Test Edition

Based on
New Sindh Curriculum
2023-24

The Textbook of Computer Education

For Class VIII

Sindh Textbook Board

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Computer Education

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Prepared by **SINDH TEXTBOOK, BOARD, JAMSHORO.**
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PREFACE

The century we have stepped in, is the century of Science and technology. The modern disciplines of Technology are strongly influencing not only all the branches of science but each and every aspect of human life.

To keep the students abreast with the recent knowledge; it is must that the curricula at all the levels be updated. Moreover regularly by introducing the rapid and multidirectional development taking place in all the branches of Science.

The recent book of Computer Education for Class VIII has been written in this preview and in accordance with the revised curriculum. Prepared by Ministry of Education, Govt of Sindh. Reviewed by independent team of Directorate of Curriculum Assessment and Research, Jamshoro Sindh. Keeping in view the importance of Computer Science, the topics have been revised and re-written according to the need of the time.

Among the new editions the introductory paragraphs, information boxes, summaries and a variety of extensive exercises have been included. Which I think will not only develop the interest but also add a lot to the utility of the book.

The Sind Textbook Board has taken great pains and incurred expenditure in publishing this book inspite to its limitations. A textbook is indeed not the last word and there is always room for improvement. While the authors have tried their level best to make the most suitable presentation, both in terms of concept and treatment. There may still have some deficiencies and omissions. Learned teachers and worthy students are therefore requested to be kind enough to point out the short comings of the text or pictures and to communicate their suggestions and objections for the improvement of the next edition of this book.

In the end, I am thankful to our Authors, Editors and Subject specialist of Board for their relentless service rendered for the cause of education.

Chairman
Sindh Textbook Board

Chapter 1

ICT Fundamental

Student Learning Outcomes (SLOs):

By the end of this unit, students will be able to:

- Explain and analyze how emerging technologies, including Artificial Intelligence (AI), 5G, robotics, computer-assisted translation, 3D and holographic imaging, virtual reality, distributed applications, blockchain, and machine learning, are applied across various fields and industries. They will gain insights into the unique roles and impact of each technology in everyday life and professional contexts.
- Identify the structure and purpose of a network and analyze its core components, including routers, switches, and hubs.
- Describe Software Networking component with reference to their use.
- Recognize and understand the network security issues including firewall and its application.

1.1 Introduction to Unit:

Information and Communication Technology (ICT) is a key part of our daily lives, helping us at home, school, and work. This unit will teach students how ICT makes tasks simpler, such as using computers and the internet. Students will also discover exciting topics like Artificial Intelligence (AI), the Internet of Things (IoT), and emerging technologies. By the end of the unit, they will learn to use technology smartly and think of innovative ideas for the future.

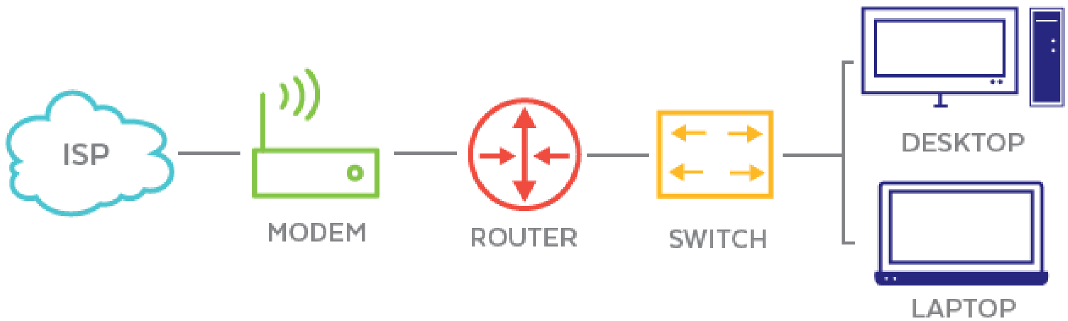


Fig 1.1 Network Diagram

1.2 Impact of Emerging Technologies:

Emerging Technologies are new advancements in information and communication technology (ICT) that improve how we live, work, and learn. They make everyday tasks easier and more efficient.

1.2.1 Internet of Things (IoT):

The Internet of Things (IoT) is a system where everyday devices are connected to the internet. These devices can talk to each other and be controlled remotely.

Examples:

- **Refrigerators:** A smart fridge can tell you what food items you need to buy and even order them online.

- **Cars:** Modern cars can use the internet to provide navigation help, detect maintenance issues, and even drive themselves in some cases.

- **Air Conditioners:** You can adjust the temperature of your home using your phone, even when you're not there.

IoT makes devices smarter and more convenient, allowing for better control and automation in our daily lives.

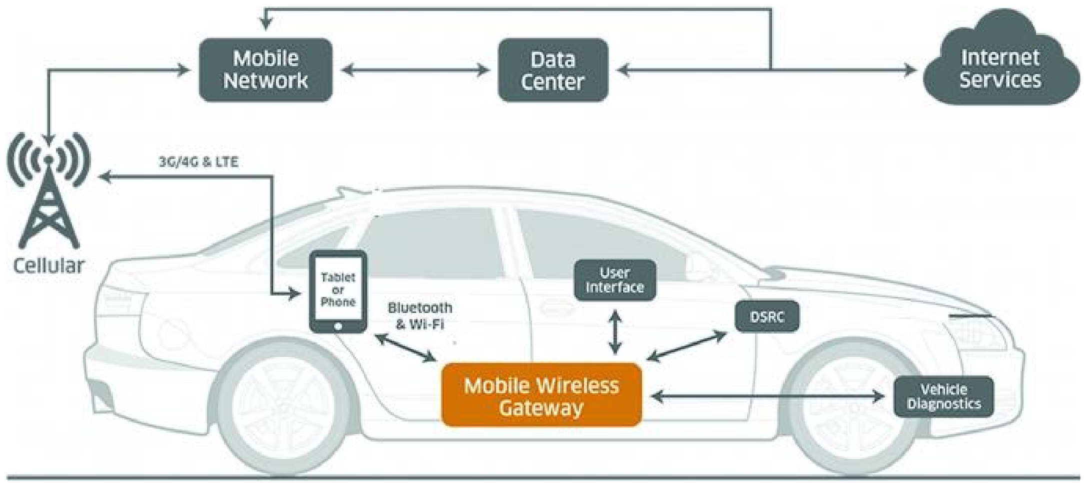


Fig 1.2.1 Connected car system

1.2.2 Embedded Systems:

An embedded system is a small computer inside a larger device, designed to perform one specific task. These systems are found in many everyday items and help them run smoothly.

Examples:

- **Cars:** Embedded systems control things like the engine, airbags, and entertainment systems.
- **Home Appliances:** Washing machines and refrigerators use embedded systems to set timers and keep temperatures just right.
- **Medical Equipment:** Devices like MRI machines and heart monitors rely on embedded systems to work accurately.
- **Phones and Internet:** Networking devices use embedded systems to manage data and communication.

- **Military Equipment:** Drones and navigation systems are controlled by embedded systems.

Embedded systems make these devices more efficient and reliable.

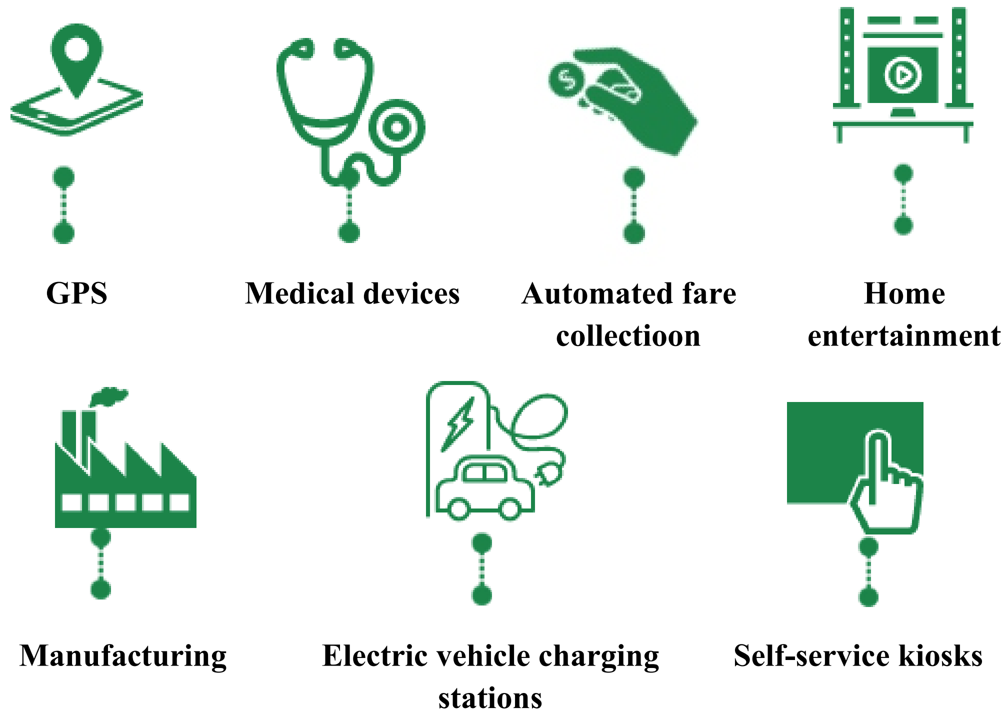


Fig 1.2.3 Applications of Embedded Systems

1.2.3 Edge Computing:

Edge computing is like having a mini-computer close to the device or sensor where data is generated. Normally, data is sent to a centralized system, a remote server that handles it. While it is effective but system can be slow due to long data travel distances. Edge computing solves this by processing data locally, making the system faster and more efficient.

Edge computing in cars helps to detect the traffic in real-time and quickly suggests a faster route quickly to avoid heavy traffic. It can also detect a train at a crossing and updates your navigation app to suggest a faster route.

The image highlights that computation takes place close to the devices means processing data directly on devices like cars, smartphones, or laptops instead of sending it to a central server. This makes the system faster and more efficient.

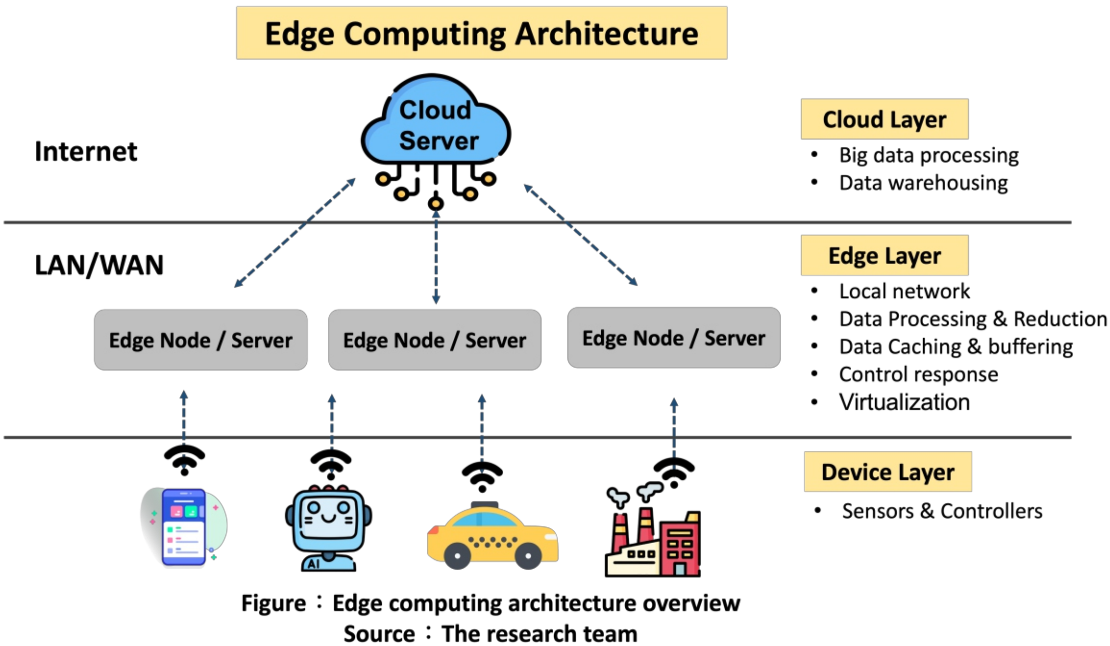


Fig 1.2.4 Edge Computing

1.2.4 5G Technology:

A **Cellular network** is a system of towers and antennas that provide wireless communication services, like mobile phone calls and internet access. 5G is the 5th generation of cellular network technology developed to make telecommunication networks faster.

With 5G, users can experience high-speed internet, which means faster mobile phone service, quicker downloads, and better connectivity between many devices. This improved speed and connectivity are helping to advance societies and enhance everyday experiences.

Example: With **5G**, you can stream a **1080p** YouTube video without buffering, offering smooth playback and high-quality resolution, unlike slower networks like 4G.

1.2.5 Artificial Intelligence:

AI can solve complex, real-world problems. Here's an explanation of each key problem AI addresses:

Decision-making: AI helps systems make decisions based on data. For example, self-driving cars use AI to make decisions about when to stop, go, or turn, just like a human driver would.

Learning: AI can learn from past experiences or data, similar to how humans learn. For instance, AI can improve its performance in a game by analyzing previous moves and adapting to new strategies.

Problem-solving: AI is used to find solutions to problems that are too complex or time-consuming for humans. For example, AI is used in medicine to analyze large amounts of patient data to diagnose diseases more accurately.

These capabilities allow AI to tackle challenges in fields like healthcare, finance, transportation, and more.

1.2.6 Robotics:

Robotics is a field of study within engineering and computer science that focuses on the design, construction, operation, and use of robots.

Robots are machines programmed to carry out specific actions, and they can work automatically or be controlled remotely. For example, in automobile manufacturing, robots are used to assemble car parts with high precision, making the process faster and safer.

Robots are used in areas like packaging, laboratory research, and home cleaning.

1.2.7 Distributed Applications:

Distributed Applications are programs that run on multiple computers at the same time to complete a task. This helps to distribute the work across several machines for processing, without overloading the single computer system.

For example, in **online banking**, several servers work together to process transactions. Similarly, **social networks** use distributed applications to manage data and posts, while **cellular networks** and **supermarket check-out systems** also rely on multiple computers to function smoothly.

Activity:

1. Can you think of an example where you've used an app that might involve distributed applications?
2. How would a distributed application help if a website had millions of users at once?

1.2.8 Blockchain Technology:

Blockchain is a system where information is stored in blocks that are linked together in a chain. Once information is added to a block, it cannot be changed or deleted. These blocks are connected to each other, forming a chain, which is known as a blockchain.

Blockchain is a type of database that ensures secure storage of digital information. It is commonly used in banks and financial services to record and share data securely, such as transactions. This technology helps to keep the information safe from tampering or unauthorized access.

Quick Tip:

Quick Tip: Blockchain ensures data security and transparency, making it ideal for use in industries like banking, where trust and accuracy are essential.

1.2.9 3D and Holographic Imaging:

3D and Laser Beam Technology uses laser beams to create three-dimensional images called holograms. These holograms look like real objects or animations, but they are digital projections created using laser light.

In **3D Holographic Imaging**, the hologram floats in space. Viewers can walk around it and see it from all angles, just like a real object. This technology is used in areas like entertainment, education, and advertising to create cool and interactive experiences.

Important: 3D means images that have depth, width, and height, while laser beams are focused light that help make clear and bright holograms. Together, they make virtual objects look real in space.

1.2.10 Virtual Reality:

Virtual Reality is a technology that makes computer-generated worlds that look and feel real. It creates a completely fake environment that users can interact with. To experience virtual reality, users usually wear special helmets or goggles. Examples include video games and flight simulators, where users can explore and interact with a virtual world.

How it helps: Virtual reality helps in training, education, and entertainment by allowing users to practice skills in a safe, controlled environment or explore things they can't do in real life.
Fun Fact: Virtual reality lets you step into a whole new world, even though it's all made by a computer!

1.2.11 Computer-Assisted Translation (CAT):

Computer-Assisted Translation (CAT) is the use of computer software to help translate text from one language to another. This software ensures consistency across translations and helps reduce costs.
Computer-Assisted Translation (CAT) helps in education, literature, and personal tasks, improving translation speed and consistency. It’s useful for students, writers, and organizations working with different communities.

Translation Memory (TM): CAT tools store previously translated text so they can reuse it later, helping keep translations consistent.

1.2.12 Data Analytics:

Data Analytics is the process of looking at large amounts of data to find patterns and trends. This helps people understand the information better and make decisions based on it.

It is used in many fields like education, healthcare, finance, and manufacturing. By analyzing data, organizations can improve their processes, predict future trends, and make smarter choices.

Activity:

Students can survey their classmates about their favorite food. If many students choose biryani, they can decide to serve biryani at the annual day event. This shows how data helps in making decisions!

1.2.13 Machine Learning:

Machine learning is a part of artificial intelligence (AI) that helps computers learn from data. Instead of being told what to do, the computer looks at past data and makes decisions or predictions based on that information.

Examples of machine learning include things like recognizing speech or images, translating languages, self-driving cars, Google Maps, and filtering out harmful software (malware). These applications use data to make tasks smarter and more efficient.

Table 1: The basic difference between "***Artificial Intelligence***" and "***Machine Learning***"

Aspect	Artificial Intelligence (AI)	Machine Learning (ML)
Meaning	Making machines smart to do tasks like humans.	Teaching machines to learn from data.
Focus	Solving problems and making decisions.	Learning patterns from past data.
Examples	Siri, chatbots, recommendation systems.	Self-driving cars, spam filters, image recognition.

1.3 Computer Network:

1.3.1 Basic Terms of Network & Networking

Network:

A computer network is a system where ICT (Information and Communication Technology) devices are connected to share resources such as hardware (printers, storage) and software (applications). It enables communication and efficient data sharing.

Networking:

Computer networking is the process of connecting two or more computing devices to share data, resources, and services. It enables communication between devices like computers, servers, smartphones, and other hardware over wired or wireless connections.

1.3.2 Data Communication:

This is the process of exchanging information between devices in a network. For communication to happen, certain components are involved:

Sender: The person or device starting the communication.
Message: The information that is sent.
Medium: The path through which the message travels (e.g., cables, Wi-Fi).
Receiver: The person or device that receives the message.
Protocol: Protocols are a set of rules that ensure the sender and receiver communicate properly. Without protocols, devices wouldn't understand each other's messages.

1.3.3 Client-Server Architecture:

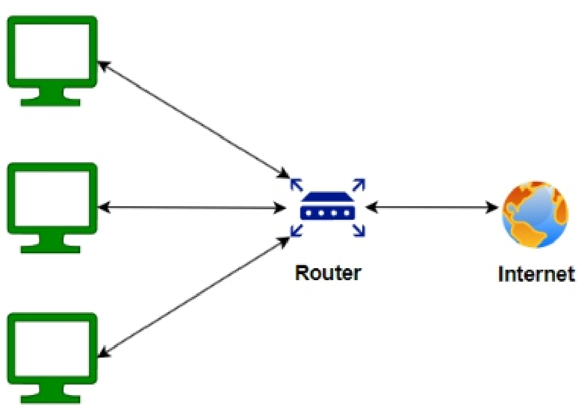
In a network, this architecture describes how devices communicate and share services:

- **Client:**
  A device or computer that requests services or data from a server. For example, when a student uses a computer in a school to access the school's online portal, the computer (the client) sends a request to the school's server.
- **Server:**
  A device or computer that provides the requested services or data to the client. In this case, the school's server processes the student's request and provides access to services such as class schedules, grades, or assignments.

1.3.4 Types of Computer Networks:

1.3.4.1 Local Area Network (LAN):

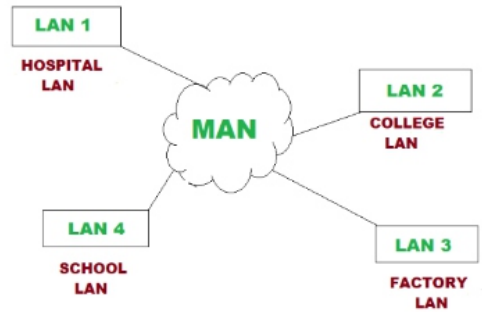
A **Local Area Network (LAN)** is a network of ICT devices connected within a small geographical area, such as a school, residence, or laboratory. It allows devices within that area to share resources like files, printers, and internet access. LANs typically provide fast and secure communication due to their limited size and scope.



Local Area Network - LAN

1.3.4.2 Metropolitan Area Network (MAN):

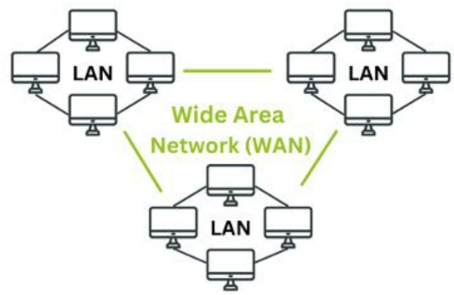
A **Metropolitan Area Network (MAN)** is a network that spans a larger geographical area than a LAN, but smaller than a WAN. It typically covers a city or a university campus with multiple buildings. MANs allow for the connection and communication between various LANs in a specific region.



Metropolitan Area Network - MAN

1.3.4.3 Wide Area Network (WAN):

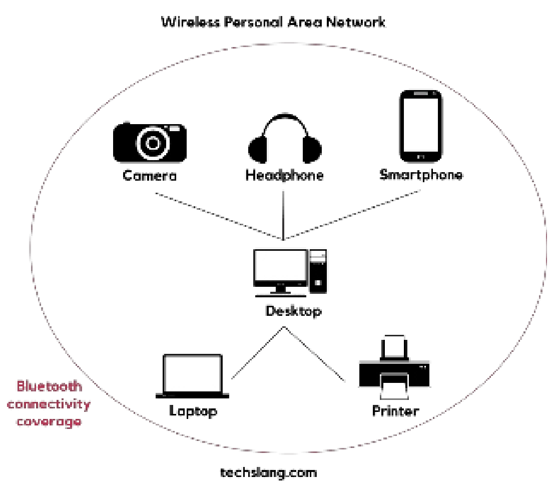
A **Wide Area Network (WAN)** is a large network of ICT devices that connects different smaller networks, including Local Area Networks (LANs), over a wide geographical area. WANs allow for communication between devices in different cities, countries, or even continents. An example of a WAN is a banking system that connects branches in multiple locations to share data.



Wide Area Network - WAN

1.3.4.4 Personal Area Network (PAN):

A **Personal Area Network (PAN)** is a network of electronic devices that connects within an individual's workspace. These devices typically communicate wirelessly and over short distances, typically less than 10 meters. PANs are commonly used to connect devices like smartphones, laptops, and Bluetooth-enabled devices.



Personal Area Network - PAN

1.3.4.5 Virtual Private Network (VPN):

A **Virtual Private Network (VPN)** allows users to securely connect to the internet by creating a private network over a public network. It encrypts the user's data and helps maintain privacy when accessing the internet. An example of a VPN is the secure connection between an ATM and the bank's central server.

Virtual Private Network - VPN

1.3.5 Software Networking Components and Their Uses:

1.3.5.1 Network Protocols:

In a data communication system, protocols play an essential role as they define the set of rules that both the sender and receiver follow to ensure effective communication and understanding of the transmitted data.

Example: TCP/IP (Transmission Control Protocol/Internet Protocol) is a common protocol that governs how data packets are transmitted over the internet, ensuring they reach the correct destination reliably.

1.3.5.2 Network Operating System (NOS):

In the client-server architecture, the server is a dedicated system that hosts and manages resources such as data, applications, and services. This often includes a Network Operating System (NOS) to manage network resources and services efficiently.

Example: Windows Server is a popular NOS that provides services like file sharing, printer management, and user authentication in business environments.

1.3.5.3 Network Management Software:

Is critical for monitoring, managing, and troubleshooting a network, ensuring it operates smoothly and securely.

Example: Solar Winds Network Performance Monitor is widely used software that helps IT teams monitor network performance, identify issues, and optimize resources effectively.

1.3.6 Hardware Networking Components and Their Uses:

1.3.6.1 NIC (Network Interface Card):

A NIC is a hardware component installed in devices like computers and printers, allowing them to connect to a network. It handles the sending and receiving of data within the network.

1.3.6.2 Modem:

A combined device for **modulation** and **demodulation** is called modem. A modem converts digital signals from a computer into analog signals for transmission over telephone or cable lines, enabling internet access. It also demodulates incoming analog signals back into digital form for the computer to process.

1.3.6.3 Hub:

A hub is a basic device used to connect multiple computers in a network. It sends data to all connected devices, which can reduce network efficiency as every device receives all the data, even if it's not intended for them.

1.3.6.4 Switch:

A switch is more advanced than a hub and connects multiple devices within a local area network (LAN). Unlike a hub, it sends data only to the specific device it is meant for, improving network performance and efficiency.

1.3.6.5 Router:

A router connects different networks, such as your home network to the internet. It directs data packets to their correct destination, ensuring that information reaches the right place.

1.3.6.6 Gateway:

A gateway serves as a bridge between two networks with different protocols, such as connecting a home network to the internet. It translates data formats so that communication between the networks is possible.

