the direction of transmission is guided by a solid medium. In wired networks, devices are connected using physical transmission media such as twisted pair cables, coaxial cables, and fiber optic cables (Figure 5.8). Guided transmission media are reliable, secure, and suitable for high-quality data transmission.

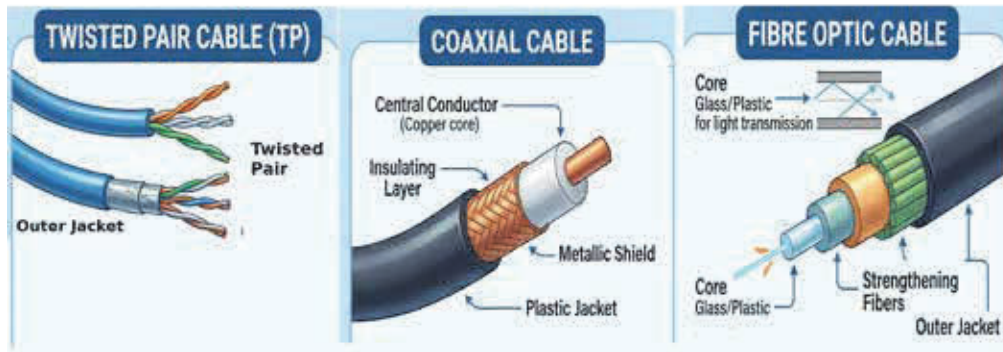


Figure 5.8 - Guided media

Table 5.1 Types of Guided Media

Type	Description	Features / Advantages	Limitations
1. Twisted Pair Cable	Consists of pairs of insulated copper wires twisted together to reduce interference. It is commonly used in telephone lines and local area networks (LANs).	• Inexpensive and easy to install • Suitable for short-distance communication.	• Prone to external interference and noise. • Limited bandwidth.
2. Coaxial Cable	Made of a central copper conductor surrounded by insulation, metallic shield, and outer cover. It is commonly used in cable TV and broadband connections.	• Better protection from noise. • Higher bandwidth than twisted pair.	• Thicker and harder to install • Costlier than twisted pair.
3. Optical Fiber Cable	Using light signals to transmit data through thin glass or plastic fibers	• Extremely high speed • Immune to electromagnetic interference • Suitable for long-distance communication	• Expensive • Fragile and difficult to install.



B) Unguided (Wireless) Transmission Media

Wireless networks connect devices without physical cables. Data is transmitted using electromagnetic signals (Figure 5.9). These networks provide greater flexibility and mobility, making them suitable for portable devices.



Figure 5.9 Types of Unguided Media

Table 5.2 Types of Unguided Media

Type	Description	Features / Advantages	Limitations
1. Radio Waves	Used for wireless communication over long distances, such as FM radio, TV, and Wi-Fi.	• Can penetrate buildings • Supports mobility	• Prone to external interference • Limited security
2. Microwaves	High-frequency waves used for point-to-point communication between antennas.	• High data rate • Suitable for satellite and cellular communication	• Requires line-of-sight • Can be affected by weather conditions
3. Infrared Waves	Used for short-range communication like remote controls and wireless keyboards.	• Secure and simple • No interference with radio signals	• Limited range • Requires direct line-of-sight
4. Satellite Communication	Uses satellites orbiting the Earth to transmit data across large distances.	• Covers wide geographical areas • Useful for TV broadcasting and GPS	• Very costly • Delay in signal transmission.

Transmission media are the backbone of data communication in networks. The choice of medium depends on factors like distance, cost, data rate, and environment. For example, Twisted Pair Cable is used in small LANs (Local Area Network), Optical Fiber for high-speed backbone connections, and Wireless Media for mobile or remote communication.



1. Guided transmission media use _____ cables to transmit data
2. Optical fiber uses _____ signals for data transmission.
3. Radio waves can penetrate _____ and support mobility.
4. Microwave communication is suitable for _____ communication.
5. What are the two main ways to connect computers in a network?

5.3.2 Classification Based on Geographical Coverage

Based on the area they cover, networks are classified into the following types:

- A. PAN (Personal Area Network) connects devices within a very small area, typically around one person or in a room.
- B. LAN (Local Area Network) connects computers within a room, lab, or building.
- C. MAN (Metropolitan Area Network) covers a city.
- D. WAN (Wide Area Network) span over several countries or even the globe, the best example is the Banking Network / Internet

A. Personal Area Network (PAN)

A Personal Area Network (PAN) is a type of computer network that connects devices within a very small area, typically around one person (Figure 5.10). It is designed for short-range communication, usually within a range of a few meters. PANs are commonly used to connect personal digital devices such as smartphones, tablets, laptops, printers, and wireless headsets.



Figure 5.10 - Personal Area Network

PANs can be wired or wireless. A wired PAN might use USB cables to connect devices, while a wireless PAN (WPAN) uses technologies such as Bluetooth, Wi-Fi, or Infrared for data exchange. For example, when you connect your smartphone to a wireless earphone via Bluetooth, you are using a PAN.



The main advantage of a PAN is its convenience and mobility. It allows users to synchronize data, share files, and use devices together without the need for complex network setups. PANs are ideal for personal use, home offices, and mobile users who need to connect multiple devices on the go. In summary, a Personal Area Network provides an efficient and simple way to connect personal devices within a limited range, enabling quick communication, easy data sharing, and seamless device interaction in everyday life.

B. Local Area Network (LAN)

A Local Area Network (LAN) is a computer network that connects the server with devices like computers, mobile phones, tablet, printer etc within a small geographical area such as a room, building, school, or office (Figure 5.11). It allows users to share files, resources (like printers), and internet connections quickly and efficiently. LANs usually use Ethernet cables or Wi-Fi for connectivity, and they provide high-speed communication compared to larger networks. LAN is comparatively secure as only authentic users in the network can access other computers or shared resources. Users can print documents using a network printer, upload or download documents and software to and from the local server. Such LANs provide the short range communication with the high speed data transfer rates. These types of networks can be extended up to 1 km. Data transfer speed in LAN is quite high, and usually varies from 10 Mbps (called Ethernet) to 1000 Mbps (called Gigabit Ethernet). Ethernet is a set of rules that decides how the computers and other devices connect with each other through cables in a LAN. There are different types of LANs based on structure, purpose, and technology.



Figure 5.11 - Local Area Network

1. Wired LAN

A Wired Local Area Network (LAN) is a group of computers and peripheral devices connected within a limited geographical area, such as home, school or office building, using physical cables (Ethernet or Fiber Optics cables) to transmit data. For example: Computers in a computer lab is connected using Ethernet cables.

Advantages: High speed, reliable, secure connection and low latency.

2. Wireless LAN (WLAN)

A Wireless LAN (WLAN) Uses high-frequency radio waves instead of cables to transmit data. Devices connect to the network via a Wireless Access Point (WAP). The most common technology used for WLAN is Wi-Fi. For example: Laptops and smartphones are connected to a Wi-Fi router at home or in school.

Advantages: Mobility, scalability, easy installation and cost - efficient.

C. Metropolitan Area Network (MAN)



METROPOLITAN AREA NETWORK (MAN)

Figure 5.12 - Metropolitan Area Network

A Metropolitan Area Network (MAN) is a type of computer network that covers a larger area than a Local Area Network (LAN) (Figure 5.12). It Covers an area of 5 to 50 kilometers, usually spans in a city or a large campus, connecting multiple LANs within that area.

MANs are often used in businesses, government organizations, and educational institutions to share resources, exchange data, and provide high-speed internet connectivity. They commonly use high-speed fiber optic cables or wireless connections to ensure fast and reliable communication across the metropolitan region. Data transfer rate in MAN generally ranges from 10 Mbps to 1 Gbps or higher, depending on the technology (fiber optic, wireless, etc.). Cable TV network, Public Wi-Fi hotspots or cable based broadband internet services are the examples for MAN.

D. Wide Area Network (WAN)

A Wide Area Network (WAN) is a large computer network that connects devices and smaller networks across vast geographical areas such as cities, countries, or continents (Figure 5.13). It is the largest form of network, much bigger than Local Area Networks (LANs) and Metropolitan Area Networks (MANs). WANs are essential for enabling communication, data transfer, and resource sharing over long distances. A WAN typically spans around thousands of kilometers. It uses various transmission media, including telephone lines, fiber optic cables, satellite links, and wireless systems. WANs are usually owned and maintained by Internet Service Providers (ISPs) or telecommunication companies. Data transfer speed is often slower than LANs or MANs due to distance, but with modern technologies, WANs can provide speed of several gigabits per second.



WANs allow organizations to connect offices worldwide, making communication and collaboration easier. They enable centralized data storage, resource sharing, and global access to applications. WANs support business growth by linking branches across the countries. The Internet, the most common example for WAN, demonstrates how these networks bring global connectivity. WANs are expensive to set up and maintain, requiring advanced infrastructure and skilled professionals to manage them. They are also more prone to security threats like hacking and data breaches. Additionally, long-distance communication can sometimes cause slower data transfer compared to LANs. The Internet is the largest WAN. Global banking networks, airline reservation systems, and multinational corporate networks are some examples for WAN. WANs are vital for connecting the world. Despite high costs and complexity, they provide the foundation for modern communication, making global connectivity possible.



WIDE AREA NETWORK (WAN)

Figure 5.13 - Wide Area Network

Table 5.3 Difference between WAN and Internet

WAN (Wide Area Network)	Internet
A network that connects computers and devices over a large geographical area	A global network of networks connecting millions of private and public networks
Limited to an organization or specific purpose	Worldwide, open to everyone
Owned and managed by a single organization (company, bank, government)	No single owner; managed collectively by ISPs and organizations
Restricted to authorized users only	Publicly accessible to all users
Bank branches connected across cities, Corporate offices in different countries are some examples	Websites, email, social media, cloud services are some examples
More secure as it is private	Less secure compared to private WANs
Expensive to set up and maintain	Relatively low cost for end users
Used for internal communication and data sharing	Used for global communication and information access



1. What are the different types of computer networks ?
2. Give two examples for wired connection media.
3. What type of signal is used in wireless communication?
4. Differentiate between wired and wireless networks.
5. Why is MAN called a “network of LANs”. Explain
6. How are networks classified based on the type of connection and geography.?
7. Imagine that you are setting up a PAN at home. What are the devices and technologies used for it?.
8. How does PAN improve personal productivity and convenience in a smart workspace environment.

5.4 Network devices

Network devices are the hardware components that connect computers and other electronic devices together to form a network. These devices help in data transmission, communication, and network management. Each device performs a specific role in ensuring that data travels efficiently between connected systems. To communicate data through transmission media and to configure networks with different functionality, we require devices like Modem, NIC, Hub, Switch, Repeater, Router, Gateway. Let us explore them in detail.

5.4.1 Modem (Modulator-Demodulator)

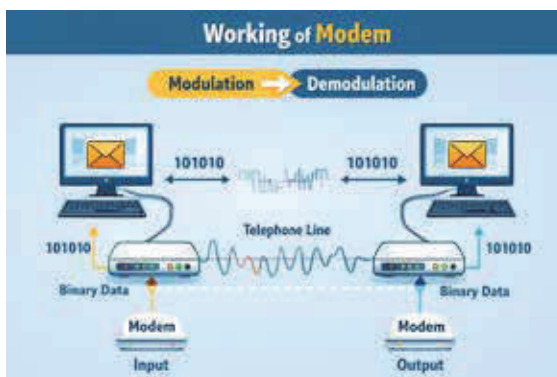


Figure 5.14 Modem

The term “modem” stands for Modulator-Demodulator. It is a network device that allows digital computers to communicate over analog communication lines such as telephone lines (Figure 5.14). The modem plays a vital role in enabling Internet connectivity in homes, schools, and offices. Computers generate and understand digital signals (composed of 0s and 1s), while traditional telephone lines carry analog signals (continuous waves). The modem serves as a bridge between these two types of signals.



The modem performs two main operations:

1. Modulation:

When data is sent from a computer to the Internet, the modem converts the digital signals produced by the computer into analog signals suitable for transmission through the telephone lines.

2. Demodulation:

When data is received from the Internet, the modem converts the analog signals coming from the telephone line back into digital signals that the computer can understand.

Table 5.4 Type of Modem

Type of Modem	Connection Medium	Speed Range	Special Features / Specialities	Common Usage
Dial-up Modem	Telephone line (analog)	Up to 56 Kbps	Converts analog telephone signals to digital; requires dialling each time	Old Internet connections, basic email and browsing
DSL (Digital Subscriber Line) Modem	Telephone line (digital)	1–50 Mbps	Allow to use Internet and telephone simultaneously; always-on connection	Home broadband and small offices
Cable Modem	Coaxial cable (TV line)	10–200 Mbps	Uses cable TV network; faster than DSL; supports multiple users	Home and office broadband
Wireless Modem	Cellular network (3G/4G/5G)	10–100 Mbps	Portable; uses SIM card; connects through mobile data networks	Laptops, mobile hotspots, remote locations
Fiber Optic Modem (ONT – Optical Network Terminal)	Fiber optic cable	Up to 1 Gbps	Uses light signals; very high speed; stable and reliable connection	Modern fiber broadband and institutions
Satellite Modem	Satellite communication	1–50 Mbps	Works in remote areas without cable or telephone lines	Rural or remote Internet access

Thus, the modem ensures smooth communication between digital devices and analog communication channels. When you connect your home computer or Wi-Fi router to the Internet, the modem communicates with your Internet Service Provider (ISP). For example:

- In a broadband connection, your modem converts signals coming through ISP's cable line into digital form.
- In a fiber network, the Optical Network Terminal (ONT) acts as a modem.

5.4.2 Ethernet Card (Network Interface Card (NIC))

Ethernet card, also known as Network Interface Card is a network adaptor used to set up a wired or wireless network. It acts as an interface between the computer and the network. A Network Interface Card is a hardware component that allows a computer or device to connect to a network (such as a LAN or the internet). It provides the physical interface for data communication between the device and the network medium. Most modern computers, laptops, and even servers come with a built-in NIC on the motherboard.



Figure 5.15 - Network Interface Card

It is a printed circuit board mounted on the motherboard of a computer as shown in Figure 5.15. The Ethernet cable connects the computer to the network through NIC. Ethernet cards can support data transfer speed between 10 Mbps and 1 Gbps (1000 Mbps). Each NIC has a MAC (Media Access Control) address, which helps in uniquely identifying the computer on the network.

5.4.3 Repeater

A repeater is a network device used to extend the coverage area of a network by amplifying and retransmitting signals. In data communication, when signals travel through cables or wireless channels, they gradually weaken (called attenuation). A repeater strengthens these weak signals and sends them forward without changing the original data.

- When data is transmitted over long distances, the signal loses strength.
- The repeater receives the weak signal, amplifies/regenerates it, and then retransmits it to the next segment of the network.
- A repeater does not filter or manage traffic, it only boosts signals.



5.4.4 Switch

A switch is a network device used to connect multiple computers or devices within a Local Area Network (LAN) (Figure 5.16). It plays a central role in a Local Area Network (LAN). A switch is called an intelligent device because it learns the MAC address of each device connected to its ports and stores them in a MAC address table. When data is received, the switch extracts the destination address from the data packet and checks the destination MAC address and forwards the data only to the specific port where the destination device is connected, instead of sending it to all ports. It can forward multiple packets at the same time. A switch does not forward the signals which are noisy or corrupted. It drops such signals and asks the sender to resend it.

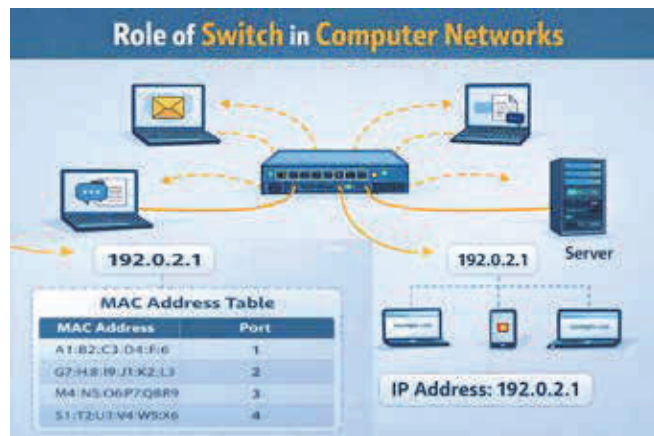


Figure 5.16 - switch

- Each device connected to a switch has a unique MAC (Media Access Control) address.
- When a device sends data, the switch reads the MAC address of both the sender and the receiver from the data packet .
- It then forwards the data only to the target device, not to every device in the network.
- This reduces network traffic and prevents data collisions.

Thus, switches make networks faster and more efficient.

An IP Address (Internet Protocol Address) is a unique numerical identifier assigned to each device connected to a network. It helps in identifying and locating devices so that data can be sent and received correctly over the Internet or a local network. IP addresses can be IPv4 (e.g., 192.168.1.1) or IPv6, which provides a much larger address space.

A **server** is a powerful computer that provides services, resources, and data to other computers in a network, called clients. It manages network resources and responds to requests sent by clients. Main roles of a server include: Data storage and sharing, Resource management, User authentication, Application hosting, Network security, Backup and recovery.

5.4.5 Router

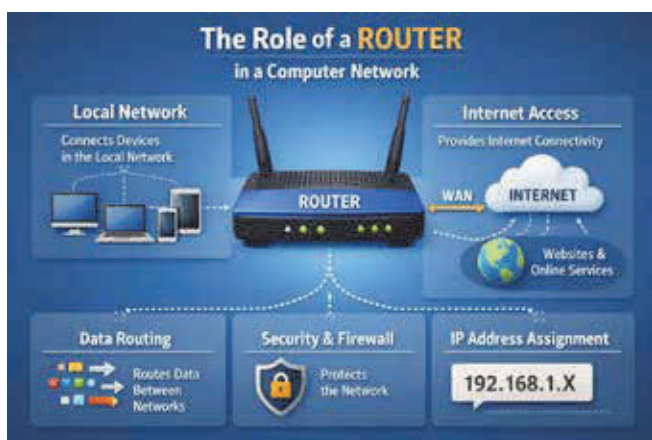


Figure 5.17 - Router

A router is a network device that connects multiple networks together (Figure 5.17). For example, connecting a Local Area Network (LAN) to the Internet. Every device in a network has an IP (Internet Protocol) address, and the router uses these addresses to forward data to the correct destination. The main function of a router is routing that is, receiving data packets, analysing destination IP address in

the packet header, and sending them to the appropriate network based on their destination IP address. A router can be wired or wireless. A wireless router can provide Wi-Fi access to smartphones and other devices. Usually, such routers also contain some ports to provide wired Internet access. Nowadays, home Wi-Fi routers perform the dual task of a router and a modem or switch. These routers connect to incoming broadband lines, from ISP (Internet Service Provider), and convert them to digital data for computing devices to process.

5.4.6 Gateway

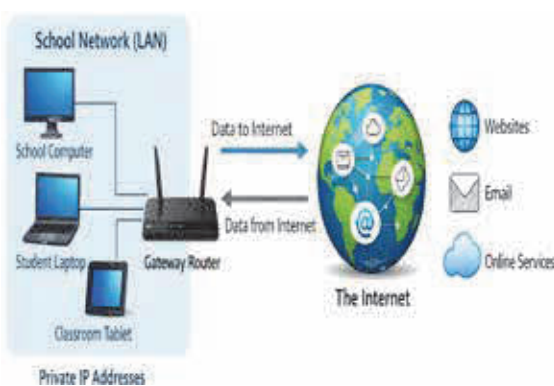


Figure 5.18 - Gateway

A gateway is a network device that connects two different networks that use different communication protocols. It acts as an entry and exit point (a “gate”) for data travelling between networks. In simple terms, a gateway works like a translator it receives data from one network, converts it if necessary, and sends it to another network in a format it can understand (Figure 5.18).

For example, when a Local Area Network (LAN) connects to the Internet (WAN), the gateway enables communication between two, even if they use different data formats, addressing schemes, or communication methods. At school/home, the router usually functions as the gateway, connecting your local devices (like computers, phones, and smart TVs) to the Internet Service Provider (ISP) and then to the wider Internet. Gateways are essential for data transfer, protocol conversion, and network



security, ensuring smooth communication between different systems and networks. A gateway can be implemented as software, hardware, or a combination of both. This is because a network gateway is placed at the edge of a network and the firewall is usually integrated with it.

Working of a Gateway

1. **Protocol Conversion:** The gateway translates data from one network's protocol to another (e.g., from LAN's TCP/IP to another system's proprietary protocol). This ensures that both networks can understand and exchange the data correctly.
2. **Data Handling:** When a device sends data to another network, the gateway receives the data packet, examines it, and converts it into a format that the destination network can interpret.
3. **Routing and Forwarding:** After conversion, the gateway forwards the data packet to the destination network using the correct route.
4. **Response Transmission:** When the destination device sends a response, the gateway again converts it back into the source network's format and delivers it to the original sender.



1. What are network devices?
2. Name any four common network devices.
3. What is demodulation?
4. What is attenuation?
5. Name the device that performs protocol conversion.
6. Explain the functions and importance of a Switch in a computer network.

Hub is a basic networking device used to connect multiple computers or devices in a Local Area Network. Hub acts as a central device where all computers in a network are connected using cables. When a hub receives data from one computer, it forwards (broadcasts) that data to all other connected devices, regardless of the intended recipient. Hub does not check MAC addresses, does not filter data, and does not decide the best path. It simply sends the signal to every port.



5.5 Network Topology

In a computer network, many devices such as computers, printers, and servers are connected to share data and resources. The arrangement or layout in which these devices (nodes) are connected to each other is called a Network Topology. It defines how data flows between devices and how each device communicates with the others in the network. It can be physical (actual layout of cables) or logical (the way data moves between devices). Number of computing devices are connected together to form a Local Area Network (LAN), and interconnections among millions of LANs form the Internet. Common network topologies are bus, star, ring, mesh and tree.

5.5.1. Bus Topology



Figure 5.19 - Bus Topology

Bus topology is a network structure in which all computers (nodes) are connected to a single central cable, called the bus(Main cable) (Figure 5.19). Data sent by any computer travels along this main cable and is received by all devices, but only the intended receiver accepts it. Terminators are placed at both ends of the cable to prevent signal reflection. When a device sends data, the signal moves in both directions along the bus. Every device checks the destination MAC/IP

address in the data packet header, only the correct device processes the data, while others ignore it.



Firewall is a network security device or software that acts as a barrier between a trusted internal network (like your home or company network) and an untrusted external network (like the Internet). Its main job is to control and monitor incoming and outgoing network traffic based on predefined security rules. Essentially, it decides which traffic is allowed and the traffic to be blocked to protect the network from unauthorized access, hackers, malware, and other threats.

Table: 5.5 Advantages and Disadvantages of Bus Topology

Advantages	Disadvantages
Low installation cost	Failure of main cable stops the entire network
Easy to install and configure	Performance degrades as devices increase
Requires less cable	Difficult to locate faults





Suitable for small networks	Limited cable length and number of nodes
Easy to add new devices	High data collisions
Simple network structure	Low security (data broadcast to all nodes)

5.5.2. Star Topology

In a star topology, all computers are connected to a central device (hub or switch) (Figure 5.20). Each node has a dedicated connection to the hub/switch. The central node can be either a broadcasting device, means data will be transmitted to all the nodes in the network (hub), or a unicast device (switch) an intelligent device that identifies the destination using MAC addresses and forwards data only to the intended node. When a computer sends data, it first reaches the central hub or switch.



Figure 5.20 - Star Topology

Table 5.6 Advantages and Disadvantages of Star Topology

Advantages	Disadvantages
Easy to install and manage	Failure of central hub/switch affects the entire network
Easy to add or remove devices	Requires more cable than bus topology
Failure of one node does not affect others	Higher cost due to hub/switch
Better performance (less data collisions) and High security (data sent to specific node)	Central device dependency
Easy fault detection and troubleshooting	Limited scalability based on hub/switch capacity

5.5.3. Ring Topology

In this topology, all computers (nodes) are connected in a closed loop (ring) (Figure 5.21). Each device is connected to exactly two neighbouring devices, and data travels in one direction (or sometimes both directions in dual-ring networks).



Figure 5.21 - Ring Topology

Working of Ring Topology

A small data packet called a token circulates around the ring.

- A device can send data only when it has the token
- The data travels from one node to the next until it reaches the destination
- This reduces data collisions

Table 5.7 Advantages and Disadvantages of Ring Topology

Advantages	Disadvantages
Data travels in an orderly manner	Failure of one node or cable affects the entire network
Reduces data collisions	Difficult to troubleshoot
Equal access to all nodes	Adding or removing nodes is difficult
Better performance than bus topology under heavy load	Network downtime during reconfiguration
Predictable data transfer	More expensive than bus topology
Suitable for small to medium networks	Less flexible compared to star topology

5.5.4. Mesh Topology

Mesh topology is a network structure in which each device (node) is connected to every other device in the network through dedicated



Figure 5.22 - Mesh Topology

point-to-point links (Figure 5.22). This provides multiple paths for data transmission, making the network highly reliable. Data can travel through many possible routes from source to destination. If one link fails, data is automatically routed through an alternate path, ensuring uninterrupted communication.



SSL (Secure Sockets Layer) is a security protocol that helps protect data transmitted over the Internet. It ensures that the information sent between a web server and a web browser remains private and secure.

When a user connects to a secure website, the browser checks the site's SSL certificate. If the certificate is valid, an encrypted connection is established. The website address will begin with `https://` instead of `http://`, and a lock icon appears in the address bar.



**Table: 5.8 Advantages and Disadvantages of Mesh Topology**

Advantages	Disadvantages
High reliability and fault tolerance because each node has a dedicated link	Very expensive as it requires large number of cables and ports
Failure of one link does not affect other connections	Complex installation and configuration
Provides high security and privacy since data travels through dedicated paths	Difficult to maintain and manage
Easy to detect and isolate faults	Requires more space for cables and hardware
Supports heavy data traffic without congestion	Not suitable for small networks
Good performance due to direct point-to-point connections	High power consumption

5.5.5. Tree Topology

Tree topology is a hierarchical network structure that combines the features of star and bus topologies (Figure 5.23). In this topology, computers are arranged in the form of a tree-like structure, with a main cable connecting multiple star networks. Each group of computers is connected to a hub or switch, forming a star. These hubs/switches are then connected to a main backbone cable.

*Figure 5.23 - Tree Topology***Table 5.9 Advantages and Disadvantages of Tree Topology**

Advantages	Disadvantages
Easy to expand by adding more nodes or segments	Failure of the main backbone affects the entire network
Well-structured and hierarchical, making the management easier	More expensive due to extra cabling and networking devices
Suitable for large organizations and wide networks	Complex installation compared to bus and star topologies
Easy fault detection and isolation in individual segments	Requires careful configuration and maintenance
Supports scalability and network growth	Performance decreases as more nodes are added
Combines advantages of star and bus topologies	High dependency on central switch or main cable

5.5.6. Hybrid Topology

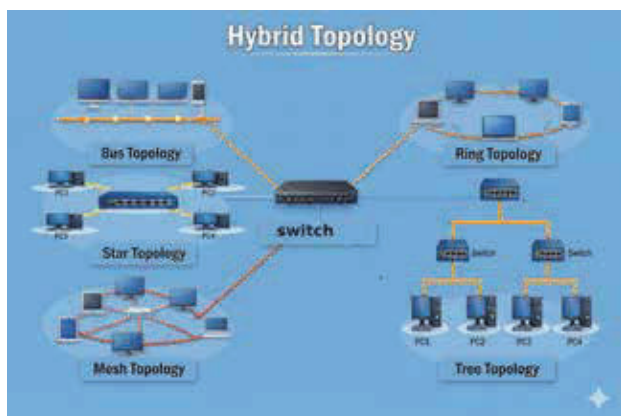


Figure 5.24 - Hybrid topology

Hybrid topology is a network structure that is formed by combining two or more different network topologies, such as star, bus, ring, or mesh (Figure 5.24). It is designed to take the advantage of the strengths of each topology while minimizing their weaknesses. Different segments of the network use different topologies.