1.3.6.7 Access Point:

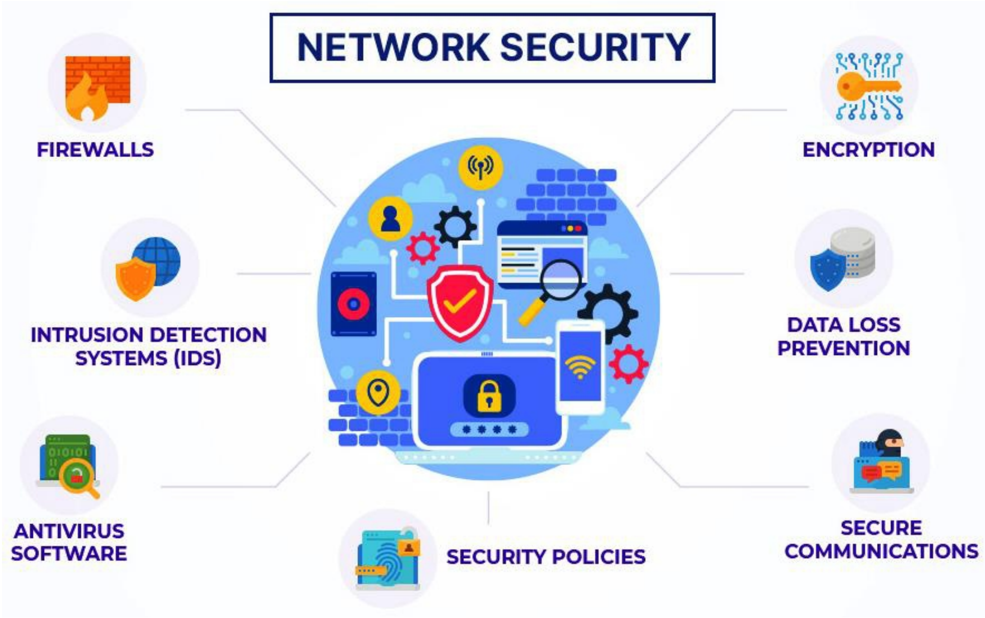
An access point creates a wireless network by allowing Wi-Fi-enabled devices, like laptops and smartphones, to connect to a wired network. It provides wireless access to the internet or other network resources.

1.3.7 Network Security Issues:

Network security is the practice of protecting a computer network from threats and unauthorized access by using tools like firewalls, encryption, and antivirus software to keep data and devices safe from cyberattacks.

1.3.7.1 Unauthorized Access:

When someone gains access to your network without permission, they can steal sensitive information, install malicious software, or disrupt services. Strong passwords, two-factor authentication, and regular software updates can help prevent unauthorized access.



1.3.7.2 Broken Components:

Broken components can lead to data loss or corruption. In a network, they can cause disruptions in communication between devices, making it difficult to access necessary resources. Regularly checking and maintaining network infrastructure can help avoid broken resources.

1.3.7.3 Viruses and Malware:

A virus or malware infection on one device can quickly spread to other devices on the network, causing widespread damage. Using robust antivirus software, practicing safe browsing habits, and being cautious with email attachments and downloads can help protect against these threats.

1.3.8 Firewalls and its Application:

Windows Firewall is a utility software that helps protect your computer by blocking harmful traffic and allowing safe connections. It acts as a security system that monitors and controls the flow of data in and out of a network, based on predefined security rules.

1.3.8.1 Applications of Firewalls:

- **Home Networks:** Protect personal devices from external threats.
- **Corporate Networks:** Secure sensitive company data and control employee internet usage.
- **Cloud Services:** Secure cloud-based applications and data from unauthorized access.

Example:

Windows operating systems have built-in security features to help protect users from online threats. One of the key security components is **Windows Firewall**, which is an essential tool for safeguarding your computer from malicious attacks.

1.3.9 Emerging Technologies in Network:

Emerging technologies in networking refer to new and advanced innovations that enhance the design, management, and security of networks. Technologies like 5G, IoT, and edge computing aim to make networks faster, more flexible, and efficient, meeting the increasing demand for data and connectivity.

1.3.9.1 5G Networks:

5G technology enhances network connectivity by providing faster data speeds, lower latency, and the ability to connect a vast number of devices simultaneously. This improvement supports more efficient communication and data transfer within a network.

- **High-Speed Internet:** 5G networks can handle more data at higher speeds, allowing for smoother streaming, quicker downloads, and better overall performance for all connected devices.
- **IoT Integration:** With 5G, the increased bandwidth and connectivity support a larger number of IoT devices, making it easier to manage and control them within a network.

1.3.9.2 Internet of Things (IoT):

The IoT creates a network of interconnected devices that communicate and share data. This allows for:

- **Automation and Efficiency:** IoT devices can perform tasks automatically and more efficiently, such as smart thermostats adjusting the temperature based on your preferences or smart fridges monitoring food supplies.

- **Enhanced Connectivity:** IoT devices use the network to exchange data and receive commands, enhancing their functionality and usability. For instance, a smart home network can connect lights, security cameras, and appliances, allowing them to work together seamlessly.

1.3.9.3 Edge Computing:

Edge computing processes data closer to where it is generated, reducing the need for data to travel long distances to centralized data centers. This approach benefits networks by:

- **Reduced Latency:** By processing data locally, edge computing minimizes the delay in data transmission, leading to quicker responses and real-time data analysis. This is crucial for applications like autonomous vehicles and smart traffic systems.

- **Efficient Bandwidth Usage:** Edge computing decreases the amount of data sent over the network, saving bandwidth and reducing congestion. This makes the network more efficient, particularly in environments with a high volume of data, like smart cities or industrial IoT setups.

Summary

- **Network** is connection of multiple devices to share data and resources.
- **Routers**: Devices that direct internet traffic between different networks.
- **Switches**: Devices that connect multiple devices within the same local network.
- **Modems**: Devices that convert digital data into analog signals for transmission and vice versa.
- **Network Interface Cards (NICs)**: Hardware components that allow devices to connect to a network.
- **Firewalls**: Security devices that monitor and control incoming and outgoing network traffic.
- **Fifth Generation (5G)**: A new wireless technology providing faster speeds and enhanced connectivity for mobile devices.
- **Internet of Things (IoT)**: A network of interconnected devices that can exchange data with each other.

- **Edge Computing**: A distributed computing framework that processes data closer to the source, reducing latency.
- **Artificial Intelligence (AI) and Machine Learning (ML)**: Technologies that allow machines to analyze data, make decisions, and improve over time.
- **Blockchain**: A secure, decentralized system used for recording transactions and managing data.

Exercise

1. Encircle the correct answers.

i. 5G technology improves network connectivity by providing:
a) Slower data speeds
b) Lower bandwidth
c) Faster data speeds and lower latency
d) Reduced number of devices connected

ii. IoT (Internet of Things) enables devices to:
a) work separately
b) connect and share data
c) only work on their own
d) do not need internet

iii. Main purpose of edge computing is:
a) To process data at a far distance
b) To process data closer to where it is generated
c) To reduce network speeds
d) To store data in the cloud

iv. In network, router:
a) connects devices within the local network
b) connects different networks and directs data to the correct destination
c) increases internet speed
d) connects wireless devices to the network

v. The main role of a firewall in network security is:
a) To block internet access
b) To monitor and control incoming and outgoing network traffic
c) To prevent data from being shared
d) To improve data transfer speeds

vi. The main feature of IoT devices in a network is that:
a) They are isolated from other devices
b) They exchange data and commands with other devices
c) They require manual operation
d) They cannot connect to the internet

vii. The following is a result of broken resources in a network?
a) Increased speed
b) Data loss or corruption
c) Improved communication between devices
d) Secure access to resources

viii. In the network, edge computing helps reduce:
a) Latency
b) Device connectivity
c) Bandwidth usage
d) Internet access

ix. 5G helps IoT devices by providing higher speeds and better connectivity for more:
a) devices connected
b) Networks
c) speed
d) data transfer

x. In a network, devices communicate more efficiently through:
a) Hub
b) Router
c) Switch
d) Modem

2. Fill in the blanks with appropriate words.

i. ________ technology enables faster data speeds and lower latency, improving connectivity for a variety of devices.
ii. ________ is the practice of processing data closer to its source, which helps reduce latency and bandwidth usage in network communications.
iii. A ________ is a device that connects different networks and ensures that data is routed to the correct destination within a network.

iv. In a network, a _______ directs data traffic between multiple devices, ensuring efficient communication within a local area network (LAN).
v. _______ are devices that collect data from their environment and send it to IoT systems, enabling automation in smart homes and other industries.
vi. _______ is the technology that connects physical objects to the internet, allowing them to send and receive data for improved functionality.
vii. The main function of a _______ in a network is to monitor and control incoming and outgoing traffic to protect against unauthorized access.
viii. _______ systems are embedded in devices like washing machines, automating tasks and ensuring they function without manual intervention.
ix. _______ technology is expected to improve connectivity for more devices, enhancing applications like autonomous vehicles and smart cities.
x. The _______ is responsible for managing communication between devices in a wide area network (WAN), which connects LANs over large distances.

3. Provide the descriptive answers of the following questions.

i. What are the main components of a computer network, and how do they enable efficient communication?
ii. What security challenges do networks face, and what measures can be taken to protect sensitive information?
iii. How does IoT improve daily life, and can you provide an example of its application in healthcare?
iv. What is the role of sensors in IoT devices, and how do they enable remote control?
v. What is an embedded system, and how does it automate devices like washing machines?
vi. Identify three devices in your surroundings that use embedded systems and explain their tasks.
vii. What is edge computing, and how does it reduce delay in data processing?
viii. Describe how edge computing can be applied to traffic management systems.
ix. How does 5G technology enhance connectivity, and what industries benefit the most from it?
x. What are the potential risks associated with 5G implementation, and how can they be mitigated?

Important points to remember

- **Emerging Technologies** are new technologies that are still being developed or are just starting to be used. These can affect many areas, like artificial intelligence, blockchain, and quantum computing.
- **Emerging Technologies in Networking** focus on new technologies that improve how networks work, helping with communication, security, and the way networks are built and run.
- **Networking Components**: The different parts of a network, like routers, switches, and cables, that allow devices to communicate.
- **IP Address:** A unique number that helps to identify a computer or device on the internet.
- **Latency:** The delay or wait time it takes for data to travel across the internet.
- **VPN (Virtual Private Network):** A tool that keeps your internet activity private and secure by creating a safe connection.
- **Bandwidth**: The amount of data that can be transmitted over a network in a given time.
- **Firewall**: A security system that monitors and controls incoming and outgoing network traffic, protecting the network from unauthorized access.

Instruction for Teachers:

- **IoT Video or Presentation**
  Show videos or slides illustrating real-world IoT examples like smart homes or self-driving cars to highlight the technology's impact.
- **Embedded Systems in Common Devices**
  Use everyday devices (e.g., switch/router, smartphone) to demonstrate how embedded systems are integrated and function.
- **AI in Social Apps**
  Explain how AI improves social media apps with personalized recommendations, facial recognition, and chatbots.
- **Blockchain Simulation with Paper**
  Create a classroom activity using colored paper blocks to demonstrate blockchain concepts like transparency and security.
- **Simple LAN Activity**
  connect two devices (laptop/smartphone) to the same Wi-Fi network and show how they communicate and share resources within a local network.

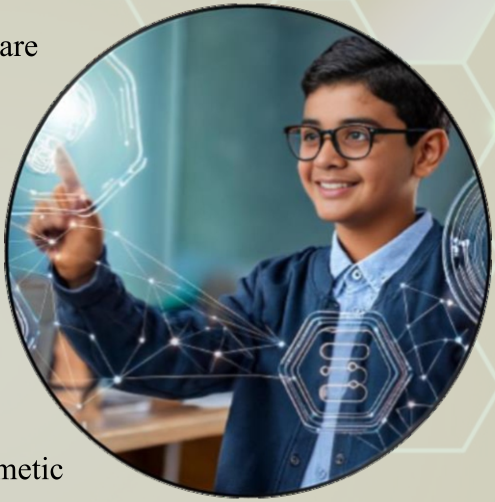
Chapter 2

Digital Skills

Student Learning Outcomes (SLOs):

By the end of this unit, students will be able to:

- Basics of Worksheets
- Purpose and uses of spreadsheets software
- Different spreadsheet software e.g. Excel, Google Sheets, Open Office
- Creating result card, home budgets, timetables etc. using spread sheets.
- Preparing Worksheet
- Organize data in worksheet within a workbook
- Select a range of cells
- Add borders
- Use simple built-in functions
- Create simple formulae (arithmetic operations)
- Create an appropriate chart for data presentation.



2.1 Introduction:

In today's society, computer skills are as essential as reading and writing. They are essential for everyday technological use, education, and future employment prospects. Learning digital abilities enables you to communicate, solve issues, and create using technology.

This chapter focusses on digital skills and how to organize data and create simple charts using spreadsheet programs like Google Sheets and Microsoft Excel.

2.2 Spreadsheet:

A spreadsheet is a digital tool used to organize, calculate, and analyze data in rows and columns (tabular form). It looks like a grid where you can enter information, such as numbers, text, or formulas, to perform calculations and make charts.

The most common spreadsheet programs are Microsoft Excel, Google Sheets and Open Office.

Excel Spreadsheet Figure 2.1

Microsoft Excel	Open Office	Google Sheet
Microsoft Excel is a powerful spreadsheet application developed by Microsoft and is a component of the Microsoft Office productivity package. Excel is widely used in business, finance, accounting, data analysis, and personal productivity due to its versatility and large feature set.	OpenOffice, also known as Apache OpenOffice, is a free open-source software suite that includes tools for word processing, spreadsheets, presentations, graphics, and databases. It is a popular choice for individuals, organizations, and schools seeking an affordable alternative to commercial office software.	Google Sheets is a free online application for creating, editing, and storing spreadsheets. It is part of Google Drive and is extensively used for personal, professional, and educational projects because it is simple to use, allows people to share information in real time, and integrates with other Google services.

2.2.1 Purpose of Spreadsheet:

A spreadsheet is a tool used to organize, calculate, and manage information. It helps you work with lots of data in an easy and clear way. A spreadsheet is like a digital version of a paper worksheet. A spreadsheet can be useful for

- **Organizing Data:** neatly into rows (side to side) and column (up and down) making it easy to read and find what you need.

- **Doing Calculation:** working with mathematical formulas (add, subtract, average number etc.) and performing more complex calculations.

Fig 2.2 Purpose of Spreadsheet

- **Analyzing Data:** to look at data closely to see patterns or trends. You can sort, filter and summarize data to find important information.

- **Creating Charts and Graphs:** Data turns into charts and graphs using spreadsheet, making it easier to understand and share with others.

Fig 2.3 Working with Spreadsheets

2.3 Microsoft Excel:

Microsoft Excel is a computer program used for creating and working with spreadsheets. It is part of the Microsoft Office suite which provides tabular sheets (*having cells that contains data in rows and column*) that makes it easier to analyze, organize and managing data. It is popular in businesses to perform financial analysis.

Following are the common uses of Microsoft Excel:

Personal Use: Track your budget, manage a list of contact, maintain your monthly expense

School: Organize homework assignments, track grades and create graphical charts.

Work: Analyze sales data, manage employee schedules or track the financial result of companies.

2.4 Working with Microsoft Excel:

- **Start Microsoft Excel:** Click on windows icon and type **"Excel"** in search box. Excel app icon will visible click on it or click open option showing as in below figure.

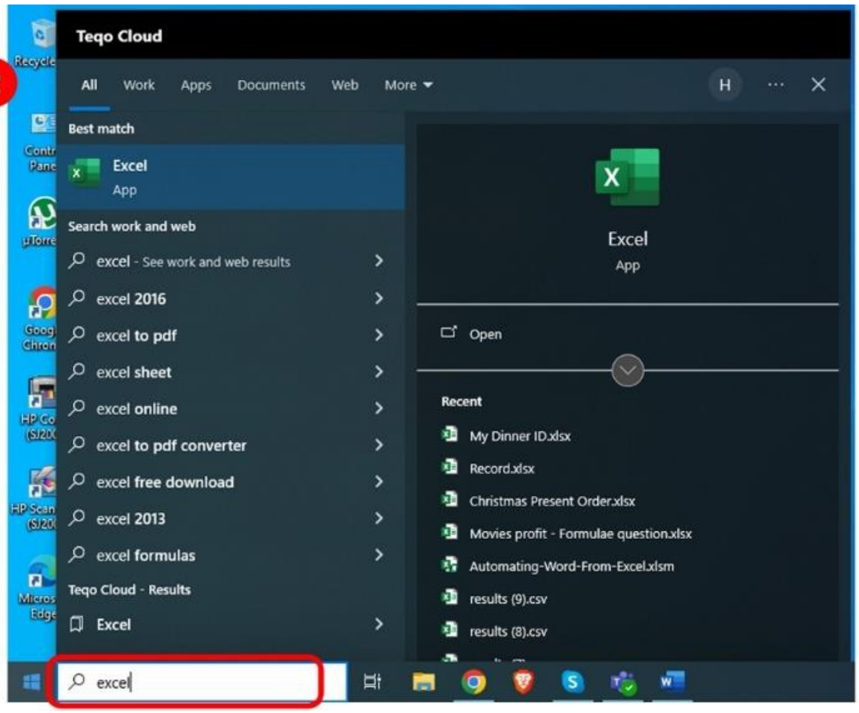
Start Microsoft Excel

❶ Click on windows icon start button.

❷ Type "Excel" in search text box.

❸ Click on Excel icon to start it.

2


Teqo Cloud
All
Work
Apps
Documents
Web
More
H
Best match
Excel
App
Search work and web
excel - See work and web results
excel 2016
excel to pdf
excel sheet
excel online
excel to pdf converter
excel free download
excel 2013
excel formulas
Teqo Cloud - Results
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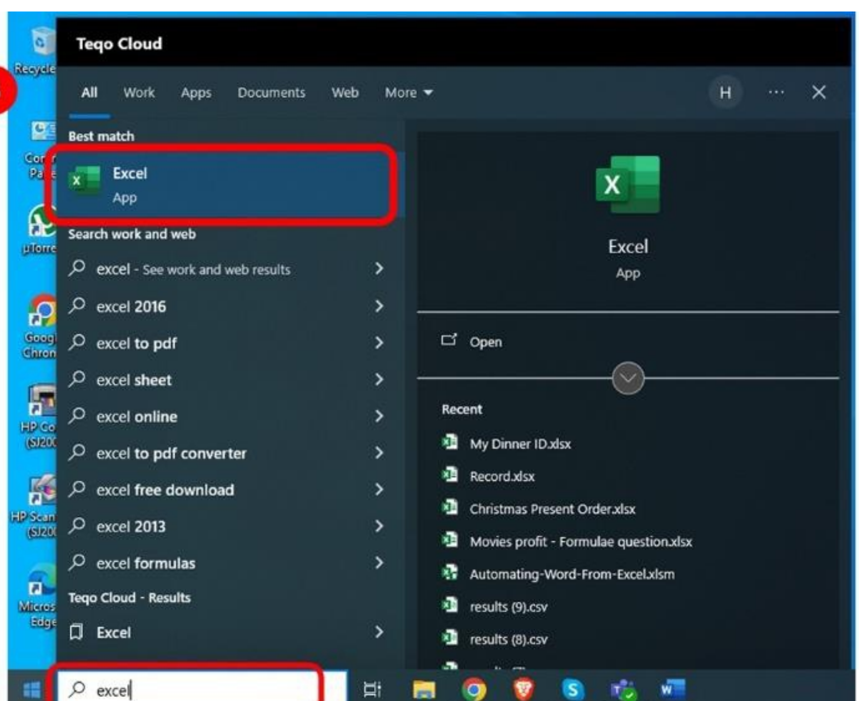
excel
Excel
App
Open
Recent
My Dinner ID.xlsx
Record.xlsx
Christmas Present Order.xlsx
Movies profit - Formulae question.xlsx
Automating-Word-From-Excel.xlsm
results (9).csv
results (8).csv

3


Teqo Cloud
All
Work
Apps
Documents
Web
More
H
Best match
Excel
App
Search work and web
excel - See work and web results
excel 2016
excel to pdf
excel sheet
excel online
excel to pdf converter
excel free download
excel 2013
excel formulas
Teqo Cloud - Results
Excel
excel
Excel
App
Open
Recent
My Dinner ID.xlsx
Record.xlsx
Christmas Present Order.xlsx
Movies profit - Formulae question.xlsx
Automating-Word-From-Excel.xlsm
results (9).csv
results (8).csv

- **Create a New Workbook:** When Excel application is open, you will be given the option to start with a blank workbook or choose a template. A blank workbook is the best place to start.

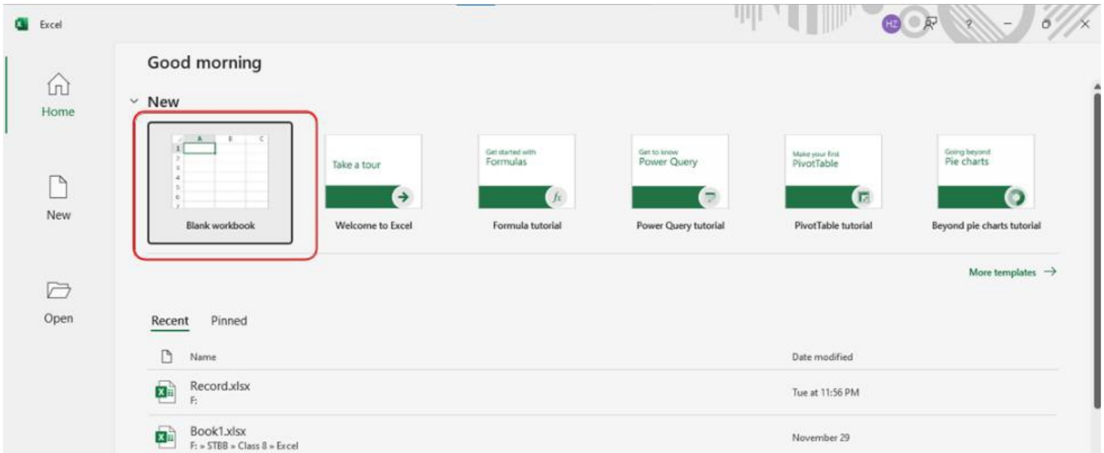


Figure 2.4(a) Excel Blank document open

- **Opening an Existing Workbook:** If you want to open an existing file, click **File > Open** and choose the file you want. There are some more options under Open which are as fellow
    - **Recent:** it will show you the last saved worksheet as showing in below figure.

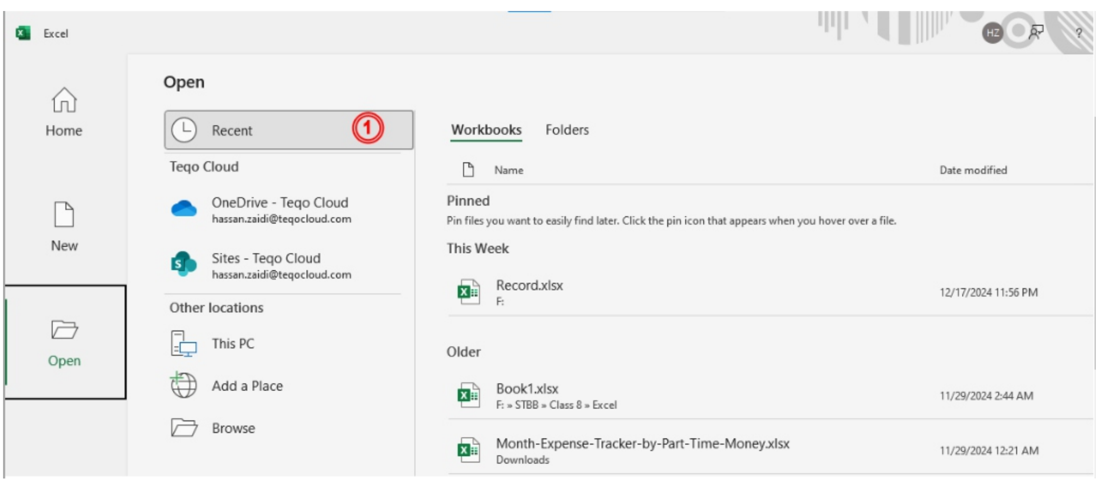


Figure 2.4(b) Excel Open Recent documents

- **This PC:** it will show you the folders present in My Document where you can open your last saved worksheet.

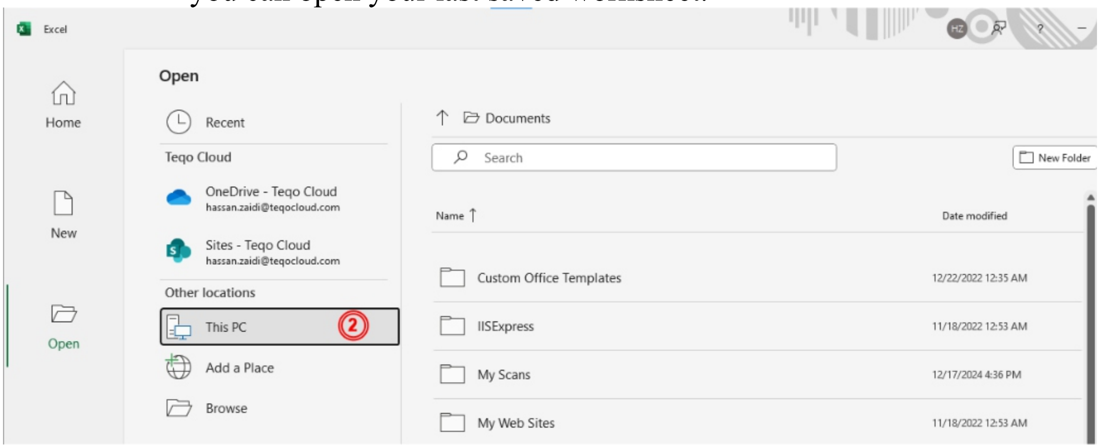


Figure 2.4(c) Excel Open documents from My PC

- **Browse:** it will show a dialog box from which you can select any drive from your computer and go to you desired folder to open your existing excel file.