For example, one department may use star topology, while another uses bus topology. These segments

are interconnected using routers, switches, or main cable links, allowing smooth communication across the network.

Table: 5.10 Advantages and Disadvantages of Hybrid Topology

Advantages	Disadvantages
Highly flexible as it combines two or more different topologies	Very expensive as it require more devices and complex cabling
Reliable and fault tolerant; failure in one segment does not affect others	Complex design and implementation
Scalable and easy to expand according to network requirements	Requires skilled network administrators
Suitable for large organizations and enterprises	Difficult to manage and maintain
Good performance due to optimized use of different topologies	High maintenance cost
Can be customized to meet specific needs	Not suitable for small networks



1. The structure that defines how computers are connected in a network is called _____.
2. In a bus topology, all devices share a single _____.
3. The central device used in star topology is _____ or _____.
4. In a ring topology, data travels in _____ direction(s).
5. A mesh topology provides a dedicated _____ between each pair of nodes.
6. The tree topology is a combination of _____ topologies.



5.6 The Internet

The Internet is a global network that connects millions of computers and devices worldwide, allowing them to communicate and share information (Figure 5.25). It works by transferring data between devices through a series of interconnected networks using standard communication protocols like TCP/IP. When a user tries to open a website, his/her device (client) sends a request through an Internet Service Provider (ISP) to a web server that hosts the website. The request travels across several network devices such as routers, switches, and gateways that direct the data to its destination. Once the web server receives the request, it sends the required data (such as web pages, images, or videos) back to the user's browser in the form of data packets. These packets travel across multiple paths and are reassembled at the destination device to display the complete webpage. The Transmission Control Protocol (TCP) ensures that all packets arrive correctly, while the Internet Protocol (IP) manages addressing and routing. In short, the Internet functions as a massive system of connected networks that enables seamless communication, data sharing, and access to online resources worldwide.



Figure 5.25 - Internet

5.6.1 Protocols for Data Communication

Data communication refers to the exchange of data between two or more computing devices through some transmission medium. For successful communication, both sender and receiver must follow a set of rules that ensure accurate, reliable, and efficient data transfer. These rules are called Protocols and Standards. A network protocol defines how data is formatted, transmitted, and received over the network. Protocols ensure that computers around the world can understand and exchange information just like people use a common language to talk any one.

1. HTTP (Hyper Text Transfer Protocol)

HTTP (Hyper Text Transfer Protocol) is the standard communication protocol used for transferring web pages over the Internet. It defines how messages are formatted and transmitted between a web browser and a web server. When you type a web address beginning with `http://`, your browser uses HTTP to request a web page from the server, which then sends back the page content. Data is not

encrypted, so it's not secure for confidential information. HTTP is the communication protocol of the World Wide Web, enabling browsers and servers to exchange information across the Internet.

2. HTTPS (HyperText Transfer Protocol Secure)

HTTPS (HyperText Transfer Protocol Secure) is the secure version of HTTP used for transferring data between a web browser and a web server. It uses SSL (Secure Socket Layer) to encrypt data, ensuring that information like passwords, banking details, and personal data cannot be stolen or read by hackers. HTTPS keeps online communication safe and confidential, especially on websites that handle sensitive information (Online banking, shopping, email services, etc.).

Example: <https://onlinesbi.sbi.bank.in/>

3. FTP (File Transfer Protocol)

FTP (File Transfer Protocol) is a standard protocol used to transfer files between a client and a server over the Internet or a local network. It allows users to upload, download, rename, or delete files on a remote computer. Data is not encrypted in standard FTP, so it can be insecure. (Secure versions include FTPS and SFTP.)

4. TCP/IP (Transmission Control Protocol / Internet Protocol)

TCP/IP (Transmission Control Protocol/Internet Protocol) is a set of communication rules used to connect computers on the internet and other networks. It defines how data is divided into packets, transmitted, and reassembled at the destination. TCP ensures reliable data transfer by checking for errors, maintaining sequence, retransmitting lost packets and confirming delivery, while IP handles addressing and routing the packets to the correct destination. Together, they enable communication between different types of devices and networks. TCP/IP is the foundation of the Internet and supports many protocols like HTTP, FTP, SMTP, and DNS for various online services and applications.

5. SMTP (Simple Mail Transfer Protocol)

The Simple Mail Transfer Protocol (SMTP) is a standard communication protocol used to send and route emails over the Internet. It works between email clients and mail servers. SMTP ensures email messages are properly transferred to the recipient's mail server. SMTP uses port 25 by default and relies on TCP to provide reliable data transfer. When a user sends an email, SMTP transfers it from the sender's device to the outgoing mail server,





which then forwards it to the recipient's mail server. The recipient retrieves the email using protocols like POP3, IMAP. SMTP commands and responses help to manage the communication between mail servers, ensuring that each part of the email such as headers, sender, recipient, and contents are correctly delivered. SMTP is essential for email transmission, providing a fast, reliable, and standardized method of sending messages across networks.

A. POP3 (Post Office Protocol Version 3)

The Post Office Protocol Version 3 (POP3) is an Internet standard protocol used by email clients to retrieve messages from a mail server. It uses port 110 by default (or port 995 for secure connections). POP3 allows users to download emails from the server to their local computer, enabling them to read messages offline. When a user accesses their email through a POP3 client, the messages are typically downloaded and then deleted from the server, freeing up storage space. However, some configurations allow messages to remain on the server for backup or access from multiple devices. POP3 is simple and efficient, making it suitable for users who check email from a single device. Although newer protocols like IMAP offer more advanced features, POP3 remains a reliable and widely supported method for retrieving emails.

B. IMAP (Internet Message Access Protocol)

The Internet Message Access Protocol (IMAP) is an email protocol used by clients to access and manage messages stored on a mail server. It typically uses port 143 (or port 993 for secure connections). Unlike POP3, IMAP allows users to view and organize emails directly on the server without downloading them, enabling access from multiple devices such as computers, tablets, and smartphones. With IMAP, users can create folders, mark messages as read or unread, and synchronize changes across all devices connected to the same account. This makes it ideal for modern email usage where messages need to be available anytime and anywhere. IMAP ensures that emails remain stored on the server until the user deletes them, providing better management and backup. It is widely used by email services like Gmail, Outlook, and Yahoo Mail for efficient and flexible email access.

C. MIME Protocol (Multipurpose Internet Mail Extensions)

MIME is a protocol that enhances the standard email format to support the transmission of multimedia content such as images, audio, video, and application files. Originally, email systems



supported only plain ASCII text, which made it impossible to send non-textual data or files. With MIME, an email can contain multiple parts in a single message, such as text, images, and attachments, separated by boundaries. This allows modern email clients to display rich content consistently across platforms. MIME ensures compatibility, reliability, and versatility in email communication, making it essential for everyday internet use. Without MIME, sending multimedia content via email would not be feasible.

6. DNS (Domain Name System)

The Domain Name System (DNS) is a hierarchical and distributed naming system used to translate human-readable domain names (like `www.google.com`) into IP addresses (like `142.250.190.68`) that computers use to identify each other on the Internet (Figure 5.26). Without DNS, users would need to remember long numerical IP addresses to access websites. DNS works like a telephone directory of the Internet. When a user types a website address in a browser (`example.com`), the DNS starts by checking the local DNS cache to see if the IP address is already stored. If not found, the request goes to a DNS resolver, which contacts the root DNS server, then the Top-Level Domain (TLD) server and finally the authoritative DNS server that holds the actual IP address of the domain. Once the IP address is found, it is sent back to the user's device, allowing the browser to connect to the web server and display the requested website. This process happens in milliseconds. DNS makes Internet browsing simple, fast, and user-friendly by converting easy-to-remember names into machine-readable addresses automatically.

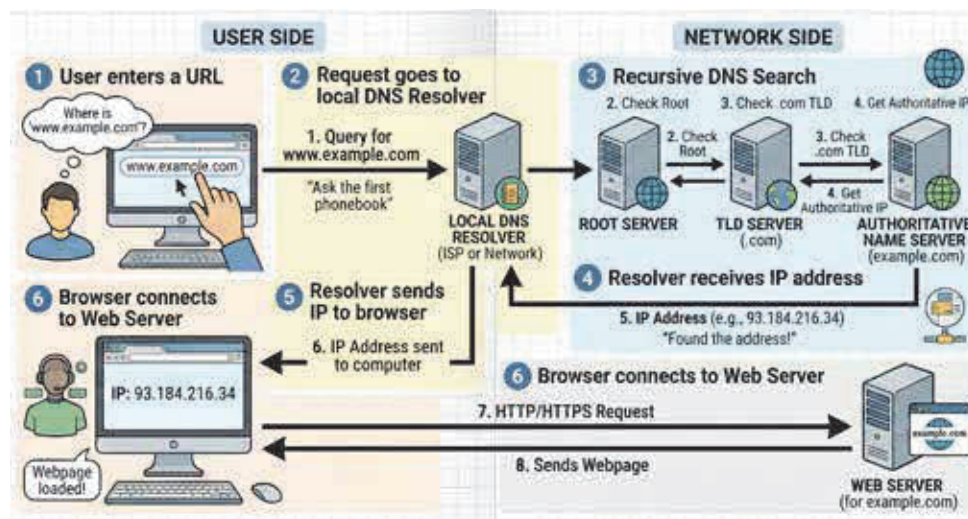


Figure 5.26 - Domain Name System

**Table: 5.11 Protocols for Data Communication**

Protocol	Full Form	Purpose / Used For
HTTP	Hyper Text Transfer Protocol	The foundation of data exchange on the web; used to fetch HTML documents and resources.
HTTPS	Hyper Text Transfer Protocol Secure	The secure version of HTTP; uses encryption (SSL/TLS) to protect data like passwords and credit card info.
FTP	File Transfer Protocol	A standard way to transfer files between a client and a server over a network.
TCP/IP	Transmission Control Protocol / Internet Protocol	The fundamental suite of protocols that governs how data is packeted, addressed, transmitted, and routed across the internet.
SMTP	Simple Mail Transfer Protocol	Used specifically for sending and routing outgoing email from a client to a server.
POP3	Post Office Protocol version 3	Used to retrieve emails from a server. It usually downloads the mail to your device and deletes it from the server.
IMAP	Internet Message Access Protocol	A more modern way to retrieve email that synchronize messages across multiple devices, keeping them on the server.
MIME	Multi-Purpose Internet Mail Extensions	An extension that allows email to support non-text content like images, audio, video, and attachments.
DNS	Domain Name System	The "phone book" of the internet; it translates human-friendly URLs (like google.com) into IP addresses (like 142.250.190.68).

Network protocols are like rules that computers use to communicate. Each protocol has a specific purpose some send web pages, some transfer files, others handle emails. Together, they make the Internet efficient, secure, and reliable.

5.7 Network-Based Services

Network-based services are the various functions and resources provided over a computer network, especially the Internet (Figure 5.27). These services allow users and devices to communicate, share data, access resources, and perform online activities such as browsing, emailing, and file sharing. They are the



Figure 5.27 - Network-Based Services

foundation of modern digital communication and play a vital role in education, business, entertainment, and government operations. Network-based services refer to the applications and processes that make use of a network (usually the Internet or a private network used within an organization) to deliver specific functions or information to users. Some common examples of network-based services include E-mail service, file transfer service, web service, video conferencing service, cloud storage service, social networking service etc.

Table 5.12 Network-based services

Network Service	Description	Purpose / Use	Example
E-mail Service	Allows users to send and receive electronic messages over a network	Communication and information sharing	Gmail, Outlook, Zoho Mail
File Transfer Service	Enables users to upload or download files from one computer to another	Sharing documents and data	FTP, Google Drive
Web Service (www)	Provides access to websites and web pages using browsers	Information access	Google, Wikipedia
Chat Service	Allows real-time text communication between users	Instant messaging	WhatsApp, Telegram
Video Conferencing Service	Supports live audio and video communication over a network	Online meetings and classes	Zoom, Google Meet
Remote Login Service	Allows users to access another computer remotely.	Remote system management	Telnet, SSH
Cloud Storage Service	Stores data on remote servers accessible via the Internet.	Data backup and storage	Dropbox, OneDrive
Streaming Service	Delivers audio or video content over the Internet without downloading.	Entertainment and learning	YouTube, Netflix
Online Transaction Service	Enables financial transactions through networks.	Banking and shopping	Online banking, Amazon
Social Networking Service	Helps people to share content and interact online.	Social interaction	Facebook, Instagram





Network-based services are essential in every field from education and healthcare to entertainment and commerce, making digital collaboration and information sharing faster and more reliable.



1. When you open a website, your device sends a request to a _____.
2. The full form of WWW is _____.
3. Each web page has a unique address called _____.
4. A school wants to conduct online classes with live interaction between teachers and students. Which network-based service should be used and why? Give one example.
5. A customer purchases products from an online shopping website and pays digitally. Which network-based service enables this activity and what is its purpose?

Summary

A computer network is a collection of interconnected devices that communicate with each other to share data and resources. This chapter begins with introducing to basic concepts of computer networks and the importance of data communication in today's digital world.

This chapter explains the components of data communication and different modes of data transmission across devices. It further classifies networks into PAN, LAN, MAN, and WAN based on their geographical spread and applications.

Students learn about transmission media, which are categorized into guided (wired) and unguided (wireless) media, along with their characteristics, advantages, and limitations. The role of essential network devices such as NIC, Hub, Switch, Router, Modem, and Firewall is discussed to show how data flows securely and efficiently across networks.

Different network topologies are explained with their structure, benefits, and drawbacks, helping students understand how computers are physically and logically connected. The chapter also introduces the Internet, its structure, and the role of the Domain Name System (DNS) in World Wide Web (WWW).

Finally, the chapter covers important network protocols and commonly used network-based services such as e-mail, file transfer, remote login, video conferencing, and cloud services, highlighting their significance in everyday life.