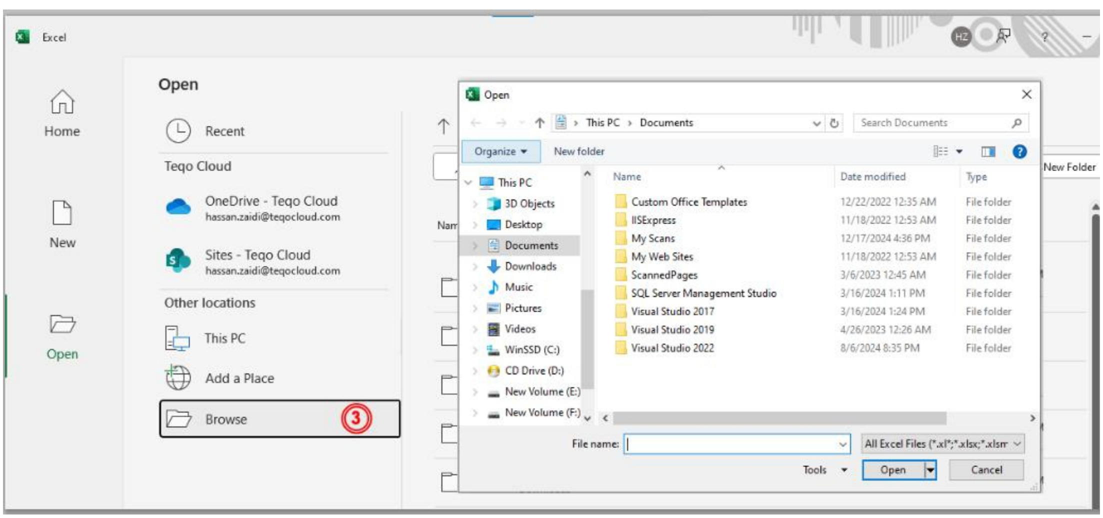


Figure 2.4(d) Excel opening browse window

2.4.1 Microsoft Excel Interface (Version 2021):

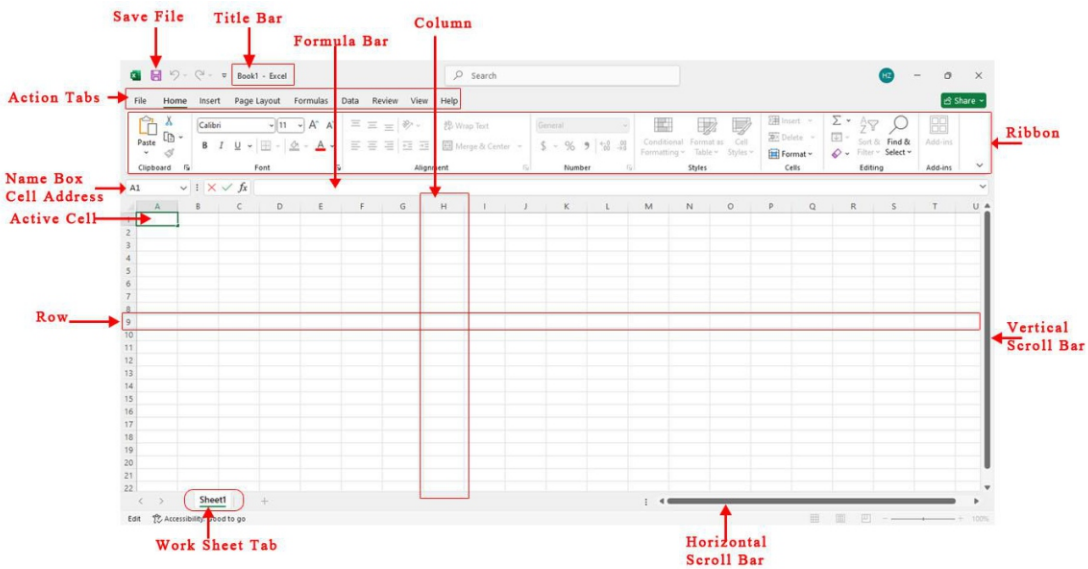


Fig 2.5 Microsoft Excel Interface

Workbook:

A workbook represents an Excel file containing one or more worksheets. It functions similarly to a binder, holding all of the sheets, charts, and data. Each workbook can hold several worksheets, and you can save them using the extension.xlsx.

Worksheet:

A worksheet is a single page or tab of a workbook. It consists of a grid of rows and columns in which you may enter and manipulate data. A workbook may contain several worksheets, each worksheet is a grid of rows and columns where you can enter data. The rows are numbered (1, 2, 3,...) and the columns are labeled with letters (A, B, C,...). Worksheet represented by a tab at the bottom of the screen. Each worksheet contains its own set of data and can be worked on independently.

Cells:

Each box in the grid is called a cell. Each cell has a unique reference, such as A1 (column A, row 1) or B2 (column B, row 2).

Ribbon:

The top section of the Excel window is called the Ribbon, where you'll find different tabs like Home, Insert, Formulas, Data, Review and more. Each tab contains tools and options for working with your data.

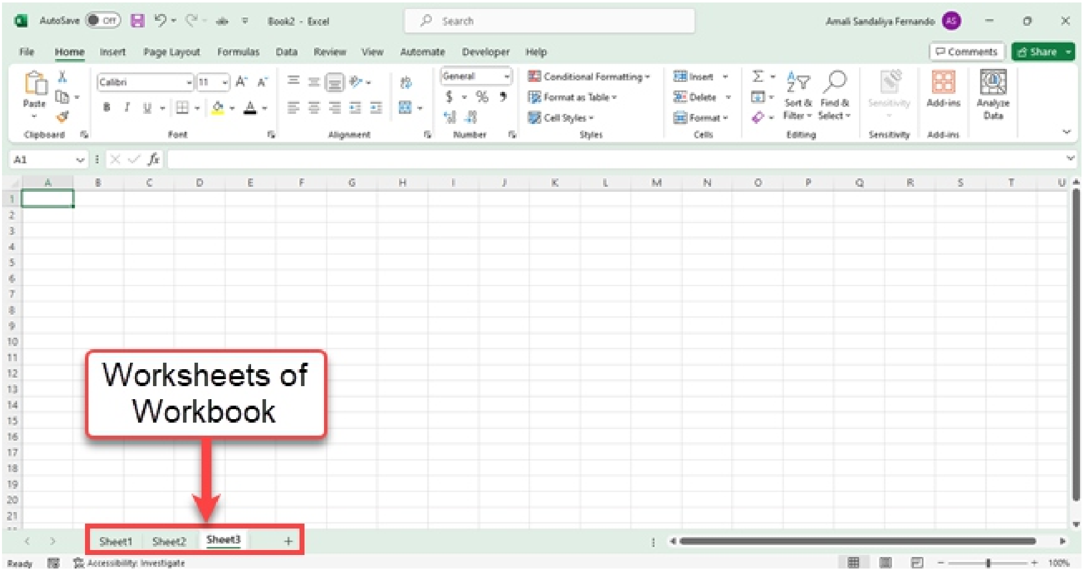


Fig 2.6 Worksheets of Workbook

Quick Tip:

Tabs: (e.g., "Home", "Insert", “Draw”, "Layout") to view the commands in that tab.
Groups: Within each tab, tools are grouped by category. For example, in the "Home" tab, the Font group contains tools for text formatting, and the Editing group has tools for finding, selecting, and clearing data.
Commands: Click on any command (e.g., Bold, Insert Table, or AutoSum) to perform the action.

2.4.2 Home Tab:

The Home tab provides basic options to perform tasks like formatting text, organizing data, performing calculations, and managing how your information is displayed.

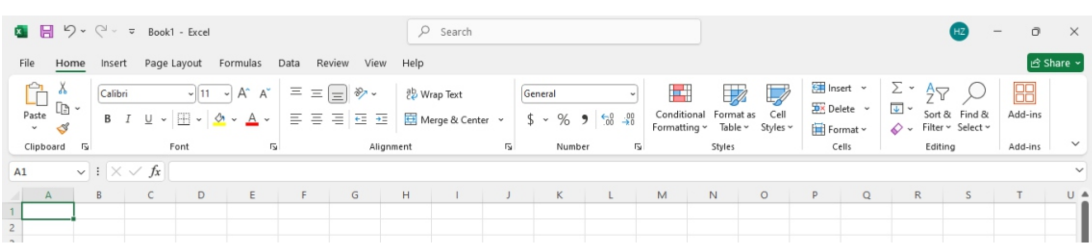


Fig 2.7 Home Tab options

Quick overview of Home Tab Group

Group	Key Tool
Clipboard	Cut, Copy, Paste, Format Painter
Font	Font Style, Size, Bold, Italic, Underline, Color, Borders
Alignment	Left/Center/Right Align, Merge, Wrap Text, Orientation
Number	Number Format, Increase/Decrease Decimal, Currency, Percent
Style	Conditional Formatting, Format as Table, Cell Styles
Editing	Find & Select, Clear, Sort & Filter, AutoSum

Home tab provides following features:

- **Clipboard Group:**

Cut: Removes the selected content and put it on the clipboard so you can paste it somewhere else. Short key: **Ctrl + X.**

Copy: Makes a copy of the selected content on the clipboard without removing it from its original location. Short Key: **Ctrl + C.**

Paste **Paste:** is used to pastes the content you have copied or cut. Short Key: **Ctrl + V**

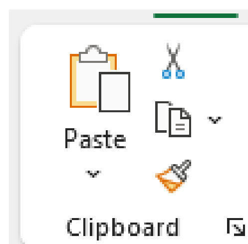


Fig 2.7(a) Clipboard Options

Format Painter: Copies the formatting (colors, fonts, borders) of a cell and applies it to another cell. Short Key: Use **Alt + Ctrl + C** to copy a format, and **Alt + Ctrl + V** to paste a format.

- **Font Group:**

Font Style: Change the font of your text (e.g., Arial, Calibri). Short Key: **Ctrl + Shift + F**
Font Size: Change the size of the text. Bold, Italic, Underline: Make the text bold, italic, or underline. Short Key: **Ctrl + Shift + P**
Font Color: Change the color of the text.

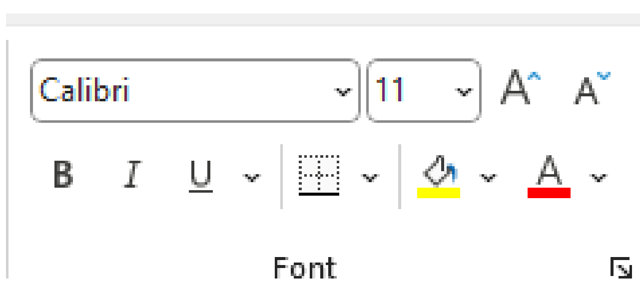


Fig 2.7(b) Font Group options

- **Alignment Group:**

Align Text Left, Center, Right: Align the text in the selected cells to the left, center, or right.

Merge & Center: Combines multiple selected cells into one and centers the text within the merged cell.

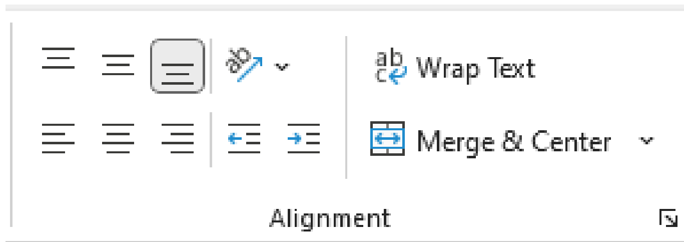


Fig 2.7(c) Alignment Group options

Wrap Text: Allows text to wrap within the cell, so it doesn't overflow into adjacent cells.

Orientation: Change the angle of the text (e.g., rotate the text to make it vertical or at an angle).

top, **middle**, and **bottom** alignment options are used to position the content of a cell vertically. Click on any of these icons to adjust the alignment of the content in the selected cells.
Short Key: **Alt** + **H** + **A** + **T** (Top Align), **Alt** + **H** + **A** + **M** (Middle Align),
Alt + **H** + **A** + **B** (Bottom Align)

- **Number Group:**
  Change the number format (e.g. General, Currency, Percentage, Date etc.). It customizes how the data displayed in cell.

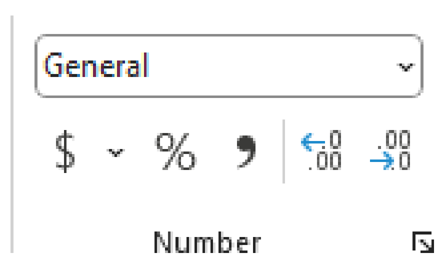


Fig 2.7(d) Number Group options

Apply number formats such as dates, currency, or fractions to cells in a worksheet. For example, if you are working on your quarterly budget, you can use the Currency number format so your numbers represent money. Or, if you have a column of dates, you can specify that you want the dates to appear as March 14, 2012, 14-Mar-12, or 3/14.

Follow these steps to format numbers:

1. Select the cells containing the numbers you need to format.

2. Select CTRL+1.
3. In the window that displays, select the Number tab.
4. Select a Category option, and then select specific formatting changes on the right.

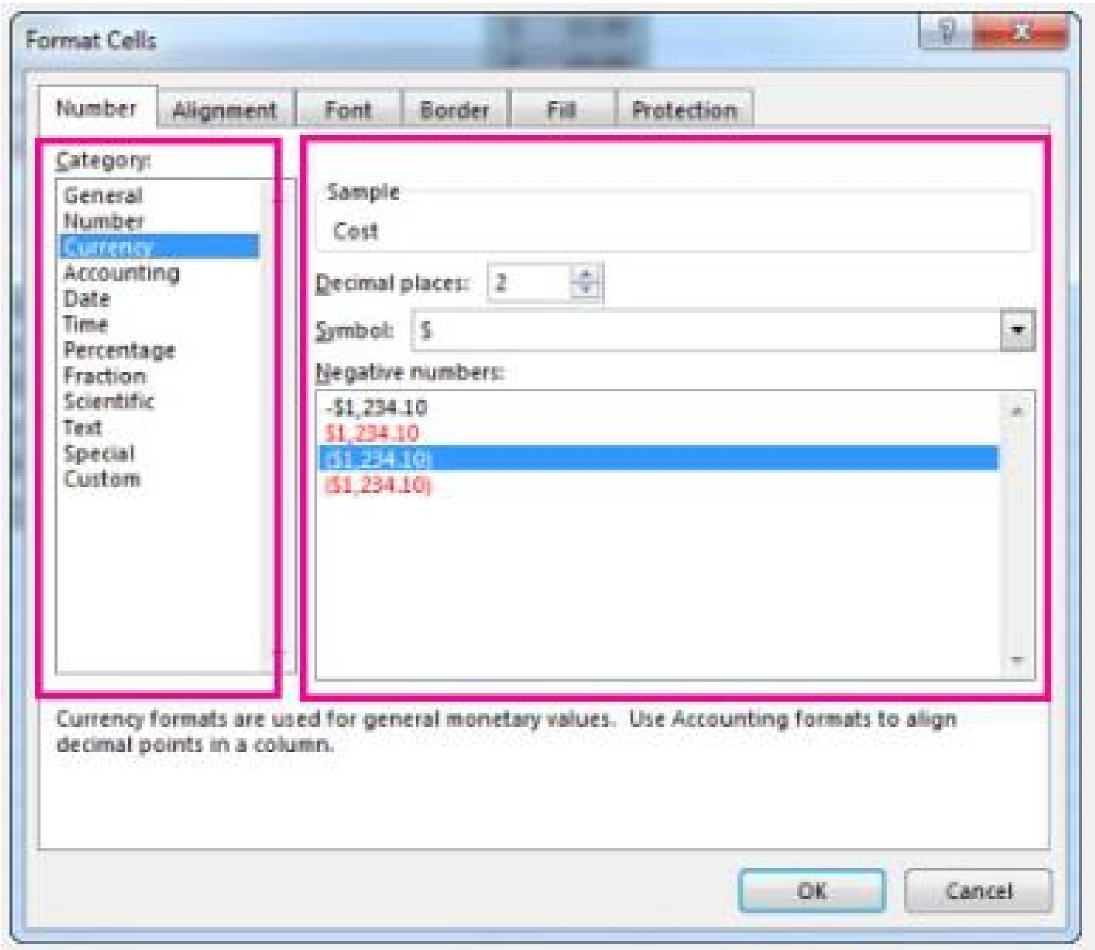


Fig 2.7(e) Style Group options

- **Style Group:**
  Conditional Formatting: Highlights cell based on certain rules (e.g. values above a threshold).
  Cell Style: Apply predefined styles to cells for quick formatting.

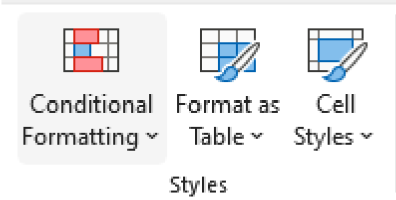


Fig 2.7(f) Style Group options

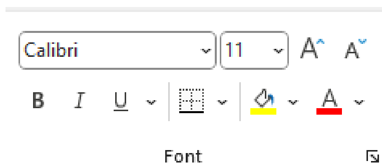
2.4.2.1 Creating a Sales Report:

We are going to format and organize data for a simple sales report using options from the Home Tab by performing following steps.

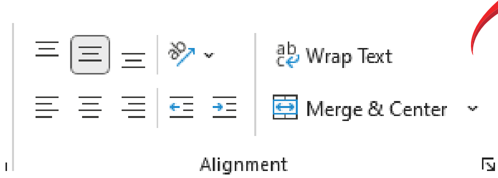
1. Open Excel software and create enter following data.

	A	B	C	D
1	Product	Quantity	Price	Total
2	Apple	10	2.5	
3	Banana	15	1.8	
4	Orange	8	3	
5				
6				
7				

2. Apply basic formatting by using font group:
   - Select the table header (Product, Quantity, Price, Total) and press "**B**" from Font group to bold the selected text.



   - Center aligns the headers using Alignment Group.



Teacher demonstrates the students how to apply different alignment on text.

   - Add background color to the header (e.g. light blue) using **Fill Color**.

Teacher demonstrates the students how to apply different fonts, background and text color.

- Following image is showing the above steps result.

	A	B	C	D
1	Product	Quantity	Price	Total
2	Apple	10	2.5	
3	Banana	15	1.8	
4	Orange	8	3	
5				

3. Calculate Totals:
In column D (Total) we are using a formula (***will discuss in this Chapter 2.5***) to calculate the total for each product (Quantity * Price).
Example: In cell D2, enter =B2 *C2 as showing in below picture.

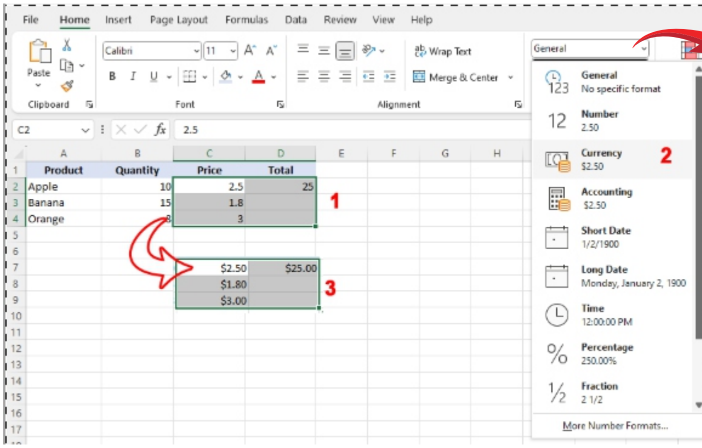
	A	B	C	D
1	Product	Quantity	Price	Total
2	Apple	10	2.5	=B2*C2
3	Banana	15	1.8	
4	Orange	8	3	

After entering the formula select the cell and move your cursor to the bottom right of the selected cell now your cursor change to + sign drag up to the cells where you want the calculation as showing in below picture.

	A	B	C	D
1	Product	Quantity	Price	Total
2	Apple	10	$2.50	$25.00
3	Banana	15	$1.80	
4	Orange	8	$3.00	
5				
6				$25.00
7				$27.00
8				$24.00
9				

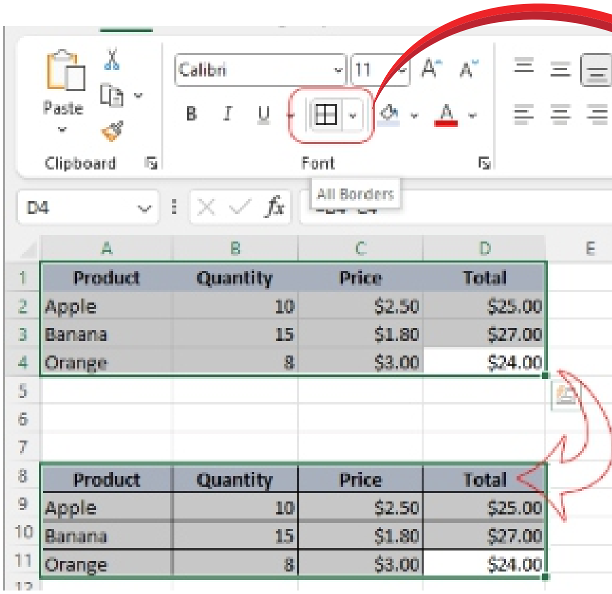
Teacher demonstrates the students how to copy the formula to rest of the cells by dragging the cursor.

4. Apply Number formatting:
   Format the Price and Total columns to currency format using the **Number** group.



Teacher demonstrates the students how to apply different text formats with examples.

5. Apply Borders:
   Select the entire table and apply **All Borders** using Font group.



Teacher demonstrates the students how to apply different borders formats.

6. Save Your work:
   Save the file with the name BasicActivity.xlsx

2.4.3 Insert Tab:

The Insert tab in Microsoft Excel is a powerful tool use to add various objects, charts, and features to your worksheet. It contains all the tools you need to insert elements like tables, pictures, charts, shapes, and more in order to make your Excel workbook more interactive and informative.

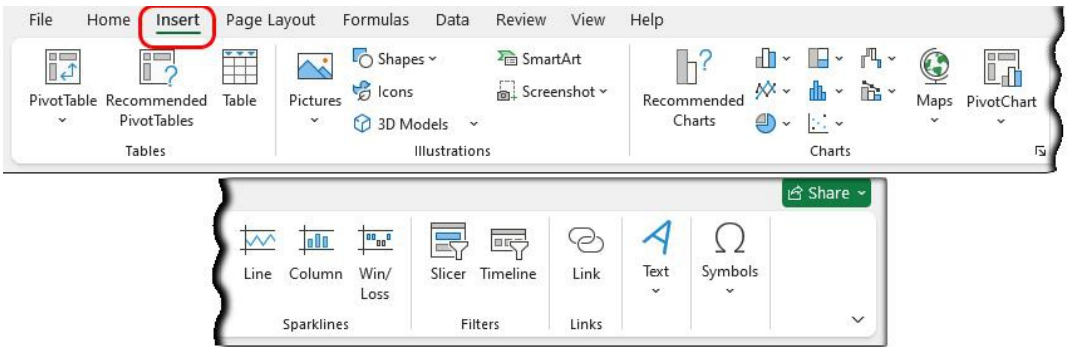


Fig 2.8 Insert Tab options

2.4.4 Page layout Tab:

The Page Layout tab in Microsoft Excel is where you can control the appearance and formatting of your worksheet for printing. It allows you to adjust page orientation, paper size, margins, and themes, as well as fine-tune how data will fit on the printed page. By using the tools in this tab, you can ensure that your Excel worksheet appears professional and is properly formatted for printing or sharing with others.

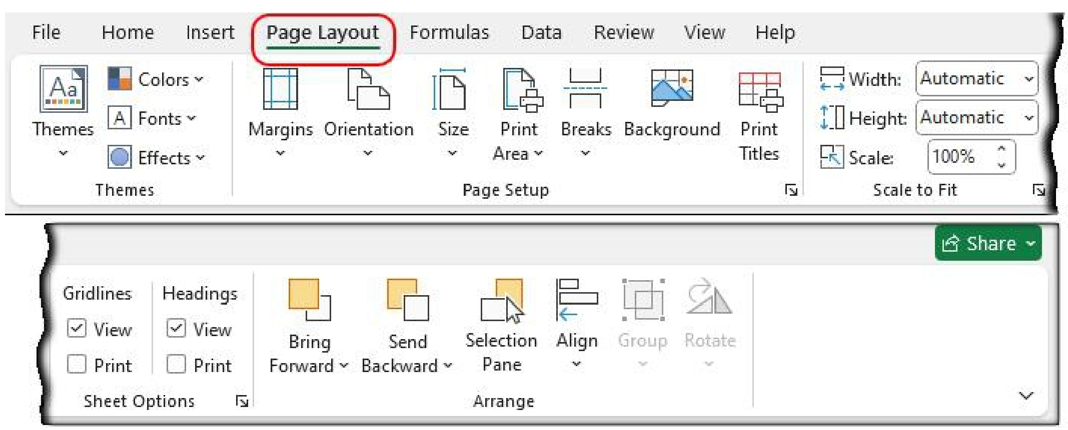


Fig 2.9 Page layout tab options

2.4.5 Formulas Tab:

The Formulas tab in Microsoft Excel provides the tools and functions related to creating and managing formulas in your workbook. It provides access to a wide range of built-in functions for calculations, as well as tools to help you organize and test your formulas. This tab is essential for anyone working with numerical data or performing complex calculations in Excel.

- Insert function helps to insert different formulas by providing their parameters.
- Auto Sum perform quick addition calculation on your worksheet.

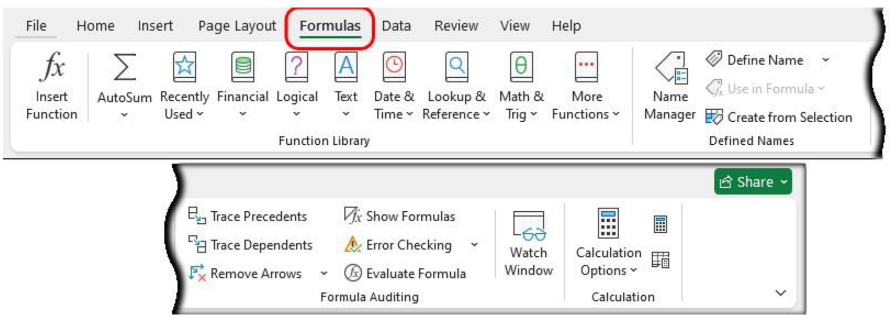


Fig 2.10 Formulas tab options

2.4.6 Data Tab:

The Data tab in Microsoft Excel provides tools for organizing, sorting, filtering, importing, and transforming your data into your desired format.