Overall, this chapter builds a strong foundation in computer networking concepts and prepares students to understand real-world communication systems.



1. A bank customer makes an online money transfer using a mobile app. Explain how data communication takes place in this process and why protocols are important for ensuring secure and accurate data transfer.
2. A teacher sends study materials from a laptop to students using an online platform. Identify the components of data communication involved (sender, receiver, message, transmission medium, and protocol) and explain the role of each in this situation.
3. A keyboard sends input signals to a computer, but the computer does not send data back through the keyboard. Which transmission mode is used in this case? Explain.
4. A company needs a fast, secure network connection between two buildings located close to each other and wants minimal signal interference. Which type of guided transmission media should be used and why?
5. A mobile user makes a video call while traveling in a moving vehicle without using any cables. Which type of unguided transmission media is used in this situation and why is it suitable?
6. A company has two office branches in different cities and wants them to communicate securely over the Internet as if they were on the same private network. Which network device is required to connect these networks and what role does it play?
7. A small office wants to set up a network where all computers are connected to a central device, and failure of one computer should not affect others. Which network topology is most suitable and why?
8. A military communication system requires a highly reliable network where data can still be transmitted even if one or more links fail. Which network topology should be used and explain how it ensures reliability.
9. A student accesses a secure website where personal information must be protected from unauthorized access. Which network protocol ensures secure communication in this situation and why is it important?



6

Cyber Security



“Information security is not a destination it’s a journey”

- Bill Cheswick

6.1 Introduction

In the 21st century, digital technology is an inevitable part of human life. We use digital devices right from early morning, starting with the alarm clocks on our mobile phones. We depend on computers and internet for online classes. Digital technology helps us to make digital payments. We use it for social media and online shopping. E-governance services also depend on computers and internet. Computers and internet influence almost every activity we do. A large part of modern life is based on digital connectivity. Therefore, the term *cyber space* has become very prominent. In today’s interconnected world, cyberspace plays a significant role in almost all aspects of life. Cyberspace refers to interconnected networks of computers and electronic systems. It is the environment where online communication, data exchange, and digital interactions take place. These include networks, hardware, software, data, and users.

In Kerala, digital literacy is relatively high, and initiatives such as Akshaya centres, e-District, K-FON and online education platforms have brought technology closer to ordinary citizens. However, along with convenience, technology also brings risks. Cyber criminals misuse digital systems to steal money, data and personal information. *Cyber security* is the practice of protecting computers, networks, devices and data from digital attacks, unauthorized access, damage, or theft. It involves using technologies, rules, and

safe practices to keep information secure while using the internet and digital devices. This makes cyber security one of the most important subjects for students to understand. This chapter introduces cyber security concepts, cyber crimes, preventive measures, ethics and laws in a structured and easy-to-understand manner.

6.2 Vulnerability in Cyber Space

Vulnerability in cyberspace refers to weaknesses or gaps in computers, networks, software or user practices that can be exploited by cyber attackers. These vulnerabilities make digital systems and data more exposed to cyber threats and security risks.

6.2.1 Causes of Vulnerability in Cyber Space

Vulnerabilities in cyberspace arise due to various factors that create weaknesses in digital systems, making them susceptible to attacks (Figure 6.1). They may come from software flaws, human mistakes, network setup errors and weak hardware. Some of the various causes and categories of vulnerability in cyber space are given below.



Figure: 6.1 - Causes of Vulnerability

6.2.1.1 Software Vulnerabilities

- **Bugs and coding mistakes:** Computers run on software (programs and apps), but those programs can have errors (called bugs) or flaws in their code. For example, a game or phone app might crash unexpectedly – that bug could let attackers sneak in.



- **Outdated Software:** If software is not updated, it will have security problems. Hackers can easily attack old software.
- **Digital footprints:** A digital footprint is the data trail created when a person uses digital devices and the internet. They show where you have been online. Some examples are search history (Google searches, browsing history, queries), social media activity (posts, likes, comments and profile info), cookies (small files tracking your browsing habits), IP Address, location data etc.

6.2.1.2 Human Factors

- **Excessive user privileges:** When users are given more access rights than necessary, a compromised account can cause serious damage, such as deleting data or changing system settings.
- **Weak passwords:** Easy passwords can be guessed quickly. Using the same password everywhere is also unsafe.
- **Lack of awareness:** When users do not know the basic cyber safety rules, they make mistakes which in turn cause attacks. People sometimes click on fake links or open unknown files. This allows hackers to enter the system.
- **Insider threats:** Users who already have access to the system may misuse it or make mistakes.

6.2.1.3 Network and Infrastructure Issues

- **Misconfigured firewalls and routers:** A firewall is like a security guard for a network. It controls incoming and outgoing network traffic. If firewall rules are weak, outdated or wrongly configured, attackers can bypass them and gain unauthorized access to the systems. Similarly, routers or network devices with default or open settings can be exploited. For instance, if a home router still has its factory password (A factory password is the default password that a device or software comes with from the manufacturer), attackers can easily take over the home network.
- **Poor security settings:** If security settings are not set properly, hackers can enter the network easily.
- **Untrusted devices or networks:** Using public Wi-Fi or unknown devices can expose data to hackers.
- **Misconfigured cloud storage:** Cloud storage becomes vulnerable when access rights are wrongly set (for example, public access enabled by mistake). It may lead to data leaks, unauthorized access, or data theft.



6.2.1.4 Hardware Vulnerabilities

- Outdated or unsupported devices: Just like software, hardware (physical devices) also needs updates. Old computers, phones or gadgets that never get security patches can be weak. An unsupported hardware can lead to security loopholes that hackers can exploit and older devices often lack modern security features, making them easy targets. Think of an old smart phone that can no longer install security updates – hackers know its old weaknesses.
- Insecure BIOS settings: The BIOS (Basic Input Output System) controls basic hardware operations. If BIOS passwords are not set or security features are disabled, attackers can change system settings, install malware or access data before the operating system starts.



1. How does human error lead to cyber attacks?
2. "Using untrusted networks can expose personal data." Justify this statement.
3. Small files used by websites to track browsing habits are called ____
4. Explain weak passwords with an example.
5. What are bugs? How can they lead to cyber attacks?
6. What is meant by insider threat?
7. What is a digital footprint?
8. Which hardware component controls basic system operations before operating system loads?

6.3 Meaning and scope of cyber security

Along with many benefits of technology, involves serious dangers too. Some people misuse computers and internet to commit crimes such as stealing money, sensitive data and personal details. Because of these growing threats, it is very important to learn about cyber security and understand how to be safe in the digital world. Cyber security involves protecting the information and systems from malignant activities in cyber space. Cyber security is not only about computers. It is also about people, data and safe behavior in cyberspace.





Three basic principles of cyber security, known as the CIA Triad: (figure 6.2)

1. **Confidentiality:** Information should be accessible only to authorized persons.
2. **Integrity:** Information should not be altered without permission.
3. **Availability:** Information and services should be available when needed.

For example, when a student in Kerala logs into the Kerala Infrastructure and Technology for Education (KITE) portal to access digital textbooks, cyber security ensures that only the student can access their account (confidentiality), the content is not tampered with (integrity), and that website remains accessible during exam seasons (availability).

The three core goals of information security confidentiality, integrity and availability ensure that information is protected from unauthorized access, remains accurate and trustworthy and is available to authorized users when needed. To effectively achieve these goals, additional security objectives such as Authentication, Authorization, Non-repudiation and Access Control play a vital supporting role. *Authentication* is the process of verifying the identity of a user or system before granting access to resources. It answers the question “Who are you?”. For example, username and password, One-Time Password (OTP), biometrics such as fingerprint or face recognition. It is considered as an extended security goal because it ensures only legitimate users gain access to systems and data. *Authorization* determines what an authenticated user is allowed to do after logging into a system. For example, a student can view marks but cannot edit them; only an administrator can add or delete user accounts. It answers the question “What are you allowed to do?”. *Access Control Systems* are mechanisms that enforce authentication and authorization rules to protect resources. They ensure that only authorized users can read, modify or use digital resources. They work by verifying identity (authentication) and then granting permission (authorization) based on predefined rules. For example, a customer logs in using username, password, and OTP (authentication), the system allows



Figure 6.2 - CIA Triad

customer to view balance and transfer money but blocks access to admin functions (authorization). *Non-repudiation* ensures that a user cannot deny performing an action after it has occurred. Non-repudiation provides proof of origin and action, which is important in legal and financial systems like digital signatures on emails, online transaction records etc.



1. Which of the following is NOT part of the CIA Triad?
 - a) Confidentiality b) Integrity
 - c) Authentication d) Availability
2. When a server is hacked, the computer acts as
 - a) Tool b) Target c) Storage device
 - d) Communication medium
3. How is cyber security related to human behavior?

6.4 Importance of Cyber Security

The importance of cyber security cannot be ignored, as digital technology becomes a part of every aspect of our lives. India is a rapidly growing digital economy. Digital India initiatives have promoted online banking services, UPI payments, Aadhar based services, e-Governance, digital classrooms etc. In Kerala, services such as SPARK (Service and Payroll Administrative Repository for Kerala), online PSC application and exams, virtual courts, e-Health Kerala, THANAL, FRIENDS and K-SMART depend heavily on secure digital systems. Cyber security is crucial as it significantly impacts both individuals and organizations across various sectors. A single cyber attack can affect thousands of citizens. Hence, cyber security is a collective or shared responsibility. It is very important because it is necessary to:

1. Protect sensitive data (like Aadhar, PAN, bank account details etc.).
2. Prevents online fraud and scams.
3. Protects government databases.
4. Builds trust and reputation in digital services.

6.5 Different types of Cyber Security

Cyber Security encompasses a variety of specialized fields, each focusing on protecting different aspects of digital systems and data. Here are some of the main types of Cyber Security: (Figure 6.3)





- a. **Network Security:** It involves securing computer networks from intruders like hackers and malware. It uses tools such as intrusion detection systems, firewalls and Virtual Private Networks (VPNs). These tools protect the network's perimeter. For example, a firewall blocks unauthorized access while allowing outward communication.
- b. **Application Security:** Application Security focuses on protecting software and devices from cyber threats. It includes writing secure programs, checking applications for weaknesses and using firewalls to protect them from attacks. Regular updating and patching of software is a common and important application security practice.
- c. **Information Security:** It is also known as data security and it is dedicated to protecting data's confidentiality, integrity and availability. It uses techniques such as encryption, access control and prevents data loss to safeguard the data stored and in transit. Data encryption is the process of converting data into a coded form to protect it from unauthorized access. Only a person with the correct key or password can convert it back to its original form. For instance, if you encrypt sensitive data files on a corporate network, it will prevent data leakage in case of a breach.
- d. **Endpoint Security:** Endpoint security is a security approach used to protect user endpoints such as PCs, smart phones and tablets from viruses, malware, and unauthorized access. The tools used for endpoint security range from basic antivirus software to advanced solutions like EDR (Endpoint Detection and Response). When implemented properly, endpoint security ensures that each device is individually protected, preventing attackers from using a compromised endpoint to move to other systems within the organization.
- e. **Operational security:** It handles the processes and decisions for managing and protecting data assets, it covers managing permissions and access. The aim is to ensure that confidential information is only granted to authorized users. It involves options such as using multi-factor authentication to access corporate databases.



Figure. 6.3 - Types of Cyber Security

- f. **Cloud Security:** This type of security protects data, applications and infrastructures involved in cloud computing. It often involves a shared responsibility between cloud service providers and clients to secure the data hosted in the cloud.



1. Protecting smart phones and laptops comes under
 - a) Network security b) Application security
 - c) Endpoint security d) Cloud security
2. Which type of security focuses on protecting data confidentiality and integrity?

6.6 Common Cyber Security Threats

Understanding the nature of common Cyber Security threats is essential to safeguard your digital assets. Here are some of the most prevalent types of security threats that you might encounter:

- a. **Phishing Attacks:** In such attacks, the attackers pretend to be the trusted sources and deceive individuals into sharing confidential and sensitive information (*Figure 6.4*). The kind of information they can be phishing for could include a wide range – such as credit card numbers, social security numbers, passwords etc. Phishing often involves sending deceptive emails that appear to be from reputable sources. These emails often prompt users to enter personal information at a fake website.



Figure. 6.4 - Phishing

- b. **Malware:** Malware is a term for malicious software. It is any program designed to damage or exploit any programmable device, service or network. Various forms of malware exist, such as Virus, Trojan, Worms, Spyware etc.



- c. **Ransomware:** This type of malware takes control of a victim's files or systems and asks for a ransom to regain access. Ransomware can prevent you from accessing the system or encrypt your data. Once your system is infiltrated, you will not be able to access it without a decryption key. In most cases the attackers promise to provide this key only upon payment.
- d. **Man-in-the-Middle attacks (MitM):** In these attacks, the perpetrator covertly intercepts (Figure 6.5). They may modify the communications between two parties who think they are directly connecting with each other. This can happen on unsecured Wi-Fi networks, where attackers intercept data being transferred from a device to the network.



Figure. 6.5 - Man in the Middle Attack

- e. **Denial-of-Service attacks (DoS):** These attacks block users from accessing a machine or network by temporarily or permanently stopping the internet-based services of the host (Figure 6.6). Attackers typically target web servers of high-profile organizations such as banks, media, government sites etc.



Figure 6.6 - Denial of Service Attack

- f. **Zero-Day Exploits:** These occur when hackers take advantage of a security vulnerability before developers become aware of it or before a patch is available. Since there is little or no time to fix the flaw, zero-day exploits are extremely dangerous and can cause serious damage to systems and data.
- g. **Insider threats:** Sometimes, the risk comes from within. Disgruntled employees, contractors, or anyone with inside access can misuse their credentials to steal data or disrupt the systems.