- Sort option helps to arrange data in specific order (Ascending or Descending)
- Filter option allows to easily extract the records based on some criteria.

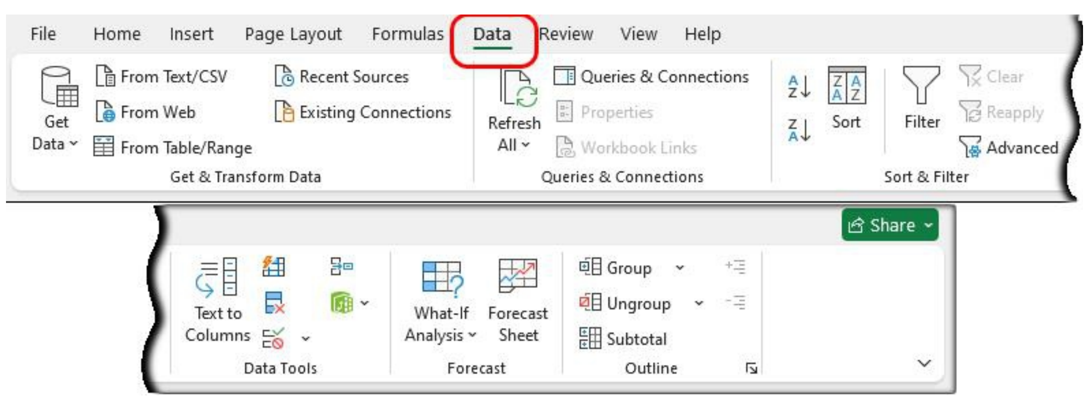


Fig 2.11 Data tab options

2.4.7 Review Tab:

The Review tab in Excel is essential for proofreading, collaborating, and protecting your workbook. Whether you are checking for spelling mistakes, adding comments, tracking changes, or securing your work.

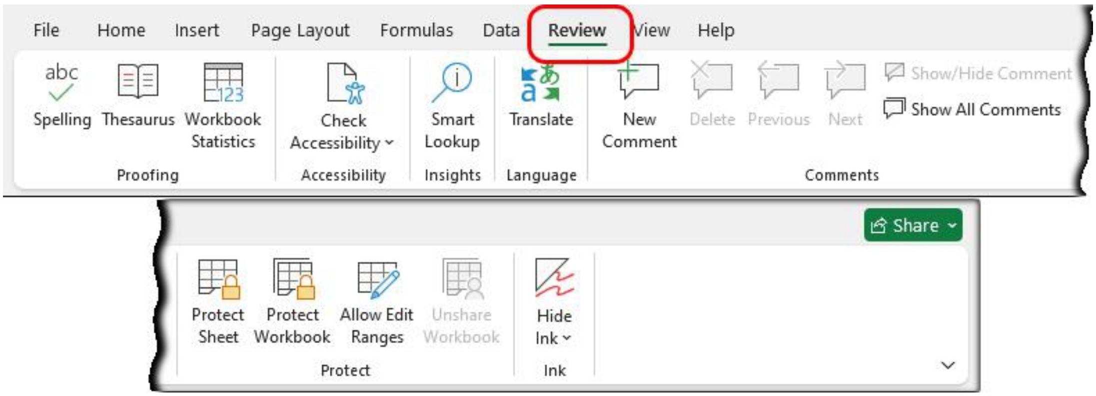


Fig 2.12 Review tab options

2.4.8 View Tab:

The View tab in Microsoft Excel help you to manage how your worksheet is displayed on your screen. It provides tools for adjusting the zoom, arranging windows, and showing or hiding elements in your workbook.

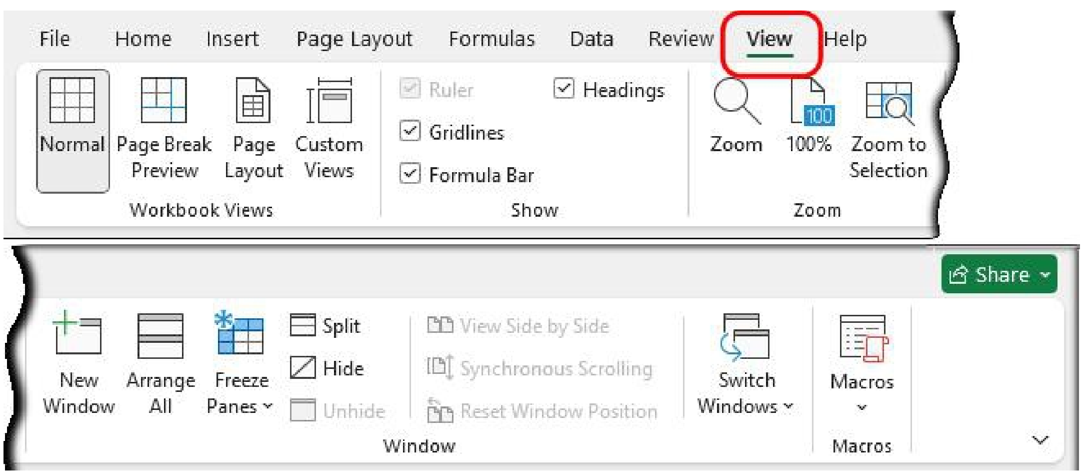
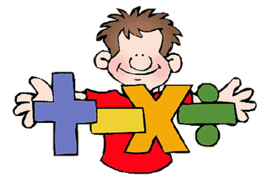


Fig 2.13 View tab options

2.5 Formulas and Functions:



In Microsoft Excel formulas and functions are essential tools that perform calculations, analyze data, and automate tasks within worksheets. While formulas are custom calculations created by the user, functions are predefined formulas that Excel provides for specific tasks.

2.5.1 Formula:

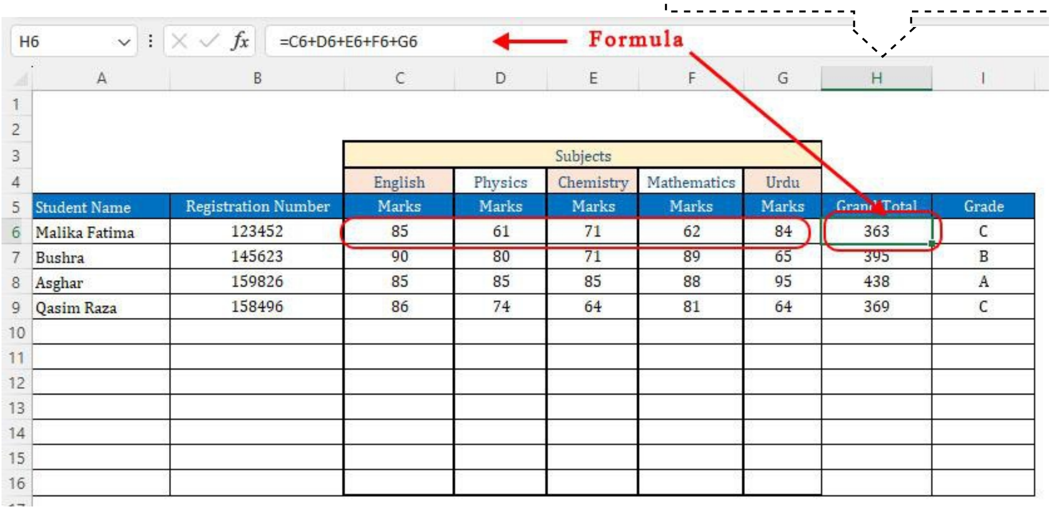
A formula is an equation that performs calculations on data in Excel worksheet. It can be simple or complex, and allow us to perform arithmetic operations, manipulate text, reference other cells, or perform logical tests.

Basic Formula Structure: A formula always starts with an equals sign (=). After the equals sign, you can include numbers, cell references, operators (like +, -, *, / etc.), and functions. Here are some examples:

Formula Expression	Description
=A1 + B1	This adds the values in cells A1 and B1
=A2 * B2	This multiplies the values in cells A2 and B2.
=A1 - B1 + C1	This subtracts B1 from A1 and then adds with the value in C1

Following is the example of student total marks:

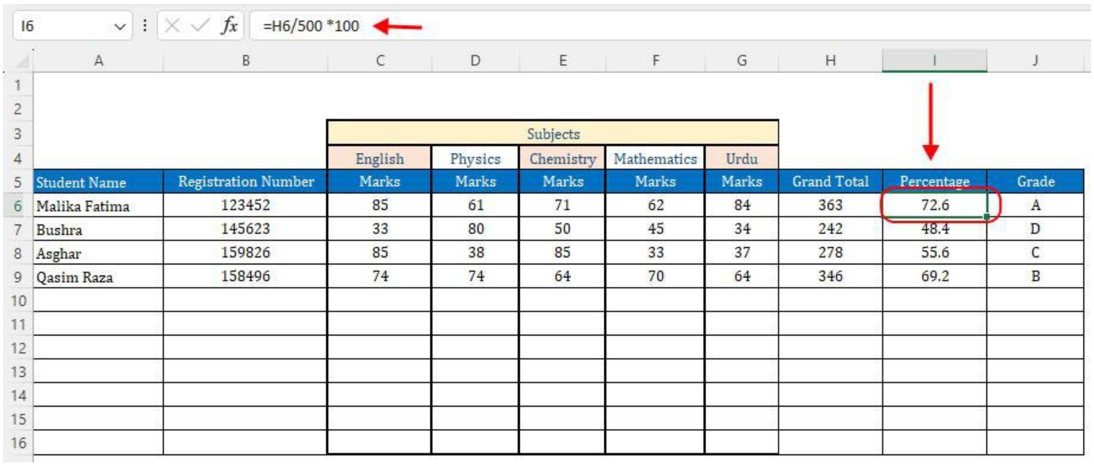
Tip: Total marks of students can also be calculated with Auto Sum ∑



Student Name	Registration Number	Subjects English Marks	Physics Marks	Chemistry Marks	Mathematics Marks	Urdu Marks	Grand Total	Grade
Malika Fatima	123452	85	61	71	62	84	363	C
Bushra	145623	90	80	71	89	65	395	B
Asghar	159826	85	85	85	88	95	438	A
Qasim Raza	158496	86	74	64	81	64	369	C

Fig 2.14 (a) Basic Addition Formula

Another example to calculate the percentage of a student's marks using formula shown below:



I6 | =H6/500 *100

Student Name	Registration Number	Subjects English Marks	Physics Marks	Chemistry Marks	Mathematics Marks	Urdu Marks	Grand Total	Percentage	Grade
Malika Fatima	123452	85	61	71	62	84	363	72.6	A
Bushra	145623	33	80	50	45	34	242	48.4	D
Asghar	159826	85	38	85	33	37	278	55.6	C
Qasim Raza	158496	74	74	64	70	64	346	69.2	B

Fig 2.14(b) Basic Percentage Formula

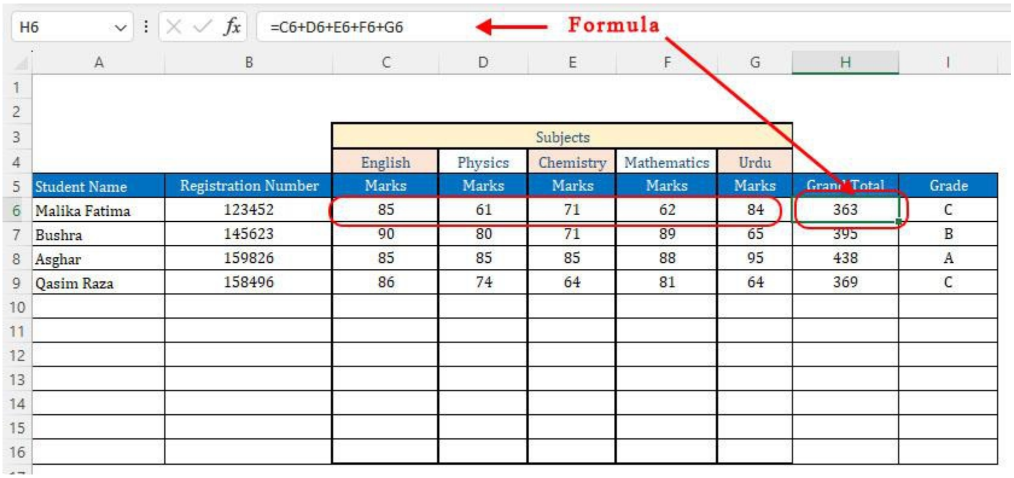
2.5.2 Function:

A function is a predefined formula in Excel that helps you perform common calculations without having to manually create a formula. Excel comes with a wide variety of functions that simplify complex tasks like summing numbers, averaging data, counting items, maximum value, minimum value and much more.

Function Structure: A function always starts with an equal sign (=) and the function name, followed by arguments enclosed in parentheses. For example:

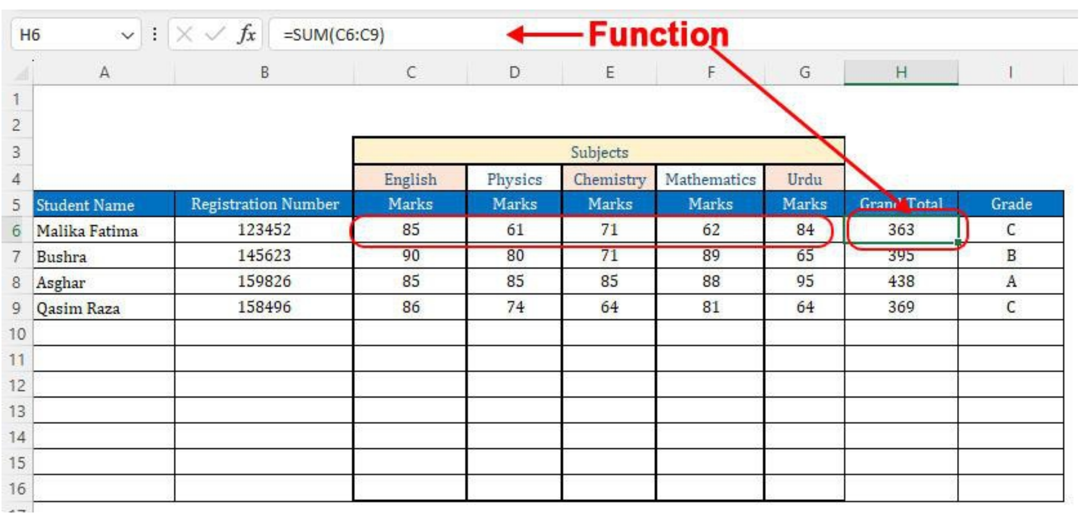
Function Expression	Description
=SUM(C6:C9)	This function adds up all the numbers in cells range C6 through C9. **Fig 2.15(a), Fig 2.15(b)** and **Fig 2.15(c)**
=AVERAGE(C6:G6)	This function calculates the average (mean) of the numbers in cells C6 to G6. **Fig 2.15(d)**
=IF(H6 > 10, "Yes", "No")	This is a logical function that checks if the value in cell A1 is greater than 10. If true, it returns "Yes"; otherwise, it returns "No." **Fig 2.15(e)**

Instead of selecting each cell for addition from C6 to C9 like **C6+C7+C8+C9** you can select range of cells by using Colon sign (**:**) e.g. **C6:C9** and use Sum function i.e. **Sum(C6:C9)**



Student Name	Registration Number	English Marks	Physics Marks	Chemistry Marks	Mathematics Marks	Urdu Marks	Grand Total	Grade
Malika Fatima	123452	85	61	71	62	84	363	C
Bushra	145623	90	80	71	89	65	395	B
Asghar	159826	85	85	85	88	95	438	A
Qasim Raza	158496	86	74	64	81	64	369	C

Fig 2.15(a) Formula to calculate the addition of columns

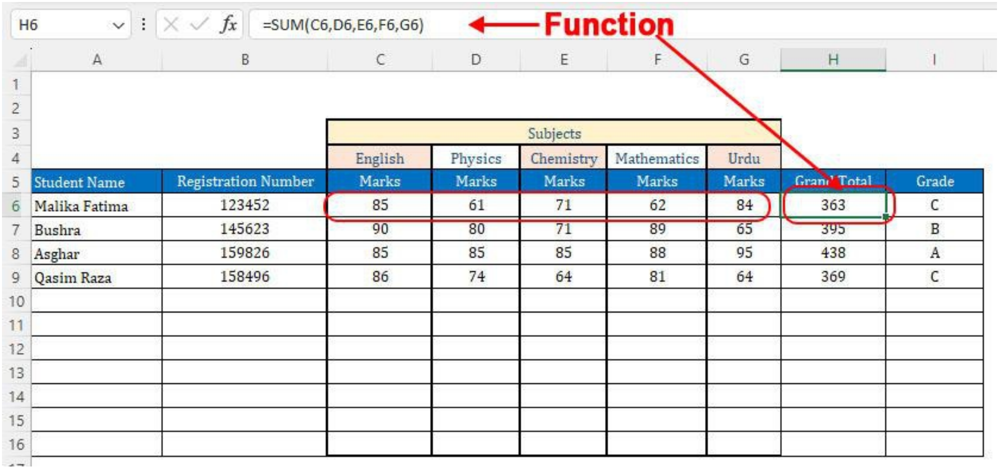


Student Name	Registration Number	English Marks	Physics Marks	Chemistry Marks	Mathematics Marks	Urdu Marks	Grand Total	Grade
Malika Fatima	123452	85	61	71	62	84	363	C
Bushra	145623	90	80	71	89	65	395	B
Asghar	159826	85	85	85	88	95	438	A
Qasim Raza	158496	86	74	64	81	64	369	C

Fig 2.15(b) Showing Sum function calculation using column range C6:C9

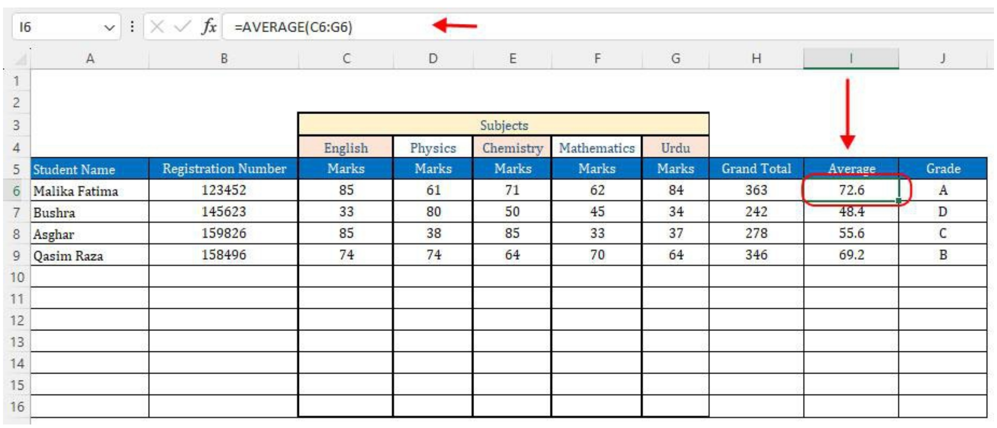
fx Insert Function

To see all the functions by category, choose **Formulas Tab » Insert Function**. Insert function Dialog appears from which we can choose the function.



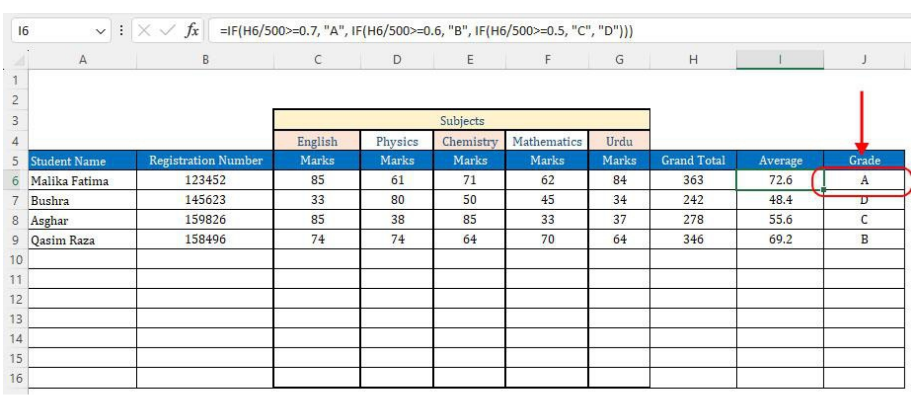
Student Name	Registration Number	English Marks	Physics Marks	Chemistry Marks	Mathematics Marks	Urdu Marks	Grand Total	Grade
Malika Fatima	123452	85	61	71	62	84	363	C
Bushra	145623	90	80	71	89	65	395	B
Asghar	159826	85	85	85	88	95	438	A
Qasim Raza	158496	86	74	64	81	64	369	C

Fig 2.15(c) Showing Sum function with different Column number



Student Name	Registration Number	English Marks	Physics Marks	Chemistry Marks	Mathematics Marks	Urdu Marks	Grand Total	Average	Grade
Malika Fatima	123452	85	61	71	62	84	363	72.6	A
Bushra	145623	33	80	50	45	34	242	48.4	D
Asghar	159826	85	38	85	33	37	278	55.6	C
Qasim Raza	158496	74	74	64	70	64	346	69.2	B

Fig 2.15(d) Showing Average function with Column range



Student Name	Registration Number	English Marks	Physics Marks	Chemistry Marks	Mathematics Marks	Urdu Marks	Grand Total	Average	Grade
Malika Fatima	123452	85	61	71	62	84	363	72.6	A
Bushra	145623	33	80	50	45	34	242	48.4	D
Asghar	159826	85	38	85	33	37	278	55.6	C
Qasim Raza	158496	74	74	64	70	64	346	69.2	B

Fig 2.15(e) IF function to calculate the Grade

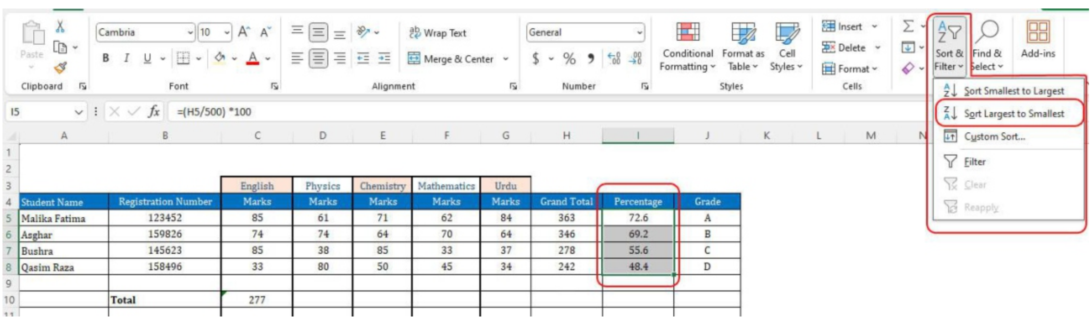
Some Examples of built-in Function:

	A	B	C	D	E
1	Numbers		Min:	1	=MIN(A2:A9)
2	1				
3	9		Max:	10	=MAX(A2:A9)
4	2				
5	5		Average:	5.75	=AVERAGE(A2:A9)
6	7				
7	4		2nd smallest:	2	=SMALL(A2:A9, 2)
8	10				
9	8		3rd largest:	8	=LARGE(A2:A9, 3)

Fig 2.15(f) Some basic built-in functions

2.5.3 Sorting Data:

Sorting is the process of arranging data into specific order like ascending or descending. Data showing in the following figure shows the data sorted percentage wise in descending order (Largest to Smallest value).



	A	B	C	D	E	F	G	H	I	J
3			English	Physics	Chemistry	Mathematics	Urdu			
4	Student Name	Registration Number	Marks	Marks	Marks	Marks	Marks	Grand Total	Percentage	Grade
5	Malika Fatima	123452	85	61	71	62	84	363	72.6	A
6	Asghar	159826	74	74	64	70	64	346	69.2	B
7	Bushra	145623	85	38	85	33	37	278	55.6	C
8	Qasim Raza	158496	33	80	50	45	34	242	48.4	D
9										
10		Total	277							

Fig 2.16 Sorting Data

Activity:

Personal Expense Calculator:

We are going to format and organize data for a simple personal expense calculator by performing following steps.

1. Open Excel software and select a blank workbook.
2. Create Headers in row 1, write the following headers starting from column A:

	A	B	C	D
1	Date	Category	Description	Amount

- **Date:** The date when the expense occurred.
- **Category:** The type of expense (e.g., Food, Rent, Transport, etc.).
- **Description:** Optional details about the expense (e.g., "Dinner at a restaurant").
- **Amount:** The cost of the expense.

3. Apply cell formatting by using Home tab (*Font group, Alignment group, Number group etc.*).
    - Apply font (bold, Time New Roman, Size etc.)
    - Apply alignment like center, left, right etc.
    - Apply borders.
    - You can increase/ decrease the cell width or height by selecting the corner of the cell and drag it as showing in the **figure 1** or right click on the column/row and select column width. A dialogue box is appeared in which you can enter the value to increase the width of column as showing in the **figure 2**.

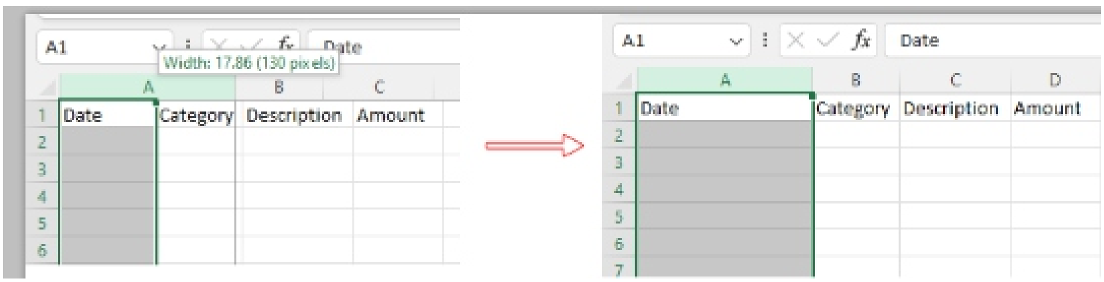


Figure 1 Showing dragging the column to increase the width

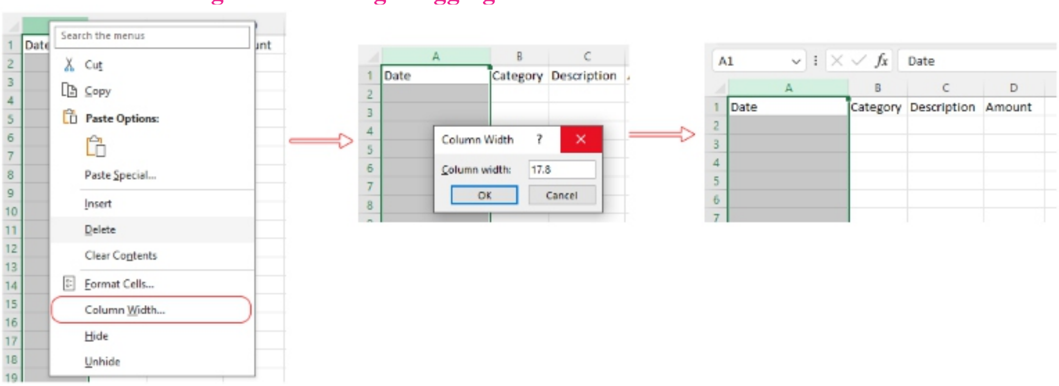


Figure 2 showing Column width dialog to increase the width

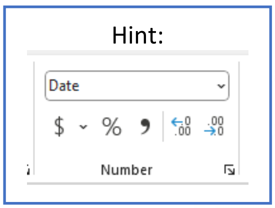
	A	B	C	D
1	Date	Category	Description	Amount
2				
3				
4				
5				
6				
7				
8				
9			Total	

Figure 3 Table design for entering data

4. Enter some sample data in the above showing table.

Date	Category	Description	Amount
1/11/2024	Food	Grocery shopping	50
2/11/2024	Transport	Bus fare	15
3/11/2024	Rent	Monthly rent payment	500

5. Modify the Date and Amount columns' formats as indicated in the following figure. Using **Home** tab and use the **Number formatting** group to achieve it. Or use short key Ctrl +1 to format.



Date	Category	Description	Amount
1/11/2024	Food	Grocery shopping	50
2/11/2024	Transport	Bus fare	15
3/11/2024	Rent	Monthly rent payment	500

Date	Category	Description	Amount
Monday, November 11, 2024	Food	Grocery shopping	$50.00
Tuesday, November 12, 2024	Transport	Bus fare	$15.00
Wednesday, November 13, 2024	Rent	Monthly rent payment	$500.00

6. Add total expenses in column D beside the Total cell in Row 9.
   - Use Sum() function to calculate the total amount
   - =SUM(D2:D8) - where D8 based on the number of rows in your table.

	A	B	C	D
1	Date	Category	Description	Amount
2	Monday, November 11, 2024	Food	Grocery shopping	$50.00
3	Tuesday, November 12, 2024	Transport	Bus fare	$15.00
4	Wednesday, November 13, 2024	Rent	Monthly rent payment	$500.00
5				
6				
7				
8				
9			Total	=Sum(D2:D8)

7. Categorize Expense to create the summary from the above data. Create table to list the categories as showing in following table.

	A	B	C	D
1	**Date**	**Category**	**Description**	**Amount**
2	Monday, November 11, 2024	Food	Grocery shopping	$50.00
3	Tuesday, November 12, 2024	Transport	Bus fare	$15.00
4	Wednesday, November 13, 2024	Rent	Monthly rent payment	$500.00
5	Thursday, November 14, 2024	Transport	Train Fare	$10.00
6				
7				
8				
9			**Total**	$575.00
10				
11				
12	**Category**	**Total**		
13	Food			
14	Transport			
15	Rent			

8. Use SUMIF() built-in function to calculate totals by Category.

Hint:

SUMIF

SUMIF(range,criteria,sum_range)

Adds the cells specified by a given condition or criteria.

SUMIF function uses range to find the criteria, if criteria successfully meets than it will sum the values from the range.

9. In the cell next to each category total use as follows
   a. for Food = SUMIF(B2:B8, "Food", D2:D8)
   b. for Transport = SUMIF(B2:B8, "Transport", D2:D8)
   c. for Rent = SUMIF(B2:B8, "Rent", D2:D8)

SUM =SUMIF(B2:B8, "Food", D2:D8)

SUMIF(range, criteria, [sum_range])

	A	B	C	D
1	**Date**	**Category**	**Description**	**Amount**
2	Monday, November 11, 2024	Food	Grocery shopping	$50.00
3	Tuesday, November 12, 2024	Transport	Bus fare	$15.00
4	Wednesday, November 13, 2024	Rent	Monthly rent payment	$500.00
5	Thursday, November 14, 2024	Transport	Train Fare	$10.00
6				
7				
8				
9			Total	$575.00
10				
11				
12	**Category**	**Total**		
13	Food	"Food", D2:D8)		
14	Transport			
15	Rent			

10. Now you expense worksheet is completed. Please save your file with the name Personal Expense.xls

	A	B	C	D
1	Date	Category	Description	Amount
2	Monday, November 11, 2024	Food	Grocery shopping	$50.00
3	Tuesday, November 12, 2024	Transport	Bus fare	$15.00
4	Wednesday, November 13, 2024	Rent	Monthly rent payment	$500.00
5	Thursday, November 14, 2024	Transport	Train Fare	$10.00
6				
7				
8				
9			Total	$575.00
10				
11				
12	Category	Total		
13	Food	50		
14	Transport	25		
15	Rent	500		

Note: You can add more functions to calculate Highest expense, Lowest expense etc. Add more conditional formatting to enhance your worksheet.

2.6 Charts:

Charts are powerful tool in Microsoft Excel that helps visually represent data, making it easier to analyze and understand patterns, trends, and relationships. Instead of displaying raw numbers, charts allow to present information in a more accessible and visually appealing way. Microsoft Excel provides range of chart types to create different types of charts e.g. column chart, bar chart, line chart, pie chart etc.

Insert Charts:

1. Select the required cells that contains data to be used in the chart. Column A (Student Name) with cell range A3:A6 and Column I (Percentage) with cell range I3:I6 are used for 3D bar chart.
2. Click on the Insert tab.

Teacher should explain the Chart details like X-axis and Y-axis, Legend, Data label, Chart Title etc. to student in computer lab.

3. Click on Chart command button.
4. Click the required type of Chart.
5. 3D bar chart is inserted as shown in the picture.

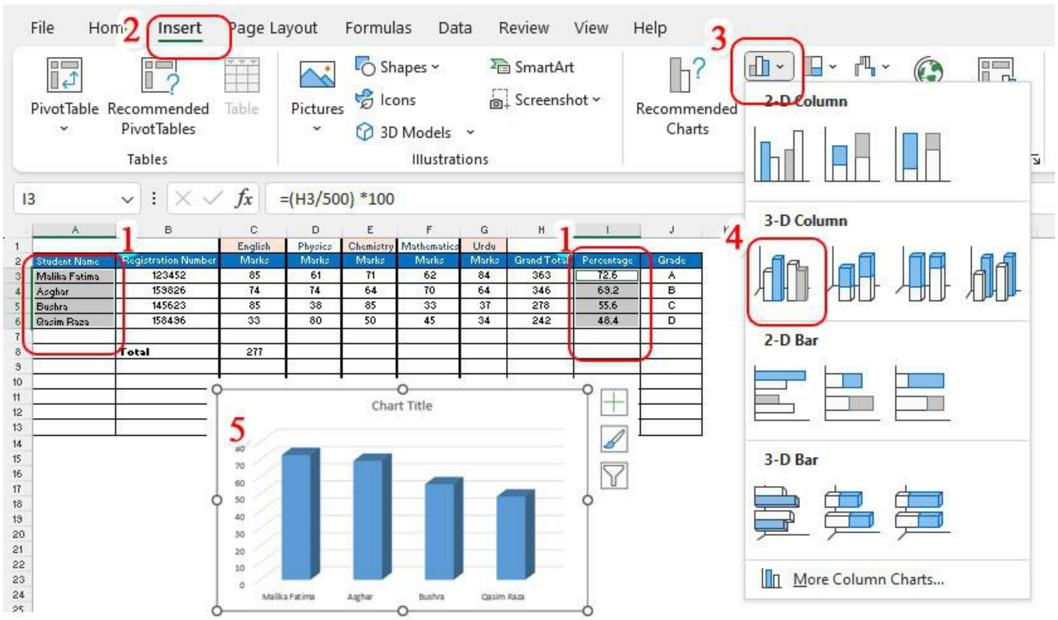


Fig 2.17 Insert Bar chart

Summary

- A **spreadsheet** software is an application software used for analysis and storage of data in tabular form.
- **Microsoft Excel** is a spreadsheet software that is used to organize and manipulate data using formulas and functions.
- **Workbook** is a collection of one or more worksheets in a single file.
- **Microsoft Excel** worksheet is a collection of cells organized in rows and columns that allows you to organize information as a table.
- **Home tab** provides groups of clipboard, editing, styles, font and paragraph; to change settings of spreadsheet such as font type and size, bullets etc.

- **Insert tab** helps to insert different objects in the spreadsheet, like tables, word art, symbols, header, footer, text boxes, equations etc.
- **Page layout** tab is used to set margins, page orientation, page size, line numbers and paragraph etc.
- **Formulas tab** provides many Excel functions categorized in different groups like math, financial, statistical, logical etc.
- **Data tab** handles huge amount of data and provides functions related to it, like importing data etc.
- **Review tab** is used to review spreadsheet for tasks like spell check, dictionary, translation etc.
- A **Formula** is an expression that operates on values in a cell or a range of cells. A formula always begins with an equality sign (=).
- A **Function** is a defined formula that performs calculation using specific values in a particular order.
- Sorting is the process of arranging data in specific order.
- Chart is graphical representation of data in a worksheet.

Workbook	Worksheet
A workbook is the entire file you create and save in Excel	A worksheet is a single page within a workbook. It is where you actually enter and organize your data, and it consists of a grid of rows and columns (cells).
A workbook can contain one or more worksheets, and each worksheet is a separate page within the workbook.	You can have many worksheets in one workbook, each with its own set of data.
It is like a binder that holds all the sheets, charts, and data.	worksheet represented by a tab at the bottom of the screen

Exercise

1. Encircle the correct answers.

i. Microsoft Excel is:
   a) Spreadsheet b) Database Management
   c) Presentation d) Workbook

ii. The intersection of a column and a row in a worksheet is called____
   a) Column b) Value
   c) Cell d) Address

iii. Excel formulas start with?
   a) / b) [ ] c) = d) &

iv. Microsoft Excel feature lets you show only the data in a column (or columns) based on certain criteria?
   a) Sorting b) Formula
   c) Filtering d) Pivot

v. In Excel, Conditional formatting is in: ______________?
   a) Insert tab b) Page layout tab
   c) Data tab d) Home tab

vi. Microsoft Excel function that checks whether a condition is true or false?
   a) SUM() b) IF()
   c) MIN() d) AVERAGE()

2. Provide the descriptive answers of the following questions.

i. Write down the uses of Microsoft Excel?
ii. What is the purpose of formula bar?
iii. Differentiate between workbook and worksheet.
iv. How to add chart into worksheet. Write down the steps.

Important points to remember

- **Spreadsheet:** Software used to store, organize, and analyse data.
- **Tabular form:** Data representation in rows and column
- **Cell:** The basic unit of a worksheet where you can enter data. It is identified by a combination of column letter and row number (e.g. A1, B2)
- **Row:** A horizontal set of cells in a worksheet identified by a number.
- **Column:** A vertical set of cells in a worksheet. It is identified by a letter.
- **Range:** A selection of two or more cells. Represented by the starting and ending cells (e.g., A1:A10).
- **Chart:** A visual representation of data, such as bar, line, or pie charts.
- **Filter:** A tool to display only the rows that meet certain criteria.
- **Ribbon:** The toolbar at the top of the Excel window containing tabs and commands.
- **Cell format:** The way a cell's content is displayed, such as number, text, currency, or date.
- **Clipboard:** A temporary storage area for cut or copied data.
- **Auto fill:** A feature that fills data automatically based on a pattern or sequence.
  - Example: Drag a cell with "1" down to fill cells with "2," "3," "4," etc.

Instruction for Teachers:

- Teachers should motivate students to explore various resources and continue learning independently.
- Divide the class into group of 2 or 3 students.
- Showing all the commands from the each Ribbon of Microsoft Excel.

i. Consider the following worksheet containing the budget and gross of each movie.

Movie	Budget ($)	World Gross ($)	Profit
Spider-Man 3	258,000,000	887,436,184	
King Kong (2005)	207,000,000	553,080,025	
Superman Returns	204,000,000	391,081,192	
Spider-Man 2	200,000,000	784,024,485	
Chronicles of Narnia, The	180,000,000	748,806,957	
Terminator 3: Rise of the Machines	170,000,000	433,058,296	
Shrek the Third	160,000,000	733,012,359	
Harry Potter and the Goblet of Fire	150,000,000	892,213,036	
Harry Potter and the Order of the Phoenix	150,000,000	822,828,538	
Mission: Impossible III	150,000,000	397,501,348	
Troy	150,000,000	497,298,577	

Highest	
Lowest	
Average	

- ➢ Write the formula to calculate the profit.
- ➢ Write the formula to find out the highest profit value.
- ➢ Write the formula to find the lowest profit value.
- ➢ Write the formula to find the average profit value.
- ➢ Sorting the data from highest profit to lowest profit movie.
- ➢ Draw pie chart on the data to show the world gross of each movie.

ii. Prepare the following worksheets and also draw the charts.

- o Student Marksheet
- o Attendance Register
- o Electricity bill

	A	B	C	D	E	F
1	Toys Ordered	Price Each	Quantity Ordered	Cost	Discount	Final Cost
2	BBQ Barbie Doll	12.99	2			
3	Price Eric Dol	8.99	3			
4	Princess Jasmine Doll	9.99	1			
5	Cinderella coach	19.99	1			
6	Spiderman gloves	14.99	3			
7	Total			-	-	-
8						

➢ In cell D2 create a formula to calculate the Cost using the following information:

Cost = Price Each * Quantity Ordered

- Copy the formula down the column to work out the other costs.
- In cell E2 create a formula to calculate the discount using the following information:
  Discount = 7 % of Cost (= 7% * Cost cell)
- Copy the formula down the column to work out the other discounts.
- In cell F2 create a formula to calculate the Final Cost using the following information:
  Final Cost = Cost - discount
- Copy the formula down the column to work out the other final costs.
- In cell B7, create a formula that will add together all the Price Each figure.
- Copy the total formula across the row to calculate the other column totals.

SOME COMMON SHORTCUT KEYS	
Ctrl + N	Opens new / blank workbook
Ctrl + A	Select all contents of the document
Ctrl + B	Bold highlighted selection
Ctrl + C	Copy selected object
Ctrl + X	Cut / move selected object
Ctrl + V	Paste, cut/copied object
Ctrl + S	Save the document
Ctrl + P	Open the print window
Ctrl + Z	Undo last action
Ctrl + Y	Redo the last action performed
Shift + F3	Insert function
F1	Help
F7	Check spelling
F11	Insert new chart
Shift + F7	Thesaurus
Shift + F11	Insert new worksheet
Alt + F4	Exit workbook
Alt +=	Autosum

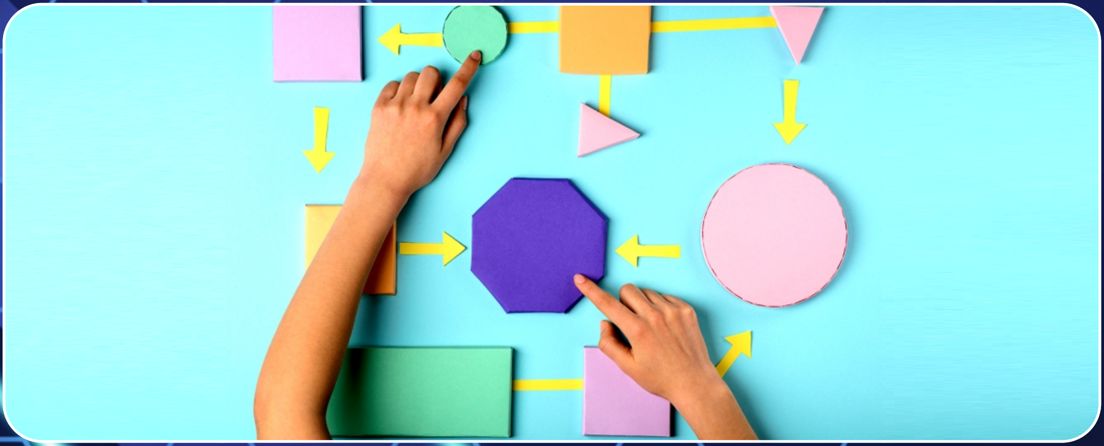
Chapter 3

Algorithmic Thinking and Problem Solving

Student Learning Outcomes (SLOs):

By the end of this unit, students will be able to:

- Define and infer simple and complex problems
- Identify simple and complex problems
- Create algorithms/solutions to simple and complex problems
- Discuss the scope and limitations of complex algorithms
- Discuss the basics of writing pseudocode
- Discuss the concept of constants and variables
- Distinguish situations/problems where If, If then else, and If with multiple conditions can be applied
- Apply repeat and forever loops in algorithm building
- Discuss the concept of nesting
- Apply the concept of nesting up to level 2 in looping and conditions
- Identify problem-solving techniques (sequence, loop, and conditions) applicable to a specific problem
- Compare the performance of two algorithms
- Apply the best possible solution to a problem from the pool of solutions
- Explain with examples, some problems, which cannot be solved computationally



3.1 Introduction to Unit:

In today's world we face various simple and complex problems. It is very important to solve these problems quickly and effectively. Algorithms play a key role in solving various tasks. These tasks can range from simple ones, such as making a sandwich, to complex ones, such as developing algorithms in artificial intelligence.

In this unit we are going to learn the approach of algorithmic thinking to solve the complex problems in a more systematic way. Moreover, we will learn and understand problem-solving strategies for finding the solutions of complex problems by identifying the most efficient algorithms. In this chapter we will also learn the core concept of nesting in algorithms to deal with more complex behavior within an algorithm.

3.2 Simple and Complex Problems:

Problem is something that needs to be solved or overcome. Problems can either be simple or complex. Simple problems have fewer steps and can often be solved in a straightforward manner. The process is clear, and the path from the problem to the solution is usually direct.

- **Example:** Solving basic math equations like 3 + 5 = ?

Whereas complex problem requires multiple steps, often involving layers of decision-making or additional sub-problems that need to be solved first. The solution may not be immediately obvious.

- **Example:** Planning a road trip across multiple cities while optimizing for time, distance, and fuel costs.

Another example of simple and complex problem is illustrated in Figure 3.1(a) and Figure 3.1(b), respectively.

(a)

Problem: Setting an Alarm to wake up in the morning.

Solution: You simply set your alarm on your phone or clock.

(b)

Problem: You want to throw a birthday party for 10 friends. You need to plan the guest list, choose a location, and decide on snacks, games, and activities.

Solution: This requires decision-making, managing different preferences, budgeting, and time

Figure 3.1 Example of Simple and Complex Problem

Activity:

Think for a problem and identify if it is a simple problem or a complex problem. Discuss it with your classmates and teacher.

Activity:

Read each problem and decide if it is simple or complex. Then, explain why you think so.

1. **Problem**: Maryam has 5 apples. Her friend gives her 3 more apples. How many apples does Maryam have now?
   Answer: Is this simple or complex? ____________________
   Explain why:
   ____

2. **Problem**: Maaz is organizing a class trip. He needs to book a bus, plan lunch, and select various activities for the whole day.
   Answer: Is this simple or complex? ____________________
   Explain why:
   ____

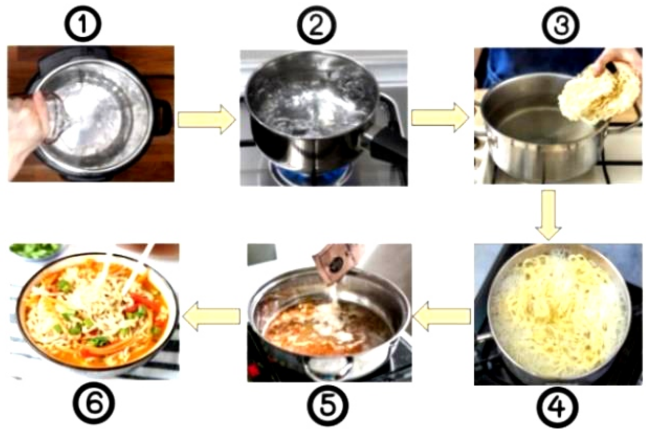
3. **Problem**: Ali is making a cake, and the recipe tells him to add 1 cup of milk, 2 cups of sugar, and 3 cups of flour. Now Ali needs to double the ingredients to make enough for a party.
   Answer: Is this simple or complex? ____________________
   Explain why:
   ____

4. **Problem**: Asher's school is planning a talent show, and he is in charge of getting permission slips, arranging practice schedules, and deciding who will go on stage when.
   Answer: Is this simple or complex? ____________________
   Explain why:
   ____

3.3 Problem Solving Approach:

Problem-solving refers to the process of finding solutions to problems that we come across in everyday life. In other words, problem-solving states that we always have to try to find the necessary steps to be taken in a sequence to complete a task.

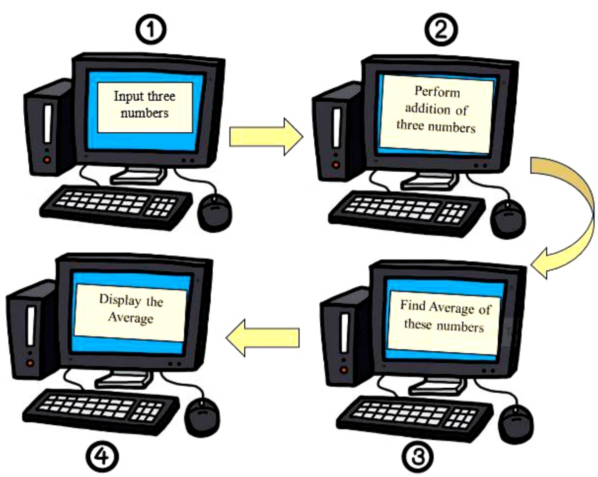
Let us understand the problem-solving approach applied to simple problems with the help of two examples given below. Example-1 is related with a real-world problem and is illustrated in Figure 3.2 along with the sequence of steps to solve it.



Example-1: [Making instant noodles]

1. Pour the water into the pot.
2. Bring it to a boil.
3. Add the noodles to the pot.
4. Cook the noodles.
5. Add the seasoning while cooking noodles.
   - Pour it into a bowl.

Figure 3.2 Step-by-step approach to solve a real-world problem



Example-2: [Finding average of three numbers]

1. Input three numbers.
2. Perform addition of three numbers.
3. Find average.
4. Display the average.

Figure 3.3: Step-by-step approach to solve a computer related problem

However, Example-2 reflects how a computer solves the problem and it is illustrated in Figure 3.3. Both of these examples use a step-by-step approach to solve the problem. This shows that there is always a need for problem-solving processes to complete a task whether it is a real-world problem or it is related to a computer system.

Do you know?

Computers solve complex problems by breaking them down into smaller, manageable tasks and using efficient algorithms to process and analyze the data step by step.

3.4. Computational Thinking:

Computational thinking is the ability to think like a computer and approach problems in a way that is both systematic and creative. It is a set of problem-solving processes that includes several characteristics and perspectives.

There are four steps of computational thinking to solve a complex problem as illustrated in Figure 3.4.

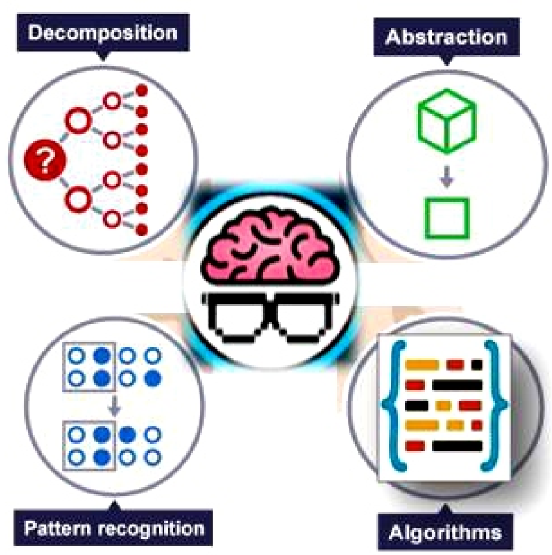


Figure 3.4: Four steps of computational thinking

Step-1: Decomposition

In decomposition step we break down a complex problem into smaller more manageable parts. Let us take an example of a problem "to build a LEGO car". This big problem (building a car from LEGOs) can be solved by decomposing it into smaller manageable tasks such as:

- Gather the LEGO pieces.
- Build the base of the car.
- Attach the wheels.
- Build the body of the car.
- Add finishing touches (lights, windows).