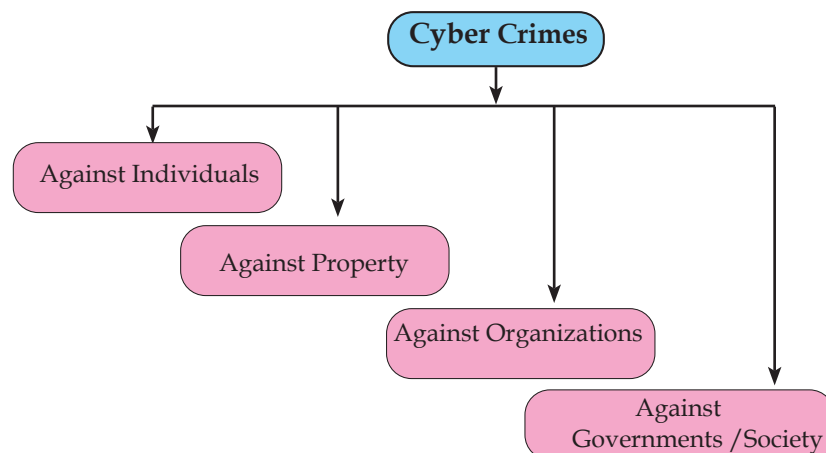
6.7 Cyber Crimes

Cyber crime refers to illegal activities carried out using computers, mobile devices or the internet. In cyber crimes, digital technologies are the target, the tool or both. These crimes affect individuals, organizations or even governments.

Computers can play different roles in cyber crimes depending on how they are used

- **Computer as a target:** The computer or network itself is attacked. Example: Hacking a server, spreading viruses, damaging data.
- **Computer as a tool:** The computer is used to commit the crime directly. Example: Sending phishing emails, online fraud, spreading malware.
- **Computer as a storage device:** Computers are used to store illegal data. Example: Storing stolen data, pirated software, and illegal content.
- **Computer as a communication medium:** Computer acts as a medium to trap victims or it is used to communicate or coordinate criminal activities. Example: Planning crimes through emails, chats, or social media.

Cyber crimes can be classified into four major categories:





6.7.1 Against Individuals

These types of cyber crimes target a person's privacy, identity or mental wellbeing. It includes

- **Identity theft:** Identity theft is a serious cyber crime that involves stealing and misusing personal information. Awareness, safe online behavior and security measures are essential to protect oneself from identity theft. Using stolen or fake identity information to commit fraud is referred to as Identity fraud or theft.
- **Email spoofing:** A spoofed email is one in which the e-mail header is forged so that the mail appears to originate from one source but actually it has been sent from another source.
- **Phishing:** Phishing is a type of identity theft that occurs online. It is an attempt to acquire information such as usernames, passwords, credit card details etc by pretending as the original website, mostly that of banks and other financial institutions. Phishing websites have URLs and home pages similar to their original ones. The act of creating such a misleading website is called *spoofing*. These frauds use this information to steal money. Phishing is currently the most widespread financial threat on the Internet.
- **Pharming:** In this case the users are redirected to fake websites often by manipulating DNS servers or exploiting website vulnerabilities. While phishing is like a direct attack, pharming is more like a trap door.
- **Spamming:** Spamming means sending multiple copies of unsolicited mails or mass e-mails such as chain letters.
- **Cyber defamation:** This occurs when defamation takes place with the help of computers and/or the internet. For instance, someone publishes defamatory matter about another person on a website or sends e-mails containing defamatory information.
- **Cyber stalking:** Cyber stalking is the activity of repeatedly harassing, threatening or following an individual's activity over internet.
- **Cyber bullying:** Cyber bullying uses digital platforms to insult, or embarrass someone, especially repeatedly.

6.7.2 Against Property

These crimes involve damage or theft of digital or physical property.

- **Credit card fraud:** As the name suggests, this is a fraud activity by using a credit card. This generally happens if someone gets to know the card number or other details or if the card gets stolen.



- **Intellectual Property crimes:** These include
 - i. **Software piracy:** Illegal copying of programs, distribution of copies of software.
 - ii. **Copyright infringement:** Using copyrighted material without proper permission.
 - iii. **Trademarks violations:** Using trademarks and associated rights without the permission of the actual holder.
 - iv. **Theft of computer source code:** Stealing, destroying or misusing the source code of a computer.
- **Internet time theft:** This occurs when internet hours paid by one person are used by an unauthorized individual.

6.7.3 Against Organizations

Cyber crime against organization include unauthorized accessing of computer, denial of service, computer contamination virus attack, e-mail bombing, salami attack, logic bomb, Trojan horse and data diddling.

- **Unauthorized accessing of computer:** Accessing the computer/ network without permission of the owner. The intention behind this illegal access may be for:
 - i. **Changing/deleting data:** Unauthorized modification of data.
 - ii. **Computer voyeur:** The criminal reads or copies confidential or proprietary information, but the data is neither deleted nor changed.
- **Denial of service:** When the Internet server is flooded with continuous bogus requests so as to denying legitimate users to use the server or to crash the server.
- **Malware attacks:** Malware means malicious software designed to harm or exploit computer network or device.

The following are the different types of malware:

- i. **Virus:** A computer virus is a computer program that can replicate itself by attaching it to other files or programs. It needs a host to spread and can cause all sort of trouble like data loss or system crashes.
- ii. **Worm:** A worm is like a virus, but it can spread itself without the need of a host. It is self-contained and can propagate through networks, causing chaos and consuming resources.





- iii. **Trojan:** An unauthorized program which functions from within that seem to be an authorized program, thereby concealing what it is actually doing. Once inside, it lets attackers access your system, steal data, or cause chaos.
 - iv. **Ransomware:** It is like a digital kidnapper. It encrypts your files and demands payment (ransom) for the decryption key. Payment does not guarantee to getting the data back.
 - v. **Spyware:** It is a software that secretly monitors and collects your data, like browsing habits or keystrokes. It's like having a digital spy in your system.
- **Email bombing:** Sending large number of mails to the individual, company or mail servers and thereby ultimately crash the system.
 - **Salami attack:** Salami Attack is a type of cyber crime in which a large amount of money or data is stolen by taking very small amounts repeatedly, so that each individual theft goes unnoticed – just like slicing thin pieces of salami.. These attacks are used for the commission of financial crimes.
 - **Logic bomb:** It is an event dependent program. As soon as the designated event occurs, it crashes the computer, release a virus or any other harmful possibilities.
 - **Data Diddling:** This kind of attack involves altering raw data just before it is processed by a computer and then changing it back after the processing is over.

6.7.4 Against Governments / Society

- **Forgery:** Currency notes, revenue stamps, mark sheets etc. can be forged using computers, high quality scanners and printers.
- **Cyber terrorism:** Use of computer resources to intimidate or coerce people and carry out the activities of terrorism.
- **Web jacking:** Hackers gain access and control the website of another, and they may change the content of website for fulfilling political objective.





1. Altering data before processing and restoring it later is called
 - a) Logic bomb
 - b) Data diddling
 - c) Email bombing
 - d) Salami attack
2. Flooding a server with fake requests to crash it is known as _____ attack.
3. Malware that needs a host file to spread is called _____.

6.8 Cyber Security Controls

Cyber security controls are tools or steps that help to keep computers and data safe. There are three main types of controls.

1. **Preventive controls:** In this step we try to stop security problems *before they happen*.
 - **Use strong passwords:** Instead of common words or personal information, use unique, complex passwords and change passwords regularly.
 - **Keep software updated:** Regularly update operating system, applications and patch vulnerabilities.
 - **Multilevel authentication:** It is also called Two-Factor Authentication (2FA). It requires more than one method to verify the identity. Add extra security along with your password. Example: password and OTP or password and biometric verification.
 - **Firewalls:** A firewall monitors and controls incoming and outgoing network traffic to block unauthorised access. It acts like a protective wall between a computer or network and the internet. The firewall allows the safe data to pass through and blocks unauthorized or harmful access, helping to prevent hacking and cyber attacks.
2. **Detective Controls:** They are designed to identify and alert when something suspicious is happening or already occurred.
 - **Antivirus software:** Antivirus software is a security program used to protect computers and mobile devices from viruses and other harmful software. It detects, prevents, and removes malware such as viruses, worms, trojans, and spyware. Antivirus software scans files, emails, and websites to find threats and blocks them before they can damage the system or steal data. Keeping antivirus





software installed and regularly updated helps to ensure better protection against new cyber threats.

- An alert or email when someone logs into your social media account from a new device.

3. **Corrective Controls:** corrective controls help fix problems *after they happen*

- Reinstalling a clean operating system or app after a virus infection. Resetting a hacked password and removing unauthorized users from your account.

However, Cyber security focuses on prevention rather than cure. Cryptography, hashing and digital signatures are three important concepts that work together to ensure secure communication, data integrity, authentication and trust in digital systems.

Cryptography is a technique of protecting information by converting it into a secret code. In cryptography, readable data (plain text) is encrypted into an unreadable form (cipher text) so that unauthorized people cannot understand it. Only authorized users with the correct key can decrypt the data and read the original information. Cryptography is widely used to ensure data security, privacy and safe communication on the internet, such as in online banking and secure messaging.

Hashing is a process that uses a mathematical function to convert data into a fixed-length value called a *hash*. This hash acts as a unique digital fingerprint, which helps verify that the data has not been changed.

Digital signatures use cryptography and hashing to prove the identity of the sender and to ensure that a message or document cannot be denied later. Cryptography, hashing and digital signatures together form the foundation of modern cyber security and are widely used in applications such as secure websites, online transactions, e-governance services and electronic documents etc.



1. Antivirus software is an example of
 - a) Preventive control
 - b) Detective control
 - c) Corrective control
 - d) Legal control
2. What is multilevel authentication also known as?
3. Mention any two characteristics of a strong password.

6.9 Cyber Security Do's and Don'ts

Do's	Don'ts
Use strong passwords with letters, numbers and symbols.	Do not share passwords or OTPs with anyone. Do not save passwords on public or shared computers. Do not use the same password for multiple accounts. Do not over share personal information online.
Verify links and emails before clicking or downloading anything.	Do not click on unknown or suspicious links in emails or messages.
Download apps and files only from trusted sources and keep them updated.	Do not download apps or files from untrusted websites and donot ignore software and app updates.
Lock your devices using PIN, password or biometrics.	Do not leave devices unlocked or unattended.
Use antivirus software and scan your device regularly.	Do not ignore antivirus warnings or alerts.
Log out after using email or social media on shared computers.	Do not stay logged in on shared or public computers.
Use secure networks for online transactions.	Do not use public Wi-Fi for banking or sensitive activities.
Report suspicious messages to a trusted adult or authority.	Do not respond to online threats or fake prize messages.
Backup important data like assignments and projects.	Do not rely on a single copy of important data.
Use privacy settings on social media accounts.	Do not accept friend requests from unknown people.

6.10 Legal and ethical behaviour in cyber space

Cyberspace has become an important part of our daily life. We use the internet for learning, communication, shopping, banking and entertainment. While using cyberspace, it is very important to follow legal and ethical behavior to ensure safety, trust and respect for everyone.

- **Legal behavior in cyberspace:** It means to follow the laws and rules related to the use of computers and the internet. This includes not hacking systems, not spreading viruses, not stealing personal or financial information and not sharing illegal or copyrighted content. Cyber laws are made to protect users,





data and digital systems. When people follow these laws, it helps to prevent cyber crimes and ensures justice in the digital world. The Information Technology Act, 2000 was passed by the Indian Parliament to provide legal recognition to electronic records and digital signatures. This act was amended by The Information Technology Amendment Bill, 2008 to strengthen cyber security laws and address emerging cyber threats.

- **Ethical behavior in cyberspace:** It refers to do what are morally right activities while using technology, even when there is no direct law. Ethical users respect others' privacy, do not bully or harass people online, do not spread fake news, and use digital resources honestly. Ethical behavior also includes giving credit to original creators and using the internet responsibly. Together, legal and ethical behavior helps to create a safe, respectful and reliable cyberspace. When users act responsibly, cyberspace becomes a positive environment that supports learning, innovation and healthy communication.

◆———— Summary ———◆

The chapter explains the growing importance of protecting digital systems in today's technology-driven world. It introduces cyberspace and highlights how daily activities such as education, banking, governance and communication depend on computers and the internet. The chapter discusses vulnerabilities in cyberspace, explaining how software flaws, human errors, weak passwords, misconfigured networks and insecure hardware create opportunities for cyber attacks.

Students learn the meaning and scope of cyber security, including the roles of computers in cyber crimes and the importance of the CIA Triad – Confidentiality, Integrity and Availability, along with supporting concepts like authentication, authorization, access control and non-repudiation. The chapter also explains the importance of cyber security for individuals, organizations and governments, especially in protecting sensitive data and building trust in digital services.

Different types of cyber security such as network, application, information, endpoint, operational and cloud security are introduced. Common cyber threats and cyber crimes are explained with examples, covering crimes against individuals, property, organizations and society. The chapter also emphasizes cyber security controls, safe practices through Do's and Don'ts, and the need for legal and ethical behavior to ensure a safe and responsible cyberspace.





1. Define cyberspace and explain its components.
2. Explain why cyber security has become an important subject for students.
3. What is meant by vulnerability in cyberspace? Explain vulnerability in cyberspace with suitable examples.
4. Explain insecure BIOS settings as hardware vulnerability.
5. Describe the role of digital footprints in increasing cyber risks.
6. How does outdated software increase security risks?
7. Give one real-life situation from daily life where lack of cyber security can cause serious problems. Explain.
8. How can vulnerability in a system be misused by cyber attackers? Explain with one example.
9. How does human error lead to cyber attacks? Explain with examples.
10. "Using untrusted networks can expose personal data." Justify this statement.
11. Define non-repudiation. Why is it important?
12. Describe the CIA Triad and explain its importance in cyber security.
13. Explain authentication and authorization. List any two differences between them.
14. Explain how confidentiality, integrity and availability are ensured when students access online education portals.
15. What is malware? Name any two types of malware.
16. How do phishing emails deceive users?
17. What happens to data during a ransomware attack?
18. Explain Man-in-the-Middle attacks.
19. Describe Denial-of-Service attacks and their effects.
20. A hacker exploits a software flaw before a patch is released. What is this attack called? Why is it dangerous?
21. What are intellectual property crimes? Mention any two examples.
22. Explain cyber crimes against individuals with suitable examples.
23. Explain email bombing, salami attack, logic bomb and data diddling.
24. Describe the working and importance of firewalls in preventing cyber attacks.
25. What is multilevel authentication? Explain with suitable examples.
26. Explain antivirus software, its functions and the need for regular updates.
27. Explain cryptography, hashing and digital signatures and their roles.
28. Explain the three types of cyber security controls with suitable examples.
29. Explain how cryptography helps in online banking and secure messaging.
30. Mention any two characteristics of a strong password.
31. List and explain any five cyber security Do's and Don'ts
32. Why should students avoid public Wi-Fi for online transactions? Explain
33. Explain legal and ethical behavior in cyberspace.