Figure 3.5: Example of decomposition step for building a LEGO car

The decomposition step for building a LEGO car is illustrated in Figure 3.5. By breaking a problem into small manageable parts as described above, it becomes easier to handle each small part instead of solving the whole problem at once.

Step-2: Pattern recognition

Pattern recognition looks for similarities within the problem to make the decision easily. Let us understand it with the help the same example "to build a LEGO car". To identify the similarities for solving the problem of building a LEGO car, you actually observe the past experiences or similar situations such as

- Identifying the pattern of how wheels are attached in multiple cars.
    - This pattern may help you to decide how to attach wheels for building a LEGO car.
- Last time you built a LEGO vehicle by first building the chassis (base of the vehicle), then adding wheels, bodywork, and other details like door and windows.
    - This pattern may help you to decide what elements to be added at the end for building a LEGO car.

Figure 3.6: Example of identifying patterns for building a LEGO car

Figure 3.6 illustrates multiple LEGO cars with similar patterns such as building a base and attachment of wheels.

Step-3: Abstraction

This step of computational thinking focuses on the important information while ignoring the details that are not essential. To understand the concept of abstraction, consider the example of "building a LEGO car". When building a LEGO car, you do not need to think about various unimportant details, such as:

- Decorative stickers
- Spare (Extra) tire
- Detailed color schemes
- Fancy wheel designs
- Fancy lights

However, you must focus on how to attach the wheels so they spin freely, build the body to match the car's style, while ignoring other unnecessary details. For example, in Figure 3.7, the spare tire and the lights are unimportant details for building a LEGO car.

Figure 3.7: Example of Abstraction for building a LEGO car

Step-4: Algorithm

This step of computational thinking involves developing a step-by-step solution to the problem. For example, you can make a following step-by-step plan that can guide you to achieve the task of building a LEGO car:

1. Start with the base (chassis).
2. Add the wheels.
3. Attach the body.
4. Add the windows and lights.

Do you know?

Computational thinking defines how problems can be solved using computer-based processes and algorithms.

3.4.1. Notations for Creating Algorithm:

An algorithm is a well-defined sequence of steps to solve a problem. The basic notations for writing an algorithm are given below:

- **Start:** To mark the beginning of an algorithm.
- **End:** To mark the ending of an algorithm.
- **Read/Input:** It represents the inputs required for the algorithm.
- **Display/Output:** It represents the final result of the algorithm.
- **Steps/Instructions:** The sequence of steps of an algorithm should be in numbered or ordered steps.
- **Conditions:** It shows the decisions using if, else, or elseif.
- **Loops:** It indicates the repetition using loop constructs such as repeat and forever loops.
- **Assignment:** Use equal sign (=) to assign a values.
- **Comments:** These are the optional notes for clarity. Comments are usually written followed by forward double slash '//'.

To understand the above algorithmic notations, let us understand the following example of a simple algorithm for adding two numbers:

```
1.  Start            // Used to mark the starting point
2.  Input: x, y      // x and y are variables that shall take numbers from the user
3.  Sum = x + y      // perform addition of two numbers
4.  Output: Sum      // Output represent the result of addition
5.  End              // Used to mark the ending point
```

It should be noted that all steps in the given example are written in an order starting from 1 to 5.

3.5. Creating Solutions to Problems:

Various methods are used to design and construct a solution to a problem which may include structured diagrams, flowcharts, algorithms, and pseudocode.

- **Structured diagrams:** Structured diagrams are the visual representations that show the organization and relationships between different parts of a solution.
- **Flowcharts:** Flowcharts are the diagrams that use shapes and arrows to represent the flow of a program or solution.
- **Algorithm:** An algorithm is a well-defined list of steps to solve a problem.
- **Pseudocode:** The pseudocode is a formal way of writing steps of an algorithm in human understandable language.

3.5.1 Creating Solutions to Simple Problems:

Creating solutions to simple problems provides help to students in developing the logical thinking and problem-solving skills in a step by step manner. Although, the problem may seem simple, breaking them down into smaller sub problems make the solution more clear and manageable. For example to convert the hours into minutes, we need to break it down into the following sub problems:

- Finding the number of hours
- Calculating the total minutes in given number of hours by multiplying it with the number of minutes present in one hour.

Let us create the algorithm for a simple problem of converting hours into minutes.

```
// Algorithm for converting hours into minutes
1. Start
2. Read: Hours.              // How many hours need to be converted
3. Minutes = Hours * 60.     // One hour = 60 minutes
4. Output: Minutes.
5. End
```

The above example shows how to create solution of simple problems using problem solving approach.

Activity:

Think of any simple problem and create its solution. Present the solution using algorithm.

3.5.2 Creating Solutions to Complex Problems:

Complex problems might require more thinking or need different ways to solve them. Let us understand the problem-solving approach applied to a complex problem with the help of the following example.

Example:

Rayyan has 5 bags of marbles, each containing 12 marbles. He gave 3 bags to his brother, Alyan and then bought 2 more bags of marble, each containing 10 marbles. How many marbles does Rayyan have now?

The solution of the above problem is not straight forward. You require the knowledge of math operations such as addition, subtraction, and multiplication to solve this problem. Also, you need to break down the problem into smaller steps such as:

- Finding how many marbles Rayyan has originally
- Subtracting marbles Rayyan gave to his brother, Alyan.
- Adding the marbles from the new bags he bought
- Finding how many marbles Rayyan has finally

This problem is complex since it requires multiple operations such as multiplication (to count the total number of marbles in a bag), subtraction (for finding the marbles given away), and addition (to count total number of marbles).

// Algorithm

1. Calculate the initial total number of marbles Rayyan has.
2. Subtract the marbles given to the brother.
3. Add the marbles from the new bags.
4. Display total number of marbles.

= 5 bags × 12 marbles per bag
= 60 marbles.

= 3 bags × 12 marbles per bag = 36 marbles.
= 60 marbles – 36 marbles
= 24 marbles remaining.

= 2 bags × 10 marbles per bag = 20 marbles.
= 24 marbles + 20 marbles
= 44 marbles.

Rayyan now has **44 marbles**.

Activity:

Suppose you are organizing a pizza party for your class of 20 students. Each student must be served 2 slices of pizza. Each pizza has 8 slices and cost 1000 rupees. Find how many pizzas you need to buy to serve all 20 students and the total cost of the pizzas for the party. Write sequence of steps to solve this real-world problem.

3.5.3 Scope and Limitations of Complex Problems:

The scope of a problem defines what we are focusing on in a problem. We may think of scope as setting the boundaries. However, the limitations refer to the things that makes it harder to solve the problem. It may also include the things that we cannot change.

To understand the scope and limitations of a complex problem, imagine you are a student trying to balance homework, sports practice, and hanging out with friends. You want to do well in school, stay active, and still save time for socialization. This becomes a complex problem because it is hard to find the perfect balance among all your activities due to the following reasons:

- **Limited Time:** There are only 24 hours in a day, and you have to juggle many tasks: school, sports, homework, and social time. You also need time to eat and sleep. Even with careful planning, there is no guarantee you can fit everything in.
- **Unpredictable Tasks and Events:** Sometimes, a homework assignment takes longer than expected, or a surprise project is assigned. Also, you might have an unexpected event such as a family emergency, or you get sick. These unexpected events can disturb your routine and make you change your plan. This can mess up your schedule and make it harder to manage everything.
- **Changing Priorities:** Some days, you might want to spend more time on sports. On other days, you may need to focus more on your school work. Your mood and what is important to you can change. This can make it difficult to follow a set plan.

This problem is considered as a complex problem because it involves multiple factor such as time limits, unexpected tasks, changing priorities, and surprise events. It is difficult to achieve a perfect balance in the presence of multiple factors. Even if you make a plan, there is no guarantee that your day will go as scheduled.

In short, Simple problems can be solved easily while the solution of a complex problem is not guaranteed. You can try your best to create a solution for a complex problem. However, various unpredictable factors make it difficult to guarantee that you will always have a solution.

Do you know?

Scope defines what part of a problem we will focus on in solving a problem. However, **limitations** define what challenges will make it harder to solve a problem.

3.6. Pseudocode:

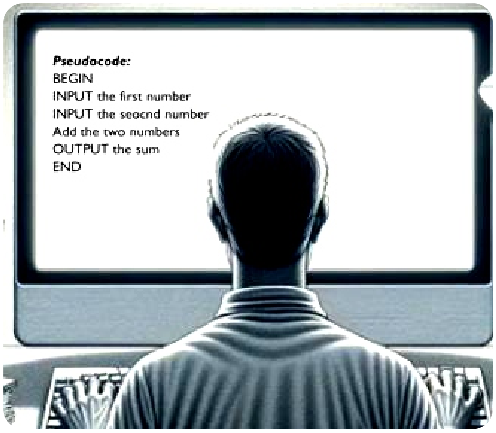
A Pseudocode is a simple method of showing an algorithm. It is a way to describe problem-solving instructions using any human understandable language. It also serves as a communication option that can help us explain our ideas to other people. Programmers often use pseudocode as an intermediate step in programming in between the initial planning stage and the stage of writing the actual executable code.

Do you know?

Pseudocode is pronounced by keeping the first character 'P' silent and breaking the remaining word into two parts: "seudo" and "code".

3.6.1. Basics of Writing a Pseudocode:

Writing the pseudocode allows you to focus on the logic of the solution. It allows you to focus without worrying about syntax. There are no set guidelines for writing a pseudocode. However, it can be helpful to use simple English words like input, output, if-then-else, for, while, do, etc. Here are some basics of writing a pseudocode:



- **Start with a Clear Objective:** A Pseudocode must begin with a clear statement of its purpose to help the readers what problem is being solved.

- **Sequential Steps:** Pseudocode should always follow a logical and clear sequence of steps. To start writing, put the tasks in proper order first then start writing.
- **Use Simple Language:** Pseudocode should be written using easy-to-understand language.
- **Proper Naming Conventions:** Use variable names which should be meaningful and concise.
- **Clear Start and End:** Start a pseudocode with a "Begin" or "Start" and end it with a "Stop" or "End" to indicate the boundaries of the process.
- **Use Indentation for Hierarchy:** Indentation means to add spaces or tabs at the beginning of lines to visually represent the structure and hierarchy of the program to make it more readable.

Do you know?

Syntax refers to the rules and structure that determine how to write lines of code in programming. **Indentation** means adding spaces or tabs at the beginning of a line in a program to show its position. For example, in English writing, indentation is used to start a new paragraph.

A Pseudocode to Compute Area of Rectangle:

To understand the above basics let us write a pseudocode for computing the area of a rectangle.

```
// Pseudocode for Displaying the Area of a Rectangle

Begin
    Input Length.
    Input Width.
    Compute Area = Length * Width.
    Display Area.
End
```

This pseudocode is written in an order and is starting with a clear objective followed by //.

This pseudocode makes use of simple English words. For e.g. Input, Display.

It follows proper naming convention. For e.g. length, width, and

It makes use of "Begin" and "End" to mark the starting and ending point of the pseudocode.

Do you know?

The main goal of pseudocode is to communicate the logic of your solution clearly and simply. Think of it as writing instructions for a friend who wants to know how to solve a problem, without worrying about the details of a specific programming language.

Activity:

Write a pseudocode to compute the area of a circle.

Activity:

Write a pseudocode to convert the temperature from Celsius to Fahrenheit

3.7. Constructs and Variables:

3.7.1. Constants:

In a computer program, a constant is a container with name. This container contains a fixed number or amount. The value of a constant does not change during the execution of a program. Some examples of constants are defined below and also illustrated in Figure 3.8.

- **Number of Days in a Week:** There are always 7 days in a week. We can say 7 is a *constant* as it cannot be changed.
- **Number of Hours in a Day:** A day always has 24 hours. This does not change, so 24 is a *constant*.
- **Pi in Math (π):** The value of Pi (π) is always 3.14 and it never changes, so we call it a *constant*.

```
// Example of constants
    days_in_week = 7
    hours_in_day = 24
    PI = 3.14
```

Here, 7 is a constant number, because the number of days in a week will always remain the same.

Here, 24 is representing a constant value which will remain fixed for any situation.

The value of pi always remains same as 3.14. So 3.14 is also a constant.

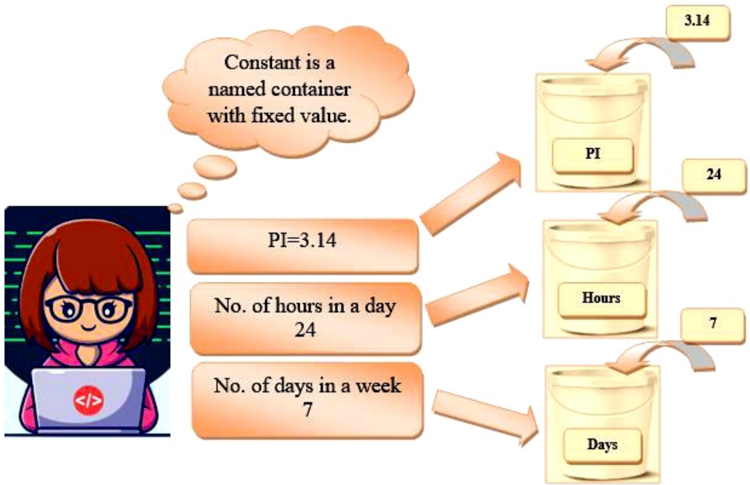
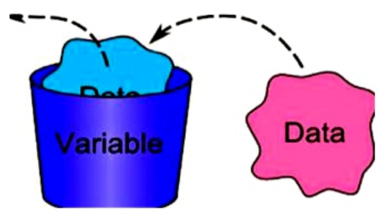
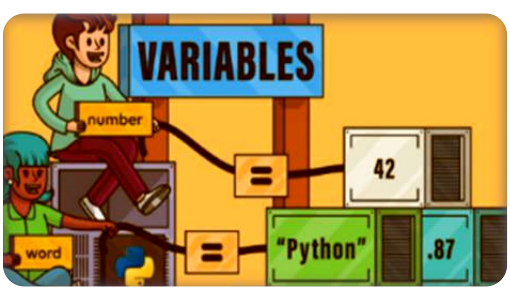


Figure 3.8: Examples of Constant

3.7.2. Variable:

A **variable** is like a container that can hold a value. However, this value can be changed or updated anytime during the execution of the program. Let us imagine we have a bowl for sugar, and today we put "2 cups of sugar" in it. Tomorrow, we might want to add more or remove some. So, if a recipe asks for different amounts each time, we will change what is in the bowl. In this example, bowl is acting like a variable. This is how variables work in code.





Variables store values that might need to be updated, like a score in a game or the number of attempts left in a game. For Example, to store the total score in a game we may use a variable "score" which is initially assigned a value of 10 and after some time it may be updated to another number as given below:

```
// Example of a variable to store the score in a game.

score = 10
score= score + 5
```

Here the "score" is the name of variable that is used as a container to contain the score of a game.

Similarly, in the following example a variable, "student_name", is used. Initially, the variable (student_name) is assigned a value of "Zara" and then updated to store another name, "Zain".

// Example of variable "student_name" to store the name of a student.

student_name = "Zara"

Here, "student_name" is a variable that holds the name "Zara." If a new student's name needs to be stored, the value of variable "student_name" can be changed.

Initially value of the variable, "student_name" is Zara.

The updated value of the same variable, "student_name", is Zain. Hence, it shows that a variable can vary.

Activity:

Read the given scenario and identify the data represented by this problem and store it in variable or constant.

"Akif is setting up a Juice shop. For each glass of juice he sells, he charges 100 rupees. He plans to work from 1:00 p.m. to 3:00 p.m., which means his shop will be open for exactly 2 hours. He wants to know how much money he will make if he sells different numbers of glasses.

Variables:

____

____

Constants:

____

____

Hint: Given scenario describes the following four different data values;

- The *number of glasses* of juice sold
- The *total money* he makes
- The *price per glass* of juice
- The *time* his shop will be open, which is 2 hours.

3.8. Sequential Flow Construct in Problem Solving:

The sequential flow construct refers to the execution of the lines in a program from top to bottom, in the exact order in which they are written. In sequential flow, each step follows the previous step without involving any conditions or repetitions.

```
// Pseudocode for Displaying the Square of a Number
Begin
  Input Number.
  Compute Square = Number * Number.
  Display Square.
End
```

In the given pseudocode, the execution flow is purely sequential as each line executes only once in the given order to display the square of a number.

3.9. Conditions in Problem Solving:

When solving a problem, we might have different options. A condition helps us pick the required one. To understand conditions consider an example shown in Figure 3.9, and imagine we want to solve a problem, "Choosing what to wear?" To solve this problem, we may decide what to wear based on the weather:

- If it is sunny, we wear a t-shirt.
- If it is winter, we wear a sweater.
- If it is raining, we wear a raincoat.

Figure 3.9: Examples of Conditions

This is a conditional statement because we are making a decision based on the condition of the weather. The condition (sunny, rainy, or winter) determines what action we will take (what we wear).

The most common types of conditional statements which allow us to control the flow of our code based on specific conditions are defined below with example.

If-Statement: If statement is a programming construct that allows us to make decisions in our code. It checks the condition and takes an action or set of actions only if the condition is true as shown in Figure 3.10. For example, imagine we are deciding whether to take an umbrella:

IF it is raining
    Take an umbrella

In this example the condition is "***Is it raining?***" and the action is ***"take an umbrella"***.

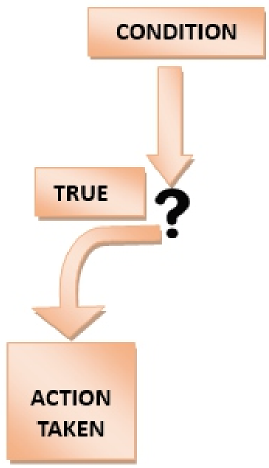


Figure 3.10: Flow of If-Statement

The pseudocode of the If statement is given below:

```
Pseudocode:

IF condition-1
    perform action-1
```

If-Else Statement: If-Else statement is another conditional statement which performs an alternative action even if the condition is false as shown in Figure 3.11. For example: "If it's raining, take an umbrella; otherwise, wear sunglasses."

IF it is raining
    Take an umbrella
Else
    Wear the sunglasses

In this example there is only one condition that is "***Is it raining?***" and there are two actions:

1. ***"take an umbrella"*** and
2. ***"Wear the sunglasses"***.

In the given example, if the condition of raining becomes true then action-1 (*take an umbrella*) will be performed and if the condition of raining becomes false then action-2 (*wear the sunglasses*) will be carried out. The If-Else construct is shown in Figure 3.11.

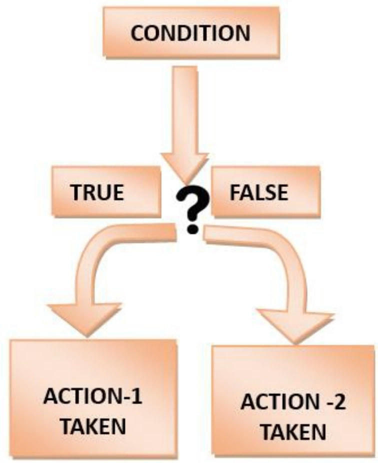


Figure 3.11: Flow of If-Else Statement

The pseudocode of the If-Else statement is given below:

```
Pseudocode:

IF condition-1
    perform action-1
ELSE
    perform default action
```

IF-ELIF-ELSE Statement: The IF-ELIF-ELSE statement allows us to check for multiple conditions. The term "ELIF" means "else if," so it keeps on checking multiple conditions in order until it finds the one that is true. If none of the conditions are true, it executes the actions (statements) in the **ELSE** block as a final option. The flow chart of IF-ELIF-ELSE statement is shown in Figure 3.12. For example, IF weather is “sunny” then wear glasses, ELIF weather is "rainy" then take umbrella, ELIF weather is "snowy" then build a snowman, ELSE "Enjoy the weather”.

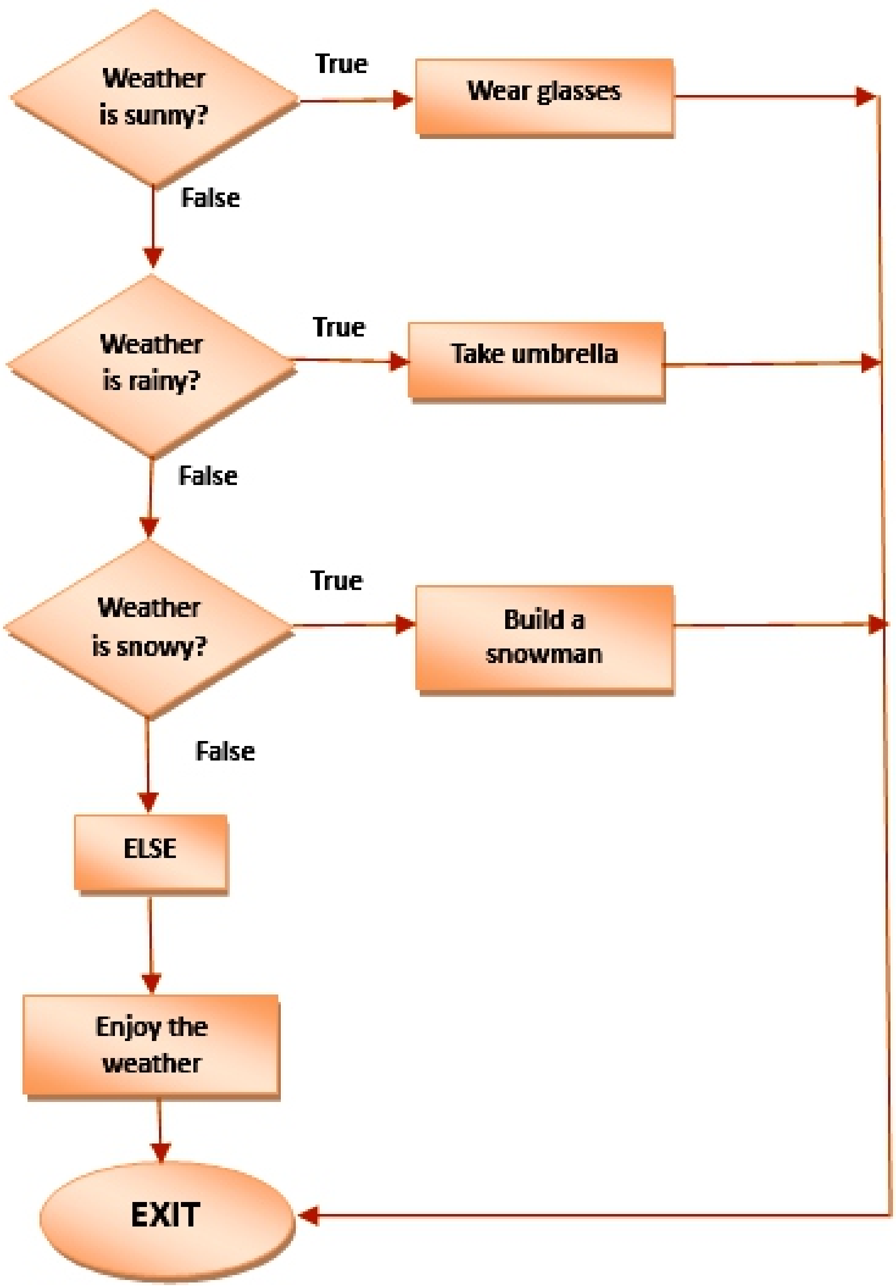


Figure 3.12: Flow of If-ELIF-ELSE Statement

Quick Tip:

Conditional statements are also known as Selection Statements which allow a program to make decisions based on whether something is true or false. They are like "if this happens, then do that!

This example consists of multiple conditions and multiple actions associated to each condition. In this example there are three following conditions:

Condition-1: "Is weather sunny?"

If this condition-1 is true then Action-1 (wear glasses) will be performed and if the condition-1 is false then another condition-2 ("Is weather rainy?") will be checked.

Condition-2: "Is weather rainy?"

Similarly, if the condition-2 is true then Action-2 (take umbrella) will be performed and if the condition-2 is false then another condition-3 ("Is weather snowy?") will be checked.

Condition-3: "Is weather snowy?"

Similarly, if the condition-3 is true then Action-3 (build a snowman) will be performed and if the condition-3 is false then another condition will be checked.

In this way we can check any number of conditions. However, in the given example we have only three conditions and after checking all of the given conditions the default action (Enjoy the weather) associated with the ELSE part will be performed.

The pseudocode of the If-Else statement is given below:

```
Pseudocode:

IF condition-1
    perform action-1
ELIF condition-2
    perform action-2
ELIF condition-3
    perform action-3
    .
    .
    .
ELSE
    perform default action
```

3.10. Loop:

In computer programming, a loop is used to repeat an action many times. Loops are also called as iterative statements. A loop is a basic programming construct that repeats a single or a set of instructions until a given condition is met. It is like saying, "Keep doing this until I say stop!"

3.10.1. Repeat Loop:

The **Repeat Loop** is ideal when you know exactly how many times you need an action to repeat or iterate. It is especially useful in algorithms where you need a specific number of iterations to complete a task. Some of the examples where repeat loops can be useful are given below:

- Addition of numbers
- Counting occurrences
- Iterating through a fixed number of items in a list
- Moving a character a set number of spaces
- Collecting data a specific number of times

Example Algorithm (Counting Down Using Repeat Loop):

Algorithm to count down from 5 to 1:

```
1. Start
2. Set counter = 5
3. Repeat 5 times:
4.      Display counter
5.      Decrease counter by 1
6. End
```

In this case, the algorithm will display 5, 4, 3, 2, 1 in sequence and then stop.

3.10.2. Forever Loop:

A **Forever Loop** (or infinite loop) is useful when you want an action to repeat indefinitely. This loop iterates continuously until a **break** or **exit** condition is met. Forever loops are useful in games, animations, and programs that need to iterate constantly. For example, displaying balloons moving in the background of an image can be an example of a forever loop.

Example Algorithm (Counting Coins Using Forever Loop):

Example of an algorithm for a game where a player keeps collecting coins is given below:

```
1. Start
2. Set coins_collected = 0
3. Forever:
4.    Collect a coin
5.    Increase coins_collected by 1
6.    Display "Coins collected so far: [coins_collected]"
7. End
```

In this example, the forever loop allows the game to continuously iterate and keep on collecting the coins until the game ends.

Quick Tip:

A **Forever Loop** keeps repeating the same steps without stopping until the program is manually stopped.

3.11. Concept of Nesting:

In programming, *nesting* is like a bird's nest, where there are layers within layers. The term *nesting* in programming mirrors its use in everyday language, like a nest of a bird, which consists of layers within layers as a place of shelter. Similarly, in programming, *nesting* refers to placing one structure inside another, creating layers (steps) to work together in the code. This structure can involve either loops or conditions, each nested within the other to form a multi-layered sequence of operations. This will allow us to create more complex patterns by layering the logic.

3.11.1. Nested Loops:

The execution flow of nested loops involves the outer loop executing its entire cycle while the inner loop completes its cycle for each iteration of the outer loop. This leads to the inner loop being fully executed multiple times within a single iteration of the outer loop.

Let us consider an example where we want to loop through each day of a week for 3 weeks. To achieve this, we can create a loop to iterate three times (3 weeks). And inside the loop, we can create another loop to iterate 7 times (7 days). This is how we can use nested loops. This example is illustrated in Figure 3.13.

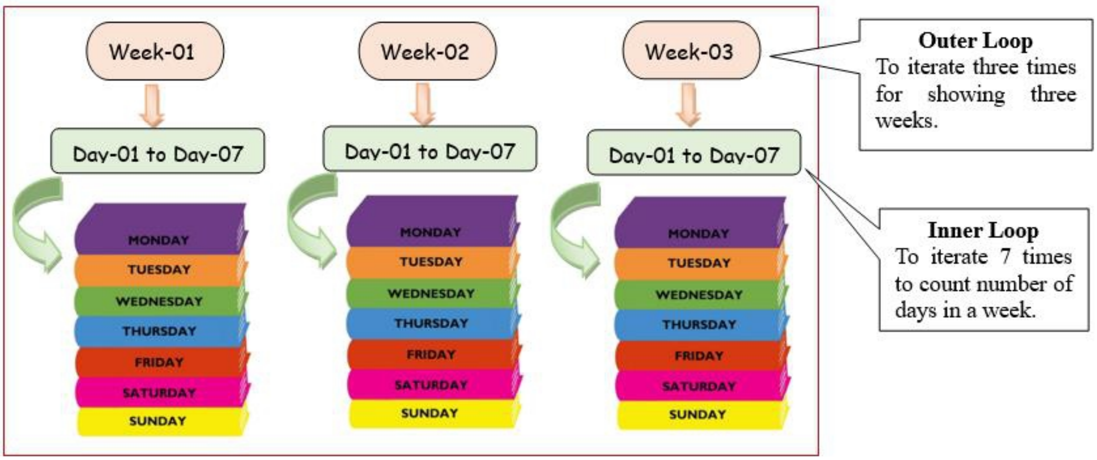


Figure 3.13: Example of a Nested Loop

The pseudocode for this example is given below:

Pseudocode:

```
BEGIN
        week ← 1
        REPEAT // Outer loop for 3 weeks
                day ← 1
                REPEAT // Inner loop for 7 days
                        PRINT " Day", day
                        day ← day + 1
                UNTIL day > 7
                week ← week + 1
        UNTIL week > 3
END
```

Outer Loop

Inner Loop

3.11.2. Nested Conditions:

Nesting conditions means placing one if (or if-else) statement inside another. This allows you to check multiple layers of conditions, where the inner condition only runs if the outer condition is true. To understand the concept of nesting condition, let us consider the following example:

Example:

Imagine Rubaisha is deciding if she can go to the park based on two things:

1. Is it sunny?
2. Does she have permission from her parents?

Here is how we can write that as a **nested condition**:

1. First, we check if it is sunny.
2. If it is sunny, we then check if Rubaisha has permission.
3. If both are true, then Rubaisha can go to the park.

The pseudocode for this example is given below:

Pseudocode:

```
IF it is sunny
    IF Rubaisha has permission
            Display "Rubaisha can go to the park!"
    ELSE
            Display "Rubaisha cannot go to the park
            because she does not have permission."
ELSE
        Display "Rubaisha cannot go to the park because it is
        not sunny."
```

Outer Condition

Inner Condition

In the above pseudocode example of nested conditions, one IF statement is placed inside another IF statement. The **outer condition** checks if it is sunny and if this condition is true (means if it is sunny**)**, then we go into the **inner condition** to see if Rubaisha has permission. If both conditions are true, then the message "Rubaisha can go to the park!" appears. If either condition is false, it explains why you cannot go.

Activity:

Which type of conditional statements is used to describe the following scenarios? Write the name of the statement.

1. If the marks of a student are 60 then he is pass.

____

2. Checks if Omer has saved 100 rupees from his pocket money. If he has, he can buy ice cream; otherwise, he needs to save more money.

____

3. A student can attend the field trip if he has a signed permission slip and if he has paid the trip fee, otherwise display a message “You need to pay the fee or You need a permission slip."

____

4. Check the following conditions and suggest clothing based on the temperature. If the temperature is 15°C then suggest to wear warm clothes, if the temperature is above 25°C then suggest to wear a light t-shirt, if the temperature is above 35°C then suggest to wear shorts. If none of the conditions become true then suggest “check weather conditions”.

____

5. If Hafsa is crying the she needs to have food.

____

6. Ahsan wants to play video games. First, he checks if it is the weekend, then he checks if his homework is done.

____

7. Sohaib is deciding whether to buy ice cream depending on whether he has enough money.

____

8. Sammer is deciding if she can stay up late. She is allowed to stay up late only if it is the weekend or if there is no school the next day.

____

3.12. Applying Problem Solving Technique:

This section will help us explore how to apply the problem-solving techniques (Sequence, Loops, and Conditions) to various scenarios or problems. To achieve this, let us examine the given scenario and determine which problem-solving technique should be used to address the given problem.

Problem: We want to write an algorithm to determine grade of a student based on the marks entered by the students. The algorithm needs to do the following:

1. Check if the marks are valid (between 0 and 100).
2. If valid, determine the grade based on the score:
   - If score is 90 or more, print "A".
   - If score is 80 or more, print "B".
   - If score is 70 or more, print "C".
   - Otherwise, display "Fail".
3. Repeat this for multiple students.

The given scenario represents a combination example. Let us see how the given scenario makes use of all three techniques: sequence, loops, and conditions.

Check if marks are valid (between 0 and 100):

- Initially, we need to check if the marks entered by the student are valid.
- If the marks are outside the range (less than 0 or greater than 100), the algorithm should inform the user that the input is invalid.
- The If- Else condition is used to solve the above task.

Determine grades based on marks:

- Once the marks are confirmed to be valid, we need to determine a grade based on the score.
- For example:
  - 90 or above: Grade A
  - 80-89: Grade B
  - 70-79: Grade C
  - Below 70: Fail
- This is where we check different conditions for each range of marks and determine the correct grade, therefore, the condition (IF-ELIF-ELSE) is used to compare the marks within predefined ranges and determine the grade accordingly.

Repeat for multiple students:

- We need to allow the algorithm to check the marks of multiple students, not just one.
- Since, for each student, the algorithm should ask for the marks, validate them, and then determine a grade. Therefore, a repeat for loop is used here to repeat the process for each student.

- A for loop can be used to ask for marks repeatedly, validate them, determine grades, and continue until all students are processed.

The complete algorithm for the given scenario is mentioned below:

```
1. START

   // Ask for the number of students
2.     DISPLAY "Enter the number of students:"
3.     READ number_of_students

        // Loop for each student
4.      FOR student FROM 1 TO number_of_students DO
                // Ask for marks
5.              DISPLAY "Enter marks for student ", student, ":"
6.              READ marks

               // Validate marks (check if they are between 0 and 100)
7.              IF marks < 0 OR marks > 100 THEN
8.              DISPLAY "Invalid marks. Please enter marks between 0 and
               100."
9.              CONTINUE // Skip the current iteration and ask for marks again

               // Determine grade based on the marks
10.            IF marks >= 90 THEN
11.                    DISPLAY "Grade: A"
12.            ELSE IF marks >= 80 THEN
13.                    DISPLAY "Grade: B"
14.            ELSE IF marks >= 70 THEN
15.                    DISPLAY "Grade: C"
16.            ELSE
17.                    DISPLAY "Fail"
               END IF

18.     END FOR
```

Represents the Sequential Flow

Represents the Repeat for Loop

Represents IF Construct

Represents the IF-ELIF-ELSE Construct

Do you know?

We use **AND** when both conditions must be true, and use **OR** when at least one condition must be true.

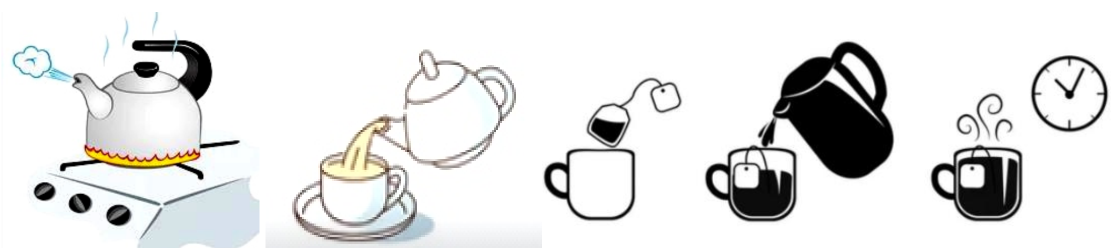
- **AND:** if condition1 AND condition2 – Both must be true for the block to execute.
- **OR:** if condition1 OR condition2 – Either one must be true for the block to execute.

3.13. Comparing the Performance of Two Algorithms:

It is important to note that even for the same task, two algorithms can perform differently. This is because there can be numerous solutions of one problem with various methods. For example, to make a cup of tea there can be following two methods as shown in Figure 3.14.

- making a cup of tea using steeping tea in a teapot
- making a cup of tea using a tea bag in a cup

Both methods result in a cup of tea, but they offer different experiences in terms of time and flavor. The first method takes a bit longer but allows the flavors to develop fully and the second method is quicker since you do not have to use a teapot, but it may not allow for the same depth of flavor as the first method. This illustrates how two different algorithms can achieve the same goal with varying approaches.



(a) (b)

Figure 3.14: Two Ways of Making a Cup of Tea

The choice of one algorithm depends on your specific needs at the moment, whether you are prioritizing time or flavor. Similar considerations are applied in algorithm design, the context and requirements of the task will guide us towards the best algorithm to use.

Do you know?

The speed and efficiency of an algorithm is measured in terms of **Time Complexity** and **Space Complexity**. It means that an algorithm will be efficient if it is taking less processing time and less storage space in a computer system.
That is why, two algorithms for the same problem will perform differently even on same computer system as both are different in using processor's time and storage space in memory.

Let us consider an example of swapping values of two variables. We will analyze the two possible algorithms in terms of time to exchange the values of two variables. These two possible algorithms are given below:

Algorithm-1: (Using a Temporary Variable)

Step-1: Start
Step-2: Take two numbers 'a' and 'b' as input.
Step-3: Create a temporary variable, 'temp'.
Step-4: Store the value of first variable, 'a' in 'temp'.
Step-5: Assign the value of variable, 'b' to variable, 'a'.
Step-6: Assign the value of variable, 'temp' to variable, 'b'.
Step-7: Display the values of swapped variable, 'a' and 'b'.
Step-8: End

Let a = 5 and b = 10.
1. temp = a → temp = 5
2. a = b → a = 10
3. b = temp → b = 5
Result: a = 10, b = 5

Algorithm-2: (Without Using a Temporary Variable)

Step-1: Start
Step-2: Take two numbers 'a' and 'b' as input.
Step-3: Add 'a' and 'b' and assign the result to 'a'.
// Now 'a' holds the sum of both numbers.
Step-4: Subtract the new value of 'a' by 'b' and assign the result to 'b'.
// Now 'b' holds the original value of 'a'.
Step-5: Subtract the new value of 'b' from 'a' and assign the result to 'a'.
// Now 'a' holds the original value of 'b'.
Step-6: Display the values of swapped variable, 'a' and 'b'
Step-7: End

Let a = 5 and b = 10.
1. a = a + b → a = 5 + 10 = 15
2. b = a - b → b = 15 - 10 = 5
3. a = a - b → a = 15 - 5 = 10
Result: a = 10, b = 5

The first algorithm is easy to understand but requires an extra variable, temp, which takes an extra space in memory. However, the second algorithm saves the space but involves the use of arithmetic operations and hence a little tricky to understand. The choice of algorithm depends on factors such as memory constraint and easiness.

Do you know?

Not all problems have same level of complexity!

Let us consider another example of computing average of five numbers. We will analyze the two possible algorithms in terms of the number of steps required to compute the average of five numbers. The two possible algorithms are given below:

Algorithm-1: (Without Using Loop Construct)

Step-1: Start
Step-2: Take first number 'n1'as input.
Step-3: Take second number 'n2'as input
.Step-4: Take third number 'n3'as input.
Step-5: Take fourth number 'n4'as input.
Step-6: Take fifth number 'n5'as input.
Step-7: Calculate the sum of the five numbers as, sum = n1 + n2 + n3 + n4 + n5.
Step-8: Calculate the average as, average = sum / 5.
Step-9: Display the average.
Step-10: End

Algorithm -2: (Using Loop Construct)

Step-1: Start
Step-2: Consider initial value of sum as zero, sum=0.
Step-3: Use a loop with five cycles.
Step-4: For each cycle of the loop do the following:
  a. Take input of a number.
  b. Add the input number to sum.
Step-5: Calculate the average as, sum divide by 5.
Step-6: Display the average.
Step-7: End

Algorithm 1 requires more steps (a total of 10) and is simpler when averaging exactly five numbers. On the other hand, **Algorithm 2**, requires fewer steps (only 7).

It offers flexibility by allowing us to easily change the number of inputs. If our goal is to be efficient with a fixed case of five inputs, **Algorithm 1** is the best choice. However, if we expect to change the number of inputs often, **Algorithm 2** would be a better option.

3.14. Selection of Alternate Solution:

Whether it is a daily life problem or a computer problem, there always exist multiple solutions to solve the same problem. However, we must choose the best one. The best solution is the one that takes minimum number of steps and computer resources to solve the given problem. To understand how to choose the best solution, let us consider the example of a computer problem to find whether a given positive number is PRIME or not. To solve this problem, there can be three possible solutions whose algorithms are given below:

Solution-1

Step-1:	Start
Step-2:	Take a number ‘n’ as input.
Step-3:	If the ‘n’ is greater than 1, keep on dividing this number with natural number starts from 2 and ending with n-1.
Step-4:	If any number from 2 to n-1 divides ‘n’ and you get the reminder 0, print that the number ‘n’ is not a prime number.
Step-5:	If step-4 fails, display that the number is prime.
Step-6:	End

Solution-2

Step-1:	Start
Step-2:	Take a number ‘n’ as input.
Step-3:	If the ‘n’ is greater than 1, keep on dividing this number with natural number starts from 2 and ending with n/2.
Step-4:	If any number from 2 to n-1 divides ‘n’ and you get the reminder 0, print that the number ‘n’ is not a prime number.
Step-5:	If step-4 fails, display that the number is prime.
Step-6:	End

Solution-3

Step-1:	Start
Step-2:	Take a number 'n' as input.
Step-3:	If the 'n' is greater than 1, keep on dividing this number with natural number starts from 2 and ending with square-root of n.
Step-4:	If any number from 2 to n-1 divides 'n' and you get the reminder 0, print that the number 'n' is not a prime number.
Step-5:	If step-4 fails, print that the number is prime.
Step-6:	End

Let us analyze all three solutions of the same problem of finding whether the given number is prime or not. We can observe that all of the three solutions, are correct but different. Now the question is which solution should be selected for problem solving? Before we answer this question, let us first look at the solutions carefully. We will observe that all three solutions are different in terms of the following points:

- In first solution, the steps of calculations are starting from 2 and ending on n-1 value, where n is the input number which is tested to be prime or not.
- In second solution, the steps of calculations are starting from number 2 and ending on n/2.
- In third solution the steps of calculations are starting from number 2 and ending on square root of n.

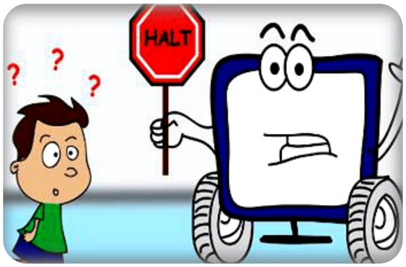
However, we know that square root of n < n/2 < n-1. It means that the third solution is offering the least number of steps with maximum efficiency of algorithm. Hence, third solution is selected as the best solution.

Do you know?

An efficient algorithm gives maximum output with minimum resources.

3.15. Problems That Cannot be Solved Computationally:

Although computers are powerful tools, they still have limitations. Some problems cannot be solved by computer. These problems are too complex or unpredictable. An example is the halting problem.



The term "Halting" means stopping or finishing a program after it has run for a while. The Halting problem happens when computer cannot tell if a program will ever stop.

For example: If our program does not halt, it will keep the CPU busy forever. In programming, we say it is an infinite loop. Our programs should never get into infinite loops otherwise, the system will not work properly.

.

Summary

- Simple problems are those which are easy to understand, analyze and solve.
- Complex problems are those which take more time and effort to solve because they involve multiple parts or steps.
- Scope of a Problem refers to the boundaries or limits that define what the problem includes and what it does not.
- Pseudocode is a formal way of writing instructions in human understandable language to describe the steps of an algorithm.
- A constant is a value that does not change during the execution of a program.
- A variable is a storage location in a program that holds a value that can change during execution.
- Conditional statements allow a program to make decisions based on whether a condition is true or false
- A repeat loop iterates a set of instructions a specific number of times, while a forever loop iterates indefinitely until interrupted.
- Nesting refers to placing one structure (like loops or conditional statements) inside another to create more complex logic.
- The performance of two algorithms refers to how efficiently they solve a given problem.
- There are different ways to solve the same problem, each leading to the correct outcome. These solutions may vary in approach, steps, or efficiency.
- The halting problem is the challenge of determining whether a program will eventually stop or run forever for a given input.

Exercise

1. Encircle the correct answers.

i. An algorithm is _____?
a) A type of computer
b) Set of instructions to solve problem
c) Programming language
d) A game

ii. An example of a conditional statement is _________?
a) Loop
b) If-Else
c) Print
d) Variables

iii. The purpose of breaking a large problem into smaller problems in algorithmic thinking is ___________?
a) To make the problem harder
b) To make the problem easier to solve
c) To add more steps
d) To confuse the computer

iv. A computer uses __________to make decisions?
a) Looping
b) Variables
c) Conditional Statements
d) Functions

v. Identifying patterns, trends, and regularities in data, as well as recognizing similarities within the problem, is known as _______?
a) Abstraction
b) Decomposition
c) Pattern Recognition
d) Algorithmic Thinking

vi. Focusing only on the important details while ignoring irrelevant information is __________?
a) Decomposition
b) Abstraction
c) Algorithm Design
d) Pattern Recognition

vii. An example of a nested loop is _______?
a) A loop that runs 5 times
b) A loop inside another loop
c) A forever loop
d) IF-ELSE-IF condition

viii. The Else part of IF-ELIF-ELSE construct is executed when _________?
a) All conditions are true
b) All conditions are false
c) Forever loop is used
d) Repeat loop is used

ix. _______ allows us to take a complex problem, understand what the problem is, and develop possible solutions.
a) Computational Thinking b) Nested Loop
c) Pseudocode d) Conditional Statements

x. An example of a "for loop" is _________?
a) "If x = 5, then do something"
b) "Repeat the steps 10 times"
c) "Print a message"
d) "Set a variable"

2. Provide the descriptive answers of the following questions.

i. What is the difference between pseudocode and a flowchart? Which one is more preferable and why?
ii. What is the difference between a problem and a solution in the context of algorithmic thinking?
iii. What is the role of decomposition in problem-solving? Provide an example.
iv. How does abstraction help in solving problems? Give an example.
v. What is meant by halting problems? Give some example of problems that cannot be solved by a computer.

3. Write pseudocode for the following tasks:

i. Write pseudocode to input ten positive numbers and find the sum and the average of these numbers.
ii. Write a pseudocode that prints all the even numbers between 1 and 100.

4. Write algorithm for the following tasks:

i. Write an algorithm that takes any number as input and check whether the number is positive or negative.
ii. Write an algorithm that finds the largest number in a list.

5. Class Activities:

i. Think of a problem which can be solved in different ways. Write algorithms for all these solutions. Also explain which solution is best and why?
ii. Write an algorithm to determine whether a student qualifies for a scholarship based on their grade. The algorithm takes the grade as input and applies the following conditions:

- If the grade is A+, the student is awarded a 100% scholarship.
- If the grade is A, the student is awarded an 80% scholarship.

- If the grade is B, the student is awarded a 50% scholarship.
- For any other grade, no scholarship is awarded.

iii. Write an algorithm to calculate the total sales of a shop for a month. The algorithm should take the sales for each day of the month as input and add them up to give the total sales. Assume the month has 30 days.

iv. Write an algorithm to print the following pattern of asterisks

```
**********
**********
**********
```

Important points to remember

- **Problem-Solving:** The process of identifying a problem, developing solutions, and selecting the best one.
- **Algorithm:** A well-defined sequence of steps to solve a problem.
- **Pseudocode:** A way of representing an algorithm using human understandable language.
- **Condition:** A statement that checks whether something is true or false (e.g., if-else).
- **Loop:** A construct that repeats a set of instructions multiple times (e.g., for, while).
- **Halting Problems:** The problems which cannot be solved computationally.
- **Sequence:** The order in which steps in an algorithm are executed.

Instruction for Teachers:

- Teachers must provide real-world examples of identifying simple and complex problems and ask students to solve these problems using problem solving approach.
- Teachers must guide students in developing logical thinking skills and breaking problems into smaller, more manageable parts.

- Teachers must arrange hands-on activities in class by giving students problems that they can solve using logical reasoning such as puzzles or games.
- Teachers must ask students to collaborate on solving problems to encourage teamwork.
- Teachers should encourage students to explore different methods to solve the same problem and discuss the advantages and disadvantages of each approach, such as simplicity, speed, or memory usage.
- Teachers should help students in understanding the boundaries and challenges of solving complex problems.
- Teachers must discuss the concept of various factors such as time, resources, and computational limits that may restrict solutions.
- Teachers should explain examples of real-world problems with limitations.
- Teachers must use real-life examples to explore the trade-offs in creating the solutions by showing that different approaches to solving a problem may have their own advantages and disadvantages. For example, faster solutions might use more resources.
- Teachers must demonstrate the practical applications of using repeat and forever loop construct.
- Teachers should make groups of students and assign problems that require nested loops or conditions, such as displaying a pattern of stars or checking multiple conditions at once or printing a multiplication table.
- Teachers must teach students using interactive exercises such as asking students to create conditions based on simple scenarios.

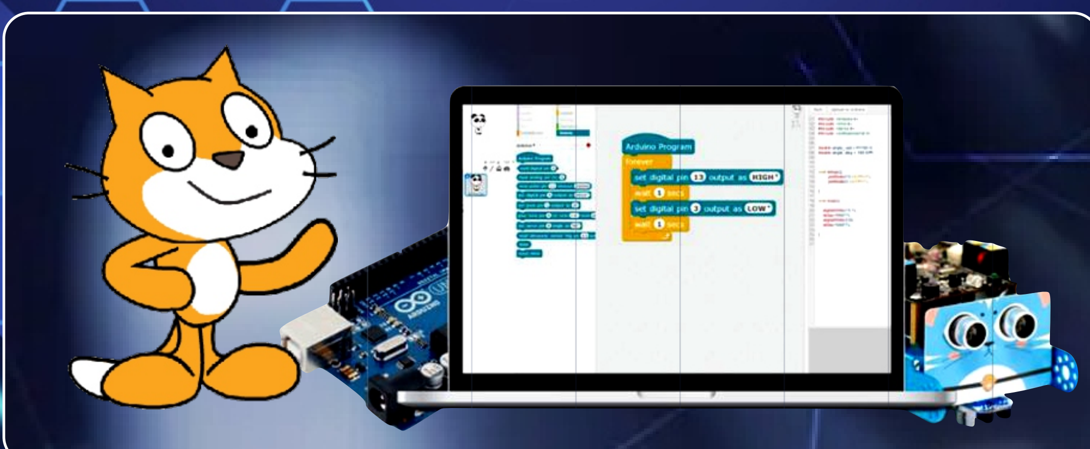
Chapter 4

Programming

Student Learning Outcomes (SLOs):

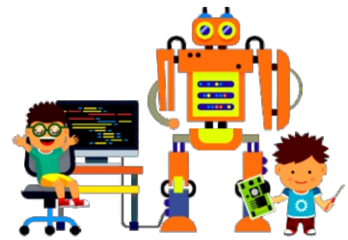
By the end of this unit, students will be able to:

- General control structure and their uses (sequence loops, and conditions)
- Simple and nested loops in computer programs.
- Difference between ***'repeat', 'forever'***, and ***'repeat until'*** loops.
- Apply simple as well as nested conditions in computer programs.
- Differentiate between if and if else conditions.
- Discuss the concept of functions in a computer program.
- Use Simple functions in a computer program.
- Discuss the concept of cloning in computer program.
- Design high-level games like tic-tac-toe, maze with multiple level etc. (***Group Project***)



4.1 Introduction:

In this chapter, we will learn and apply intermediate-level programming constructs (e.g. functions, cloning, conditional movement) by creating mini games using visual programming tool.