7

AI and its Applications



The science of today is the technology of tomorrow.

- Edward Teller

7.1 Introduction to Artificial Intelligence (AI)

Artificial Intelligence (AI) is a branch of computer science that enables machines to perform tasks which typically require human intelligence. In other words, AI is the simulation of human intelligence in machines that are designed to think, make decisions, predict the future based on patterns in data, learn and improve through training, feedback or updated data. AI system can perform tasks that typically require human intelligence. AI is used to build agents like robots or virtual assistants that can mimic or simulate human behavior and make decisions on our behalf. A machine can be called artificially intelligent when it exhibits the following features.

- Thinks and learns like a human
- Mimics human intelligence
- Improves on its own
- Detects patterns and solves real world problems
- Comprehends language and images
- Predicts and takes decisions on its own



Figure 7.1 - Features of AI and Simulation of Human Intelligence

7.1.1 History and Evolution of AI

Artificial Intelligence, or AI is a part of computer science that tries to make machines smart enough to do tasks that normally need human intelligence—like understanding speech, recognizing pictures or making decisions.

The story of AI started in the 1950s when scientists first dreamed of building thinking machines. In 1956, a famous meeting called the Dartmouth Conference officially created the name “Artificial Intelligence.”

In the initial period, AI worked by following strict rules written by programmers. These early systems could only solve very simple problems. During 1960s and 1970s, progress was slow because the computers were weak and there was not much data to use.

Turing Test (1950)

In 1950, a British scientist named Alan Turing asked the big question - Can machines think?

He proposed the “Turing Test”, where a human interacts with both a machine and a person via text. If the human cannot differentiate between the machine and the other person, the machine passes the test, which suggests its human-like conversational behavior. The context is quite similar to chatting with a robot, like Siri or Alexa. Can the chatbot fool you into thinking it’s a person?



Dartmouth Conference (1956)

The term “Artificial Intelligence” was coined at the Dartmouth Conference, by John McCarthy, one of the organizers, marking the birth of AI as a field of study.

Early pioneers discussed autonomous automata. The concept of intelligent robots was later popularized by fictional characters like R2-D2 (1977).

Expert Systems (1980)

Experts created systems that could mimic human decision-making. These “expert systems” used rules and knowledge from humans to help make decisions.

Early systems helped doctors diagnose diseases by asking questions.

In the current context think of how apps like “WebMD” ask you about your symptoms to help figure out what might be wrong with you. Earlier systems, like MYCIN (1970s), were rule-based. Modern tools, like current symptom checkers, utilize Machine Learning.

Modern AI (2000s- present)

Starting in the 2000s, AI got smarter with the rise of Machine Learning (ML) and deep learning. AI systems began learning from huge amounts of data, becoming more capable. Neural networks, loosely inspired by the structure of the human brain, power these advancements. AI can now recognize faces in photos (like Facebook tagging your friends) or help self-driving cars understand the world around them.

Another example is that of Netflix recommending movies based on what you’ve watched. AI is learning from patterns in the data!

7.1.2 Applications of AI in Daily Life

AI surrounds us more than we realize:

Smartphones: AI is integrated into many smart-phone features like improving image quality in photos, filtering spam messages and powering personal assistants.

Health care: AI can help with medical diagnosis, personalize treatment plans and empower health trackers.

Transportation: From navigation apps optimizing routes to advanced driver-assistance systems in cars and eventually self-driving vehicles, AI is changing how we travel.



Finance: AI helps with fraud detection, provides personalized financial advice and aids in automated trading.

Education: AI can provide personalized learning experiences, automate grading and enhance education tools.

8.1.3 AI Timelines

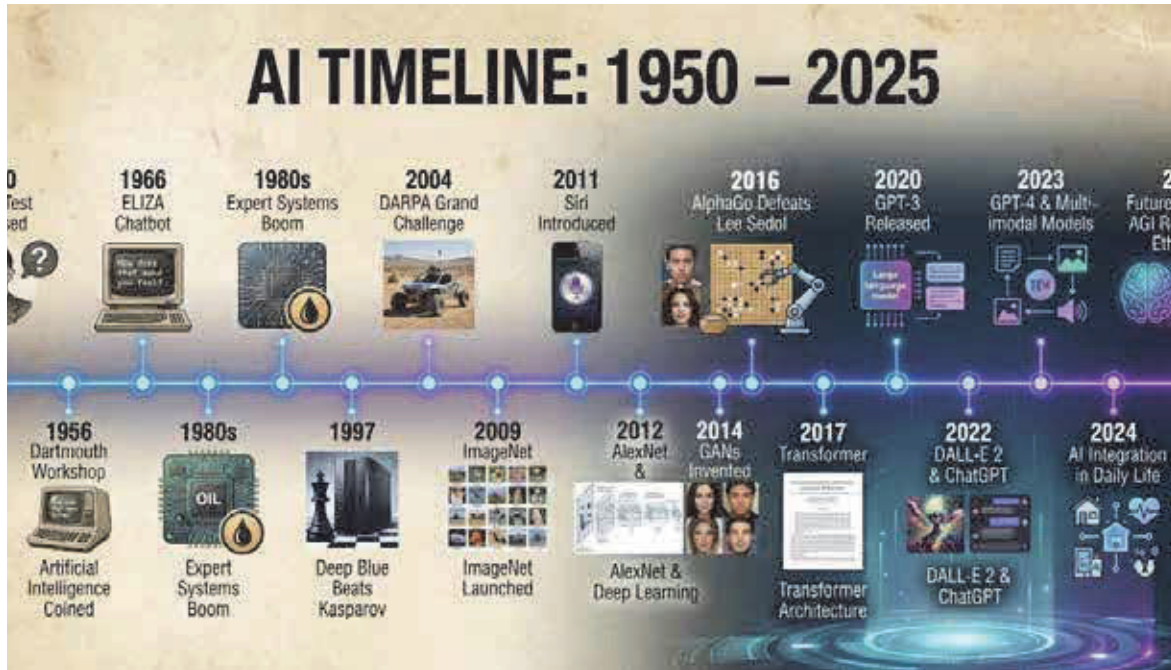


Figure 7.2 - AI History Timeline

Real-Life Issues of Artificial Intelligence

Artificial Intelligence is helpful in many real-life situations, but it also has certain limitations. For example, when an AI system is asked to generate a recipe for an eggless vegetable omelet, it may suggest ingredients that are not easily available or give steps that are not practical in real kitchens. Since AI does not have human senses like taste or smell, it cannot judge flavor or texture. Sometimes, the information provided may be incomplete or unclear due to limited or biased data. This shows that AI can support humans, but it cannot completely replace human experience and judgment.

Ethical Considerations

Although Artificial Intelligence (AI) offers many benefits and makes work easier, it is very important to use it in a responsible and ethical way. Ethical considerations help ensure that AI is used for the good of society and does not cause harm to individuals or communities.



Privacy

AI systems often collect and process large amounts of personal data, such as names, photos, locations or online activities. This information must be protected carefully. People's personal data should not be misused, shared without permission or exposed to security risks.

Bias

AI systems make decisions based on the data they are trained on. If the data contains bias or unfair patterns, the AI may also produce unfair or discriminatory results. Therefore, AI systems should be designed and tested to ensure that their decisions are fair and do not discriminate against any individual or group.

Accountability

When an AI system makes a decision, it should be clear who is responsible for that decision. Developers, companies or organizations using AI must take responsibility for its actions and outcomes, especially when mistakes or harmful decisions occur.

Employment

AI and automation can replace certain jobs that are repetitive or monotonous. While this can increase efficiency, it may also lead to loss of work for some workers. Society must adapt by creating new job opportunities and helping people learn new skills to work alongside AI technologies.



1. Describe Artificial Intelligence in your own words.
2. Who is regarded as the father of AI?
3. List any two areas where AI is applied today.
4. Why is ethical AI use important?
5. Give two examples of AI applications in daily life.
6. Explain why responsible use of AI is necessary.
7. Identify three examples of AI you have used today and describe their functions.
8. Discuss in groups how AI can improve life in your city or community.



7.2 Machine Learning – Teaching Machines to Learn

Machine Learning is a subset of Artificial Intelligence that enables computers to learn from data without being explicitly programmed. Instead of giving step-by-step instructions, we provide examples, and the machine recognizes patterns, draws insights, and makes predictions.



Figure 7.3 - Machine Learning

Consider it like teaching a child, you give numerous examples of apples and oranges rather than going into the details of each fruit. With time, the child will be able to recognize a new orange or apple on their own. In a similar vein, machine learning enables computers to “learn” from examples.

Importance of Machine Learning

Through Machine learning computers learn from data without being explicitly programmed. This has many applications like making search engines more accurate, powering personalized recommendations etc.

7.2.1 Types of Machine Learning

Based on how the learning process works, machine learning is mainly classified into three types: Supervised Learning, Unsupervised Learning and Reinforcement Learning.

1. Supervised Learning

In supervised learning, the computer is trained using labeled data. This means that each input is already associated with a correct output or answer. During training, the model learns the relationship between the input data and the expected output. Once trained, the model can use this knowledge to make predictions on new and unseen data.

Some examples of this are:

- Identifying ripe and unripe mangoes: The model is shown many images of mangoes, where each image is labeled as “ripe” or “unripe.” By studying these examples, the computer learns the differences and can correctly classify new mango images.





- Email spam detection: Emails are labeled as “spam” or “not spam.” The system learns from these labeled emails and can later identify whether a new email is spam or not.

2. Unsupervised Learning

In unsupervised learning, the computer works with unlabelled data, meaning there are no predefined answers. The model explores the data on its own to discover hidden patterns, similarities, or structures. It often groups or clusters data items that are similar to each other. Some instances of unsupervised learning are:

- Grouping students based on learning styles: The system analyses student behavior and performance to form groups with similar learning patterns.
- Clustering customers in e-commerce: Online shopping platforms group customers based on their shopping behavior, preferences and purchase history to understand trends and improve recommendations.

3. Reinforcement Learning

In reinforcement learning, the machine learns through trial and error. It performs actions and receives rewards for correct decisions and penalties for wrong ones. Over time, the system improves its strategy to maximize rewards. This type of learning is commonly used in game development, robotics and control systems.

Here are some examples:

- Training a robot to navigate a maze: The robot receives a reward when it reaches the endpoint. By repeating the task, it learns to choose better paths in future attempts.
- AI playing chess or Go: The AI learns by playing many games against itself. By winning or losing games, it improves its strategy and becomes more skilled over time.

7.2.2 Key Concepts in Machine Learning

Data Quality: The data should be accurate, complete and relevant. The machine picks up knowledge from its observations. Predictions will be unreliable if the training data is inaccurate, biased or lacking. For example, a facial recognition system trained mostly on images of people from one ethnicity may fail to recognize people from other ethnicities.

Training and Testing: Training data is the initial dataset used to train an AI model. Training data helps an AI model to learn and identify the patterns or performs particular tasks.

Testing data is used to evaluate the performance of the AI model.

Feature Selection: It is about choosing the most relevant features from a dataset to build a model. This helps to improve the model's performance, reduces complexity and makes it easier to understand. Predicting student performance based on attendance, study hours and previous grades, is an example.

7.2.3 Applications of Machine Learning

Healthcare: Predicting disease outbreaks, diagnosing illnesses from medical images.

Finance: Detecting fraud in credit card transactions.

E-commerce: Product recommendation systems like Amazon or Flipkart.

Education: Adaptive learning platforms that adjust lessons based on student performance.

Agriculture: Monitoring crop health and predicting yield.



1. How is machine learning different from traditional programming?
2. What are the three main types of machine learning?
3. Why is high-quality data important for machine learning?
4. Can you think of one example where reinforcement learning is used?
5. Define Machine Learning in your own words.

7.3 Artificial Neural Networks – The Machine Brain

Artificial Neural Networks (ANNs) are computational models inspired by the human brain. Just as the brain have billions of interconnected neurons that process information, ANNs use artificial neurons to analyze data, detect patterns and make predictions. These Neurons are sometimes called nodes.

A fundamental component of contemporary AI, ANNs are particularly useful in speech processing, image recognition and natural language comprehension applications. Like humans, they allow machines to learn from experience.





7.3.1 Structure of a Neural Network

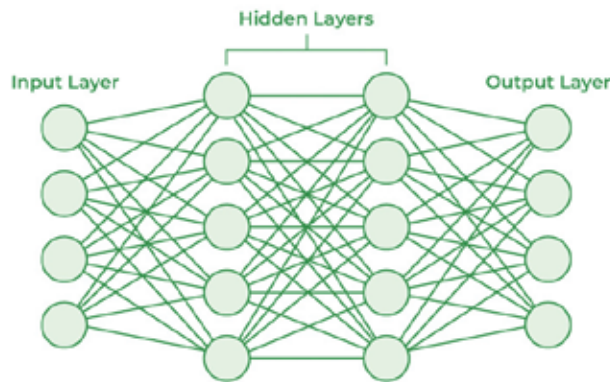


Figure 7.4 – Neural Network Structure

Input Layer: Input layer serves as the entry point for the data passing it to the subsequent layers. Each neuron in this layer represents specific feature. In image recognition, each pixel's intensity may be an input neuron.

The Hidden Layers: The Hidden layers perform the crucial computations, transforming the input data through various functions. There can be multiple hidden layers depending on the complexity of the task.

Output Layer: Output layer generates the final prediction or output. This layer communicates the outcome based on the processed information from the hidden layers.

Weights: Each connection has a strength (called a weight) that influences how signals propagate; these weights are what the network learns and tweaks during training.

For example, a neural network trained on handwritten digits can recognize the number '5' even if written in different styles or slanted positions. The network learns features such as curves, edges and orientation in the hidden layers.

7.3.2 How Neural Networks Learn

Forward Propagation: The input layer sends data to the output layer via the hidden layers.

Error Calculation: The difference between the predicted output and the actual output is measured.

Backpropagation: The network adjusts the weights of connections to minimize error.

Iteration: This process repeats until the network achieves maximum accuracy. The network improves with experience, similar to how humans learn by trial and error.

7.3.3 Applications of Neural Networks

Image Recognition: Facebook tagging, Google Photos, autonomous vehicles.

Speech Recognition: Converting spoken language into text, e.g., Siri, Google Assistant.

Medical Diagnosis: Detecting tumors or abnormalities in X-rays, MRI scans, or CT scans.

Natural Language Processing: Chat bots, translation tools, sentiment analysis.

Gaming: AI learns to play complex games like chess or Go.



1. How is an artificial neural network inspired by the human brain?
2. What are the main layers of a neural network?
3. How does a neural network improve its predictions?
4. Give two practical applications of neural networks.
5. Define an Artificial Neural Network.

7.4 Natural Language Processing (NLP) - Understanding Human Language

Humans communicate with each other using natural languages such as Malayalam, Hindi and English. For computers to interact effectively with people, they must be able to understand, interpret and generate human language. Natural Language Processing (NLP) is a branch of Artificial Intelligence that makes this possible. It helps machines bridge the gap between human communication and computer understanding.

In simple terms, NLP enables computers to:

- Read and understand text, such as emails, messages or documents
- Listen to and interpret speech, allowing voice-based interaction
- Translate between languages, helping people communicate across different regions
- Generate meaningful responses, making conversations with machines more natural and useful

NLP plays an important role in many everyday applications like chatbots, voice assistants, language translation tools and spam detection systems.





Figure 7.5 - NLP Functions and Applications

7.4.1 Natural Language Processing

It is about how computers can understand, interpret and generate human language. It involves steps like breaking down text and understanding the meaning of words and sentences.

NLP combines computer science, linguistics and machine learning. The process involves:

- **Tokenization:** Breaking text into smaller units like words or sentences.
- **Parsing:** Analyzing the grammatical structure of sentences.
- **Semantic Analysis:** Understanding the meaning of words and sentences.
- **Response Generation:** Producing meaningful and context-aware outputs.

7.4.2 Applications of NLP

- **Speech Recognition:** It turns spoken words into text, which allows devices to understand. Example: Voice-to-text typing, voice commands in smart phones.
- **Machine Translation:** It is instant translation of language, bridging communication gaps. It translates text from one language to another. Example: Google Translate.
- **Chatbots and virtual assistants:** It uses NLP to simulate human conversations. It answers user queries automatically. Example: Banking chatbots, customer support bots.
- **Sentiment Analysis:** Detects positive, negative or neutral sentiment. For example, social media posts, reviews or feedback.

- **Content generation:** Involves AI creating new text. For example, write articles, poetry etc.

7.4.3 Large Language Models (LLMs)

Modern NLP systems use Large Language Models (LLMs), such as GPT, which are trained using massive datasets to understand context and generate meaningful responses.

NLP is used in spam detection to analyze email content.

Siri, Alexa, and Google Assistant use NLP to understand spoken commands and respond intelligently.



1. Why is NLP important in human-computer interaction?
2. Name two applications of NLP you use in daily life.
3. What is the role of Large Language Models in NLP?
4. Why is it important to address biases in NLP systems?
5. Define Natural Language Processing.

7.5 Prompt Engineering – Talking to Smart Machines

As AI language models become more common, it is important to know how to communicate effectively with them. Prompt Engineering is the practice of designing clear, precise and effective instructions (called prompts) to get the best responses from AI systems. Think of a prompt as a question or instruction you give to an AI. The quality of the output largely depends on how well the prompt is formulated.

7.5.1 Prompt Engineering

Prompt engineering is important as it directly affects the quality and relevance of the output. AI helps in saving time, improving accuracy and achieving desired results.

Poorly worded prompts can produce irrelevant or incorrect outputs. Example:

Prompt Type	Response Quality
"Write about pollution."	"Vague, may produce a generic response"
"Write five sentences explaining how air pollution affects human health with examples."	"Specific, detailed, relevant response"



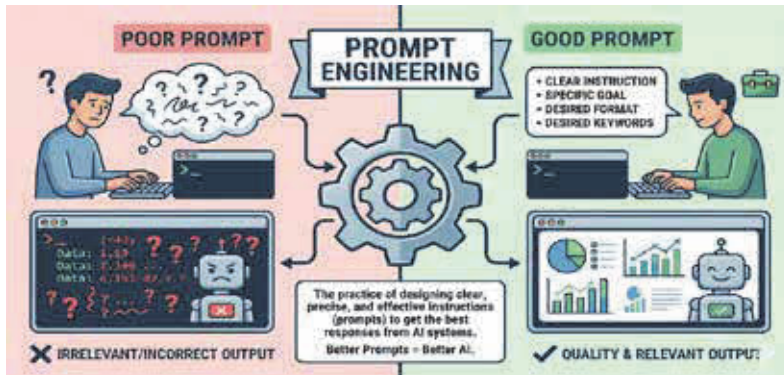


Figure 7.6 - Prompt Engineering Flow

Techniques for Effective Prompting

Be specific: goes beyond clarity, this involves precisely defining the scope and direction of the response you seek. Example: “List three advantages and two disadvantages of AI in education.”

Providing context: can include the background of the task, the target audience, or any prior information the AI needs. Example: “As a teacher, explain how AI can help students improve reading”

Defining output requirements: ensures the AI conforms to specific criteria like the number of words, whether to use bullet points etc. This helps in achieving a polished result.

Example: “Write a 100-word story suitable for class 11 students about robots in space exploration.”

Using examples: is particularly useful for complex tasks or creative content. It demonstrates the desired tone, structure, and detail.

Ethical Guidelines for Prompt Engineering

- Do not ask AI to generate personal or sensitive information.
- Avoid spreading misinformation.
- Do not use AI for harmful or dishonest purposes.
- Promote learning, creativity and responsible use of AI.

7.5.2 Applications for Prompt Engineering

- **Education:** Prompt engineering transforms education by facilitating personalized learning. Designing prompts to explain concepts, summarize content or create quizzes.
- **Content Creation:** Prompt engineering amplifies creative potential by enabling efficient and versatile generation of diverse content- writing articles, blogs, stories or poetry.

- **Programming:** Prompt engineering acts as a powerful tool for code development and comprehension. It generates code snippets or debugging solutions.
- **Data Analysis:** Prompt Engineering is a beneficial tool for optimizing data interpretation and reporting. AI tools can be used to summarize trends or generate visualization from data.



1. What is a prompt?
2. Why is the quality of a prompt important in AI interaction?
3. Mention two ethical principles to follow while using AI tools.
4. How can prompt engineering save time and improve accuracy in tasks?
5. Define Prompt Engineering in your own words.
6. Give an example of an effective prompt.
7. Explain one application of prompt engineering in education.

7.6 Robotics – Machines That Can Act

Robotics is a branch of science and engineering that combines mechanical design, electronics and Artificial Intelligence (AI) to build machines that can sense, decide and act in the real world. Robots can perform repetitive, dangerous or precise tasks, reducing human effort and risk.

To put it simply, a robot is a programmable machine that interacts with its surroundings and acts either fully or partially on its own. Robotics has various applications. In industry, robots are used for manufacturing, assembly and packaging. In medicine, they assist with surgeries, rehabilitation and patient care



Figure 7.7 - Robotic System Components





Robots are also found in exploration, from outer space to deep seas, and even in our homes for cleaning and companionship. They help students to learn coding, AI and automation.

7.6.1 Components of a Robot

A typical robot has three main components:

Sensors: Helps to perceive the environment. They can detect light, heat, sound, motion or pressure.

Eg: Obstacle detection sensors in autonomous vehicle.

Controllers: They can process information and make decisions. Controllers acts as the “brain” of the robot and make use of AI or pre-programmed instructions to decide the next action.

Actuators: Are used to perform movements or actions.

Eg: Motor, wheels, arms or grippers that carry out the robot’s tasks

Optional Components: They include Power supply (battery), communication modules, cameras or additional computing units.

7.6.2 How Robots Work

Sensing: Robots gathers data from sensors.

Processing: Controller interprets data and decides on actions.

Acting: Actuators execute movements or tasks.

Feedback: Sensors continuously provide updated information for adjustments.

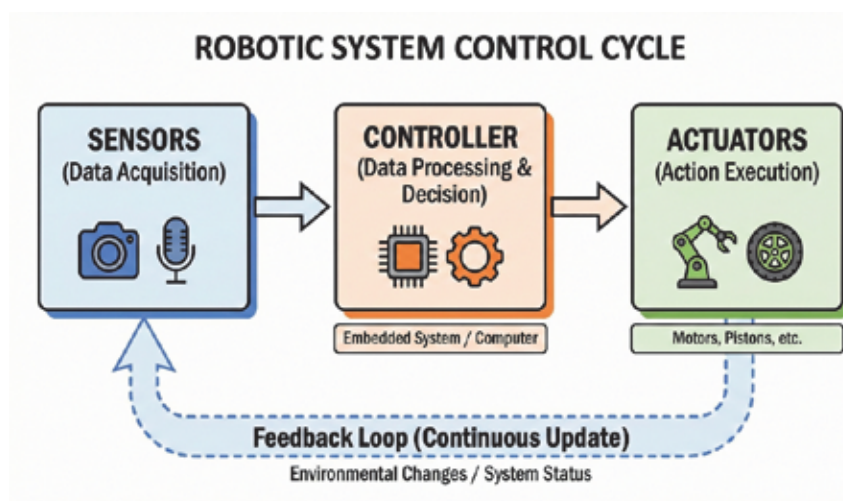


Figure 7.8 - Working cycle of Robots

7.6.3 Applications of Robotics

Manufacturing: Assembly line robots increase efficiency and precision.

Healthcare: Surgical robots assist doctors in delicate operations.

Space Exploration: Robots like NASA's rovers explore distant planets.

Disaster Rescue: Robots enter dangerous zones, e.g., collapsed buildings or nuclear sites.

Education: Robots help students to learn coding, AI and automation.

7.6.4 Ethical Considerations in Robotics

- **Employment Impact:** Automation may replace certain manual jobs.
- **Safety:** Robots must be programmed to avoid harming humans.
- **Responsibility:** Clear accountability for robot actions must be established.
- **Privacy:** Robots equipped with cameras or sensors must respect data privacy.



1. Define Robotics in your own words.
2. What are the three main components of a robot?
3. Name two real-world applications of robots.
4. Mention one ethical concern related to robotics.
5. What is a robot?
6. Identify two robots used in hospitals or factories. Describe their functions and how they improve efficiency.
7. Draw a simple block diagram of a robot showing sensors, controller, and actuators.

7.7 Computer Vision – Helping Machines See

A subfield of artificial intelligence called computer vision (CV) gives computers and other devices the ability to recognize, evaluate, and comprehend visual data from the outside world, including pictures and videos. Computer vision enables machines to “see” and comprehend their environment, much like humans do with their eyes.



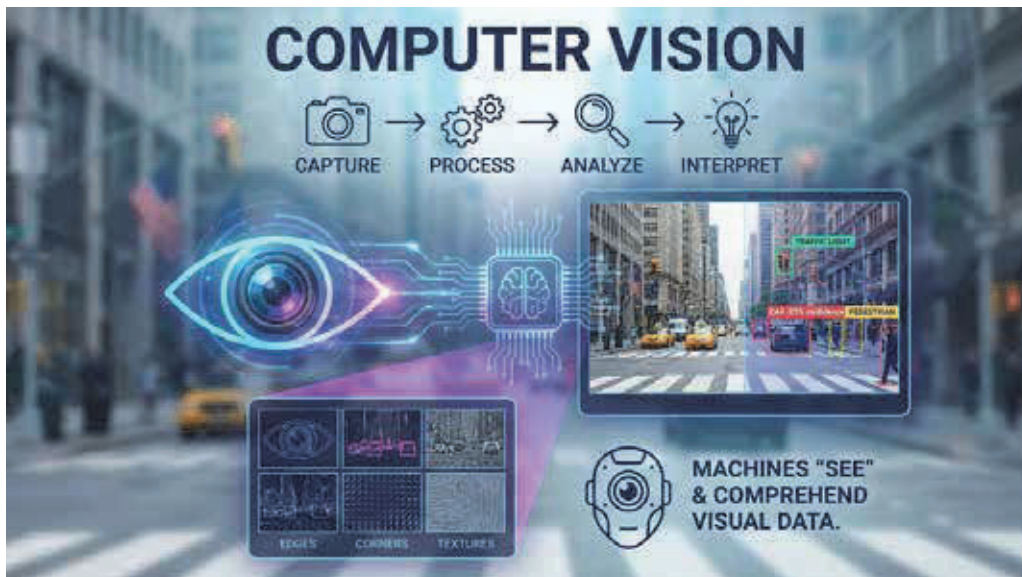


Figure 7.9 - Computer Vision Process Diagram

7.7.1 Computer Vision

Computer vision enables computers to interpret and understand the visual world. It involves capturing, processing and analyzing images and videos. This works by extracting features from visual data like edges, corners or textures and then using these to identify objects, recognize patterns or track movement.

Image Acquisition: Computer captures images using cameras or sensors.

Pre-processing: Cleans the image removing noise or adjusting brightness.

Feature extraction: Identifies important characteristics like edges, corners or textures.

Recognition and classification: Use these features to identify objects or patterns.

Decision making: Uses the results to perform tasks like guiding a robot or flagging something.

Example:

A smart phone camera detecting a face to unlock the device. The camera captures the image, identifies facial features, compares it with stored data and unlocks the phone if it matches.

7.7.2 Applications of Computer Vision

Medical Imaging: Detecting tumors, fractures or anomalies in X-rays, MRI, and CT scans.

Autonomous Vehicles: Self-driving cars detect obstacles, lane markings and traffic signs.

Security Systems: Face recognition for surveillance and access control.

Industrial Quality Control: Inspecting products on production lines for defects.

Agriculture: Monitoring crops, identifying diseased plants and estimating fruit ripeness.

7.7.3 Challenges and Ethical Considerations

Privacy: Surveillance cameras and facial recognition may intrude on personal privacy.

Bias: Misidentification may occur if the system is trained on non-diverse datasets.

Safety: Autonomous vehicles rely on accurate computer vision to avoid accidents.



1. What is computer vision and why is it important?
2. Name two practical applications of computer vision.
3. Why should privacy and fairness be considered when using computer vision systems?
4. How does computer vision impact healthcare and agriculture?
5. Describe a mini example of computer vision in action.
6. Find two applications of computer vision in daily life. Describe how they help humans.
7. What precautions should be taken to use computer vision ethically? Discuss in groups.

7.8 AI in Education - Personalized Learning

Artificial Intelligence is changing the way education is delivered by providing tools that adapt to the needs of each learner. Traditional teaching methods often follow a one-size-fits-all approach, but AI enables personalized learning, making education more effective and engaging. Personalized learning means that educational tools analyze a student's strengths, weaknesses, learning pace and style and then suggest exercises, lessons or resources tailored specifically for that student.





7.8.1 Applications of AI in Education

1. **Adaptive Learning Platforms:** AI systems analyze student performance, adjusting pace and difficulty to maximize engagement and learning outcomes. Example: Khan Academy suggests lessons based on prior quiz performance.

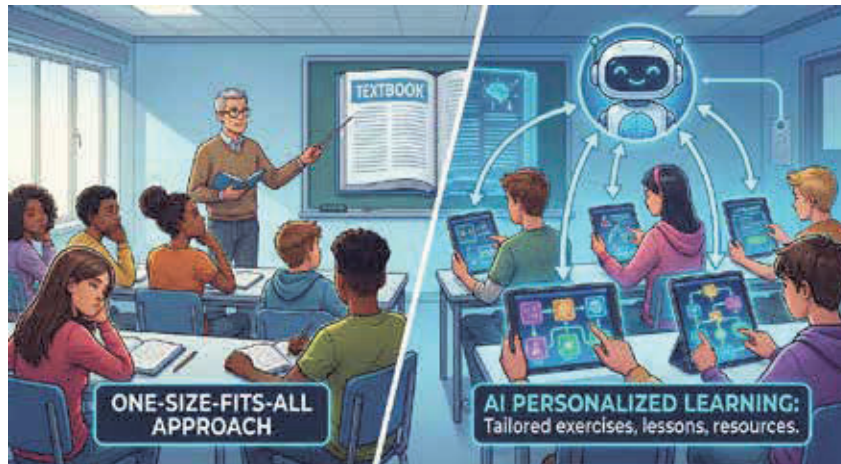


Figure 7.10 - AI in Education

2. **Digital tutors and chatbots:** It offers instant feedback and personalized assistance, acting as constant learning companions. Can guide students through complex topics without waiting for teacher intervention.
3. **Learning Analytics:** It utilizes data to assess student performance. AI tracks student progress over time, highlighting areas needing improvement. Teachers receive insights to design customized teaching strategies.
4. **Automated Grading:** It streamlines the evaluation process, saving time for educators. AI can grade assignments and quizzes, reducing teacher workload.
5. **Inclusive education:** It is enhanced through AI tools that provide accessibility support, ensure student participation, and assist students with disabilities through voice recognition, text to speech or visual aids.

7.8.2 Role of Teachers in AI-Enabled Classrooms

In AI-enabled classrooms, teachers play a multifaceted role. They become facilitators, guiding students through personalized learning paths that AI suggests. They also focus on critical thinking, creativity and social skills, areas where human interaction is invaluable.

Teachers remain central to the learning process.

AI supports them by providing insights, saving time on repetitive tasks, and offering personalized content.

Teachers guide, mentor and motivate students while monitoring ethical use of AI tools.

Ethical Considerations

- **Data Privacy:** Student information must be protected.
- **Transparency:** Students should understand how AI tools make recommendations.
- **Equity:** Ensure AI systems do not favor certain groups over others.



1. How does AI support personalized learning?
2. What is the role of teachers in an AI-powered classroom?
3. Name one ethical concern while using AI in education.
4. Give an example of AI helping students with disabilities.
5. Explain how AI supports personalized learning.
6. Give one example of an AI application that helps students learn at their own pace.
7. List three ways AI can help you learn better in school.
8. Discuss how AI could help a teacher identify students who need extra help in a particular subject.
9. Suggest one AI tool or app that can make learning personalized.

7.9 Voice Assistants – Talking to AI

AI programs known as voice assistants are able to comprehend and react to spoken instructions. They do things like play music, set reminders, answer questions and control smart devices by combining speech recognition, Natural Language Processing (NLP) and cloud-based AI services.

Particularly for those with disabilities or those who would rather speak than type, voice assistants increase the accessibility, interactivity and convenience of technology.





Figure 7.11 - Voice Assistant Technology

7.9.1 How voice assistants work

Speech Recognition: It is the process where voice is converted into text. This allows the assistant to understand what you are saying.

Natural Language Processing: Helps the AI to interpret the meaning of text, considering context. AI understands the meaning and intent behind the words.

Decision Making: Happens where the assistant determines the most appropriate response or action to take on request.

Response generation: Takes place, creating a clear and personalized response. It provides spoken or written feedback.

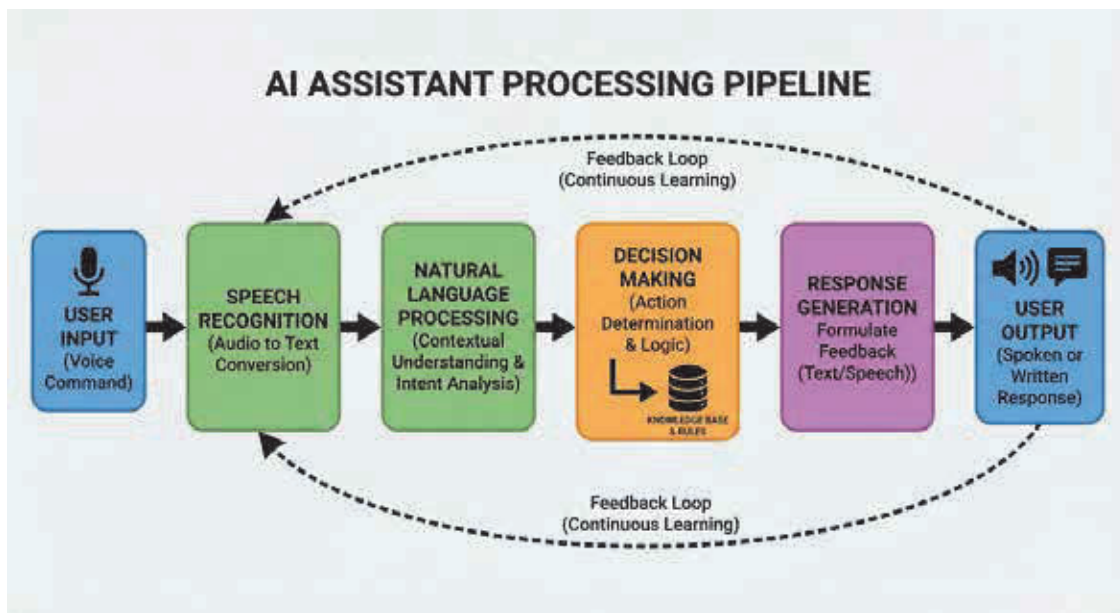


Figure 7.12 - Voice Assistant Processing

Example:

When you say, “Hey Siri, what’s the weather today?”, Siri converts your speech into text. Then it Analyses the query to understand that you want the weather report. Next it fetches weather data from the internet and finally responds aloud with, “Today’s temperature is 28°C”.

7.9.2 Applications of Voice Assistants

Voice assistants are commonly used on smart phones to perform tasks like setting alarms, sending messages or checking the weather. In smart homes, they enable controlling devices like lights, thermostats and entertainment systems hands-free. In healthcare, they can provide medication reminders, offer basic health information or assist with patient monitoring.

For navigation, voice assistants help with direction, real time traffic updates and finding points of interest. Productivity enables task management scheduling and quick information retrieval, setting alarms, reminders, creating calendar events or sending messages.

1. **Smart phones and Smart Homes:** Controlling lights, fans, thermostats or security systems using voice.
2. **Healthcare:** Assisting elderly or differently-abled individuals to set reminders or call for help
3. **Navigation:** Voice commands in GPS systems to find routes and traffic updates.
4. **Productivity:** Setting alarms, reminders, creating calendar events or sending messages.

Case Study:

Alexa, Amazon’s voice assistant, allows users to shop online, play music, and control smart home devices simply through voice commands. Over time, Alexa learns user preferences, making interactions faster and more personalized.

Advantages of Voice Assistants

- **Accessibility:** Helps people with disabilities interact with technology.
- **Convenience:** Tasks can be completed hands-free.
- **Learning Support:** Assists students with research and information retrieval.





Limitations and Ethical Considerations

- **Understanding Accents:** Voice assistants may misinterpret unfamiliar accents or dialects.
- **Privacy:** Recording and storing voice data may lead to privacy concerns.
- **Dependency:** Over-reliance may reduce critical thinking and problem-solving skills.



1. What is a voice assistant?
2. Name two examples of voice assistants.
3. Mention one advantage and one limitation of using voice assistants.
4. How do voice assistants combine AI technologies to function?
5. Define a voice assistant in your own words.
6. Describe one limitation or challenge of voice assistants.
7. List three voice assistants you have used or heard of and describe one feature of each.
8. Discuss in pairs: How can voice assistants be used safely without compromising privacy?
9. Design a simple task that a voice assistant could help you complete at home or school.

Summary

Machines can now carry out tasks that previously required human intelligence thanks to the groundbreaking technology known as Artificial Intelligence (AI). AI is changing how we live, work and learn, from using machine learning to identify patterns in data to use neural networks to simulate the human brain.

Computers can now comprehend and produce human language thanks to Natural Language Processing (NLP) and Prompt Engineering, which improves accessibility and ease of use in interactions. While voice assistants offer hands-free assistance in daily life, robotics and computer vision bring artificial intelligence (AI) into the physical world by enabling machines to sense, analyze and act.

AI in education promotes individualized instruction, giving students more agency and supporting educators with insights and tailored materials. But in addition to all of its advantages, AI also presents moral and societal issues like privacy, equity, and responsible use.

As we move forward, understanding AI, using it ethically, and leveraging its potential for creativity, innovation and problem-solving will be essential for students and society.

AI is no longer just a concept of science fiction—it is a practical, transformative force shaping the present and future of human life.



1. The ability of machines to perform tasks requiring human intelligence is called:
a) Programming b) Artificial Intelligence
c) Automation d) Machine Learning
2. Who is considered the father of Artificial Intelligence?
a) John McCarthy b) Alan Turing c) Isaac Newton d) Ada Lovelace
3. In supervised learning, the training data is:
a) Unlabeled b) Labeled c) Random d) Structured
4. Which layer of a neural network processes the input and performs computations?
a) Input layer b) Hidden layer c) Output layer d) Sensor layer
5. NLP helps computers to:
a) Recognize images b) Process human language
c) Control motors d) Store files
6. Which of the following is a key component of a robot?
a) Sensor b) Controller c) Actuator d) All of the above
7. Computer Vision is used in
a) Medical imaging b) Self-driving cars
c) Security surveillance d) All of the above
8. Large Language Models (LLMs) are used to
a) Generate meaningful text b) Train robots
c) Recognize images d) Detect motion
9. Voice assistants combine
a) NLP and speech recognition b) Robotics and actuators
c) Neural networks and sensors d) Machine translation and parsing





10. AI in education can provide
 - a) One-size-fits-all learning
 - b) Personalized learning
 - c) Only printed textbooks
 - d) Physical classrooms only
11. Define Artificial Intelligence with two examples from daily life.
12. Explain the difference between supervised and unsupervised learning.
13. What is an Artificial Neural Network? Name its three main layers.
14. Describe Natural Language Processing (NLP) and give two applications.
15. Explain what a prompt is and give an example of effective prompt engineering.
16. What are the three main components of a robot?
17. Define Computer Vision and give two examples of its applications.
18. How does AI support personalized learning in classrooms?
19. What is a voice assistant? Give two examples and one advantage of using it.
20. Name two ethical considerations while using AI systems.
21. Discuss how AI can create opportunities as well as challenges in society. Provide examples.
22. Design a simple AI-based idea for your school or community. Mention the data it would need and how it would help.
23. Do you think AI will ever replace teachers? Justify your answer with reasons.
24. Imagine you are designing a voice assistant for a multilingual region. How would you ensure it understands different languages and dialects effectively?
25. A factory wants to implement robotics for quality control. What ethical, safety, and efficiency factors should be considered?
26. Explain how Large Language Models could be misused. Suggest measures to prevent misuse.
27. How can AI help in agriculture using Computer Vision? Describe a practical scenario.
28. Compare and contrast Machine Learning and traditional programming in terms of adaptability and decision-making.
29. Discuss one scenario where improper prompt engineering could lead to wrong AI outputs. Suggest how to correct it.
30. Evaluate the impact of AI on accessibility for people with disabilities in education and daily life.
31. Interact with a chatbot or voice assistant. Write three questions and evaluate the responses.

32. Draw a simple block diagram of a robot showing sensors, controllers, and actuators.
33. Identify one AI application in healthcare, education, or agriculture and explain how it works.
34. Write two prompts for an AI model one vague and one specific. Compare the outputs and analyze the differences.
35. Discuss in groups how AI can be used ethically to improve environmental monitoring.