4.2 Visual versus Textual Programming:

Visual and **Textual** programming are two different approaches to creating computer programs. They differ mainly in how the programmer interacts with the software and expresses the logic of the program. In textual programming, the user enters input and writes the code using a keyboard (like in Java). In visual programming, like Scratch, the program is made by dragging and dropping blocks instead of typing out code. Visual programming is great for beginners or casual users, while textual programming is better for those who already have some skills and know what they want to accomplish.

Traditional Language (Java)	Visual programming language (Scratch)
`int i=0;` `int sum=0;` `for (i=0;i<10;i++) {` `sum = sum + i;` `}`	

Figure 4.1 Visual vs Textual programming

4.2.1 Difference Between Visual and Textual Programming:

Visual Programming	Textual Programming
Uses graphical elements like blocks, icons or diagram to represent the code.	Uses written code with syntax and text to write programs.
Easy to understand	Requires understanding of syntax and proper coding structure.
Ideal for beginners, kids, and educational purposes	Used by professional developers and advanced learners.
Examples: Scratch, Blockly, MIT App Inventor etc.	Examples: Java, Python, C++ etc.

In this section we will learn Scratch which is visual programming language. Every programming languages are made up of the following basic building blocks:

- Sequence Statements
- Repetitive Statements (Loops)
- Conditional Statements

In a program, the code usually runs in sequential order (from top to bottom), but you can control the flow using conditions. Repeated tasks are placed in loops to keep the code shorter and simpler.

4.3 Sequential Statements:

Sequential statements indicate that the code blocks execute in a particular order they are written in the script, one after the other. Scratch executes blocks in the order they are placed in the scripts area. This is the default mode of execution in Scratch programming.

Example: following blocks execute sequentially:

1. Start when the green flag is clicked.
2. Move the sprite 10 steps forward.
3. Make the sprite say "Hello!" for 2 seconds.

Each of these actions happens in the order they are listed, one after the other.

How it Works:

When Green Flag Clicked:

This event block starts the script when the user clicks the green flag.

Move 10 Steps:

This motion block moves the sprite forward by 10 steps.

Say "Hello!" for 2 seconds:

This block makes the sprite display the message "Hello!" for a duration of 2 seconds.

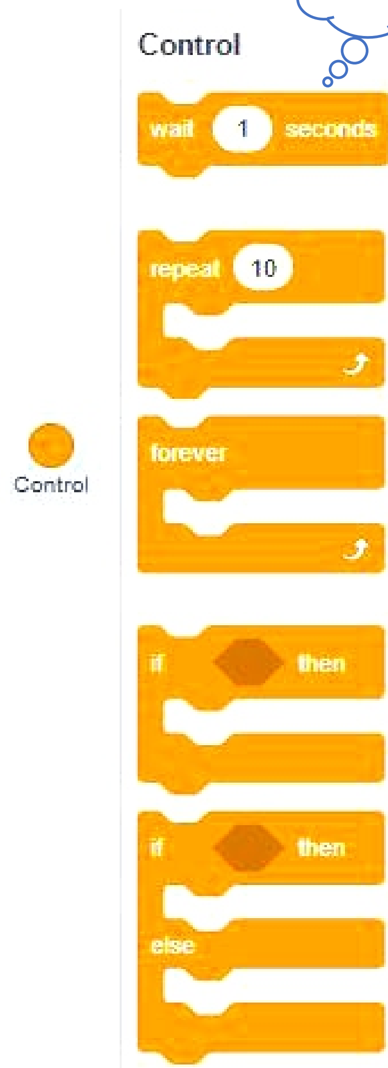
All of these blocks execute sequentially as soon as the green flag is clicked.

4.4 Conditional Statements:

Conditions are simple checks that are either **true** or **false** and helps the program to flow in the desired order to get the result you want.

Remember

Control block is used to control the scripts. It provides option to wait, use loops and conditional statements in your program.



4.4.1 if-then:

An **if-then** conditional statement is used to control the flow of a program by executing specific blocks of code only when a certain condition is true.
The follow code block moves Giga (*sprite*) 10 steps to the right when the right-arrow key is pressed, and moves 10 steps back when the left-arrow key is pressed, as shown in the figure (**4.2**(a)).

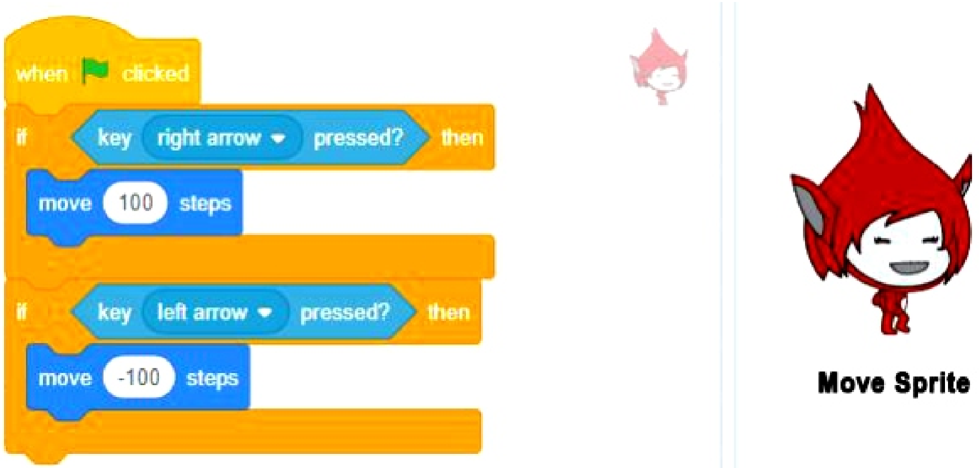


Figure 4.2(a) Code block

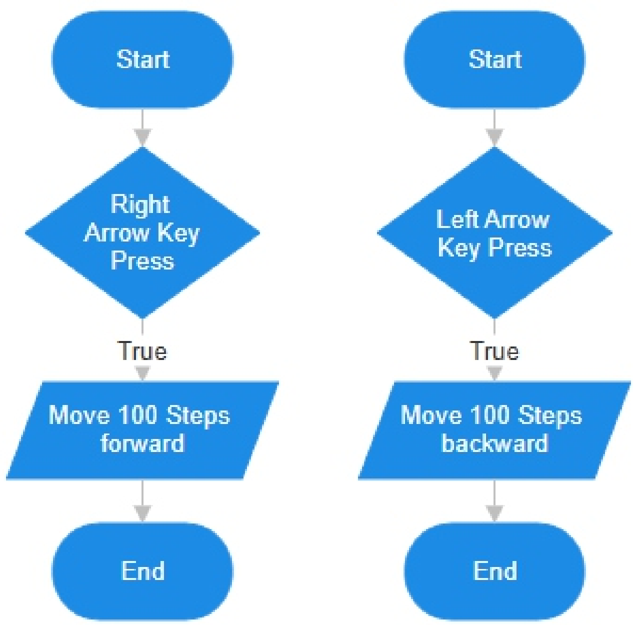
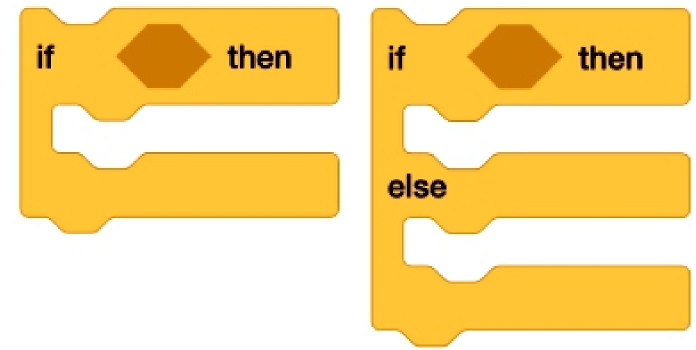


Figure 4.2(b) Flow diagram of If statement

Under the **Control** block in Scratch, you will find a number of conditional statements block that allow to adjust your program based on specific conditions. In Scratch, we have **if-then** and **if-then else.**



if (something) is true or false

Let us explore this conditional statement by practicing following example.

Create a maze game where the player controls the sprite with keyboard arrow keys. When a key is pressed, the sprite is coded to move a certain number of steps as shown in below figure **4.2**(c).

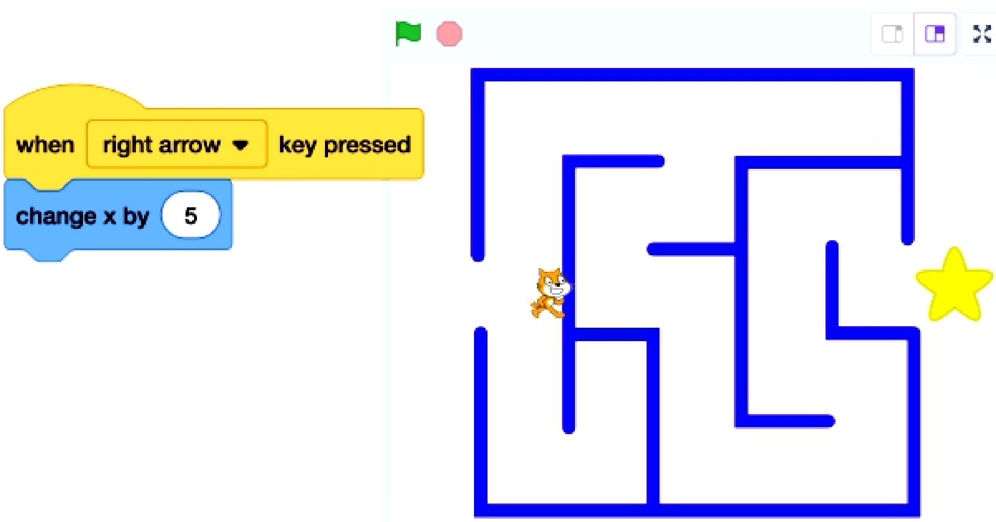
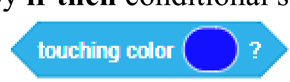


Figure 4.2(c) Sprite moves when right arrow key pressed

But we need to stop the sprite from walking through the walls. We can handle this situation by **if-then** conditional statement. We will use the "**touching color**" from **Sensing** block 

as the condition and select the color of the walls.

If the sprite touches the wall (blue color) the condition become **True** then the sprite moves the same number of pixels in the opposite direction, it will look like the sprite hasn't moved at all and has been stopped by the wall as showing in below figure **4.2**(d).

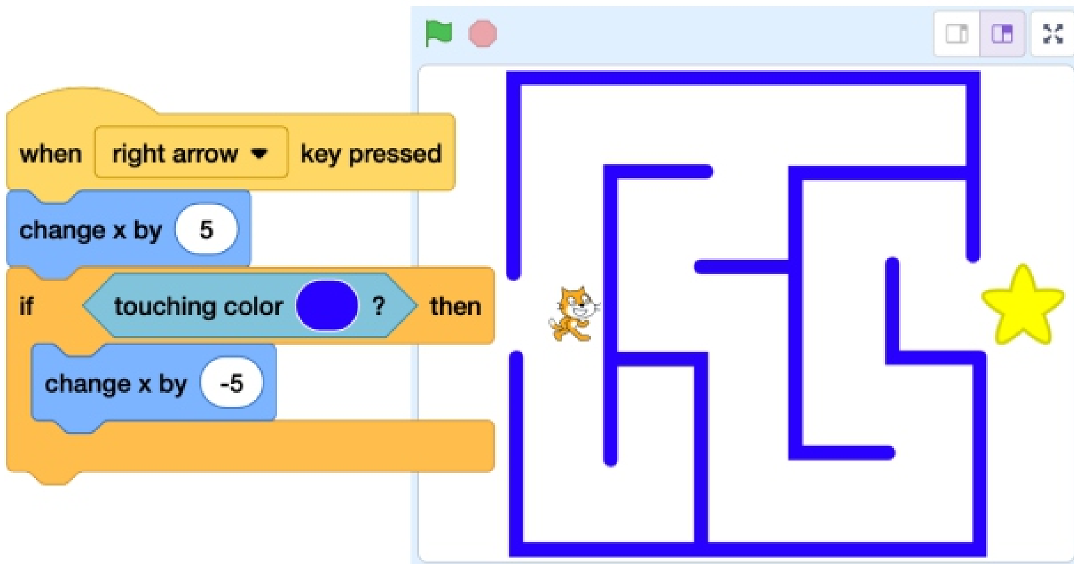


Figure 4.2(d) if-then Condition

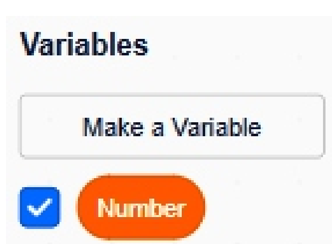
4.4.2 if-then else:

if-then-else conditional statement allows you to execute one set of actions when a condition is true and a different set of actions when the condition is false. This provides more flexibility compared to the simple "if-then" block. Let us explore this conditional statement by practicing following example.

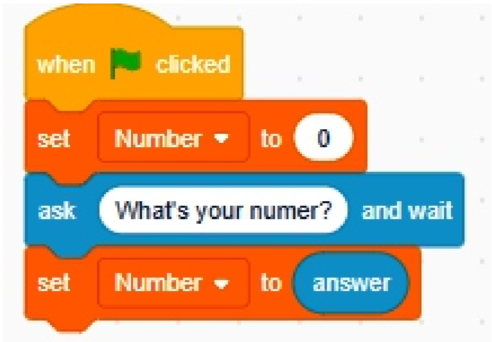
We are creating an Even-Odd Number Program in Scratch which allows a sprite to check whether a given number is even or odd. Now we can create it step by step.

1. Setup a user input we will use the Ask block 

(from Sensing category) to let the user input a number. We will store the input in a variable (name **Number**). Create a variable (from **Variables** category).

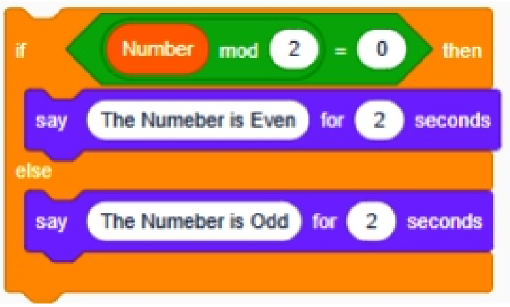


2. Set the Number variable to zero when Green flag clicked.

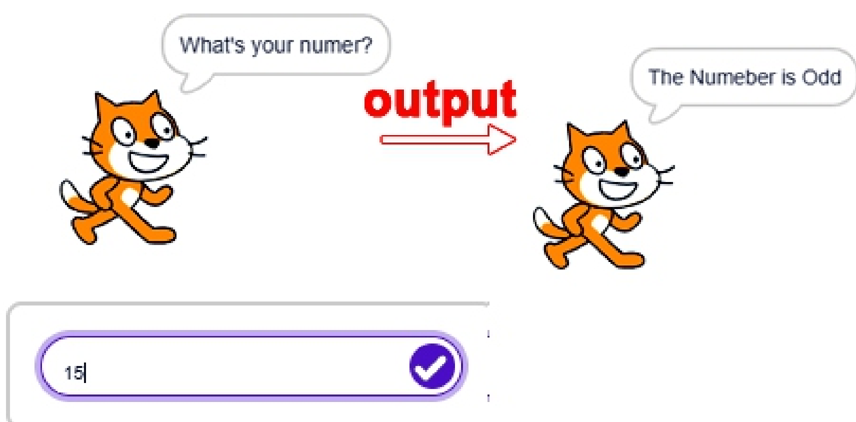


3. Check if the number is even or odd:
    - Use the **if-then-else** block (from the **Control** category).
    - Use the **mod operator** (from the **Operators** category) to check if the number divided by 2 has a remainder of 0.

4. Respond Based on the Result:
    - If the remainder is 0, the sprite will say "The number is even."
    - Otherwise, the sprite will say "The number is odd."



5. Run you program by click on the Green flag button.



4.4.3 Difference Between if and if else condition:

Aspect	if Statement	if-else Statement
Condition Outcomes	Only executes code **if** condition is **True.**	Executes one block for **True**, another for **False**.
Action for False	Skips the block **if *False.***	Executes the else block if False.
Usage	Used when no action is needed for **False**.	Used when both **True** and **False** require actions.

4.4.4 Nested if-then else statement:

A Nested **If-Then-Else** is like putting one **If-Then-Else** inside another. As a result, you can check multiple conditions, one after the other sequentially.

For example:

Consider the following scenario where you want to give message based on a score like this

- **If** the score is 80 or more, say "Great job!"
    - **Else**, **If** the score is between 50 and 79, say "Good effort!"
    - **Else**, say "You need more practice!"

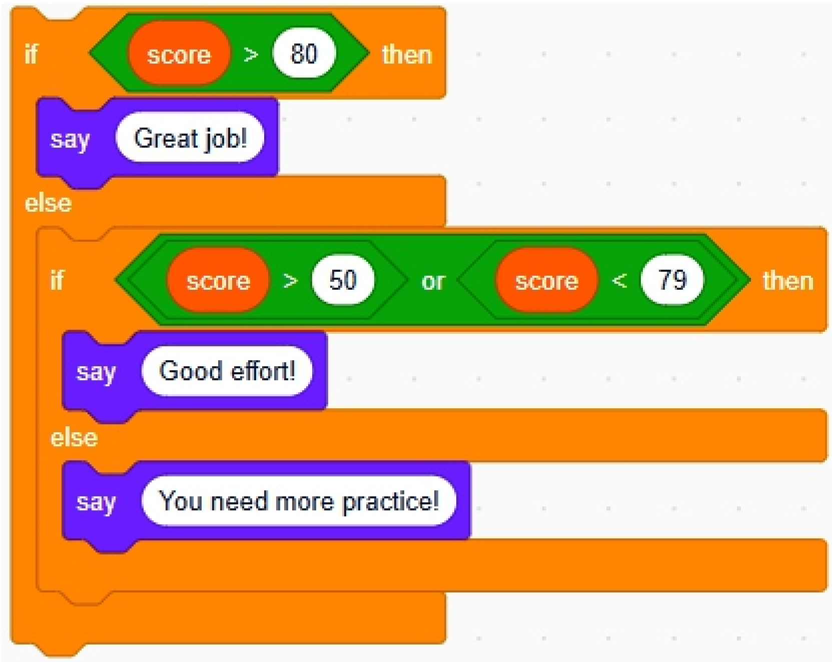


Figure 4.3 Nested If-then-else statement

In Scratch, this program looks like a Nested **If-Then-Else** because the second "**If**" is inside the first "**Else**" part.

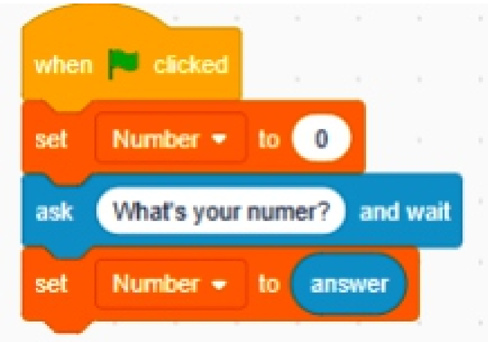
Activity:

We are creating a program in Scratch to identify whether a given number is positive or negative. It will let the Sprite decide that the given number is even or odd. We can now make the program step-by-step.

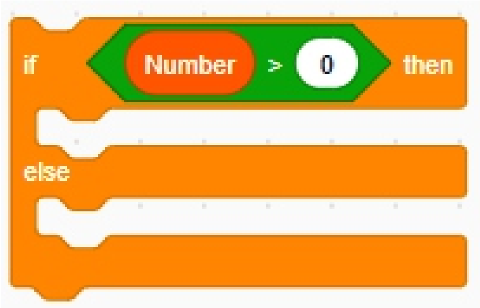
1. Setup a user input we will use the Ask block 

(from Sensing category) to let the user input a number. We will store the input in a variable (name **Number**). Create a variable (from **Variables** category).

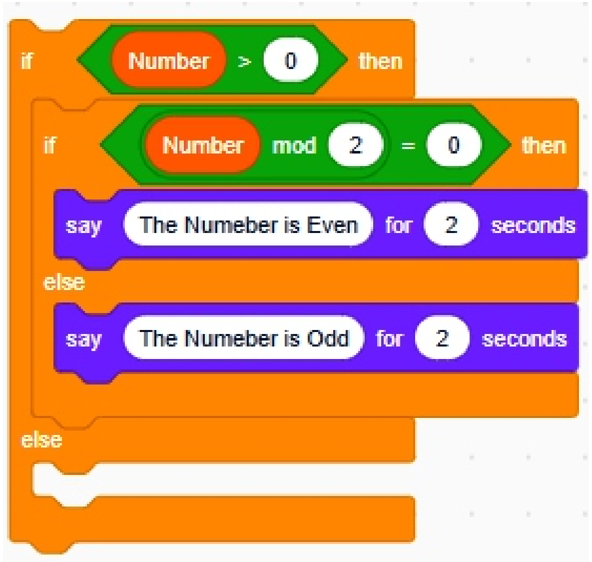
2. We have two conditions in this program. First condition says that if the number is positive or negative so we called it Outer condition. We can further check another condition (the number is even or odd) only if the Outer condition (or first condition) is true or false (depending on the logic).
3. Set the Number variable to zero when Green flag clicked.



4. Check if the number is positive or negative:
   - Use the **if-then-else** block (from the **Control** category).
   - Use the **greater than operator** (from the **Operators** category) to check if the number greater than 0.

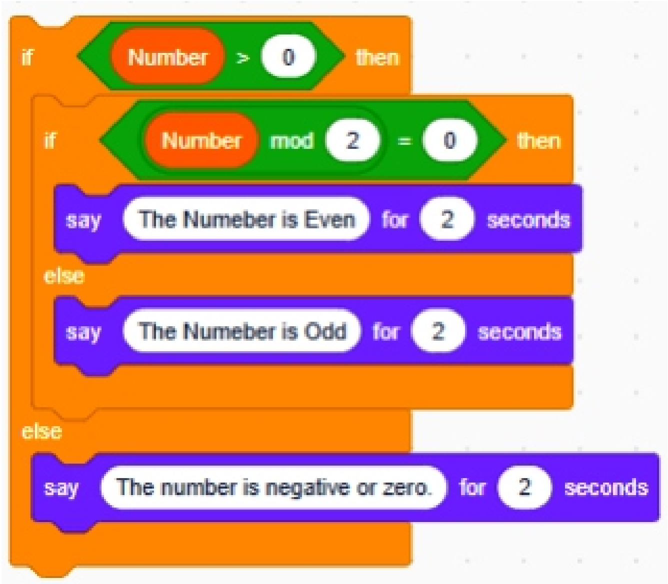


- If condition is true add another if-then-else block (put the step 4 block from **4.4.2** example) inside it.

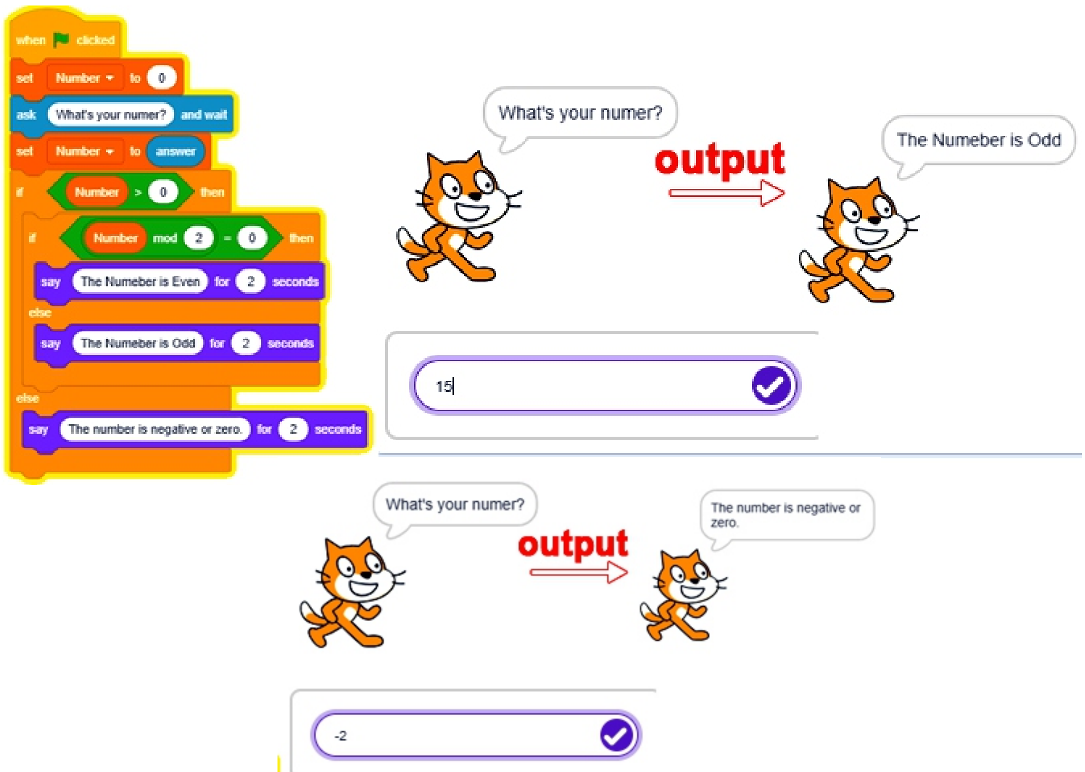


- If above condition is true, it evaluates the inner condition (check even odd number). Otherwise, it jumps to the else part.

5. In else part we declare the number as "negative or zero."



6. Run the program and verify the output.



4.5 Loop (Repetitive Statements):

A loop in Scratch is a block that allows actions or commands to repeat automatically without needing to write the same instructions multiple times. Loops help make programs shorter, easier to read, and more efficient.

For example, sprite will say “Meow” and making sound “Meow” too forever.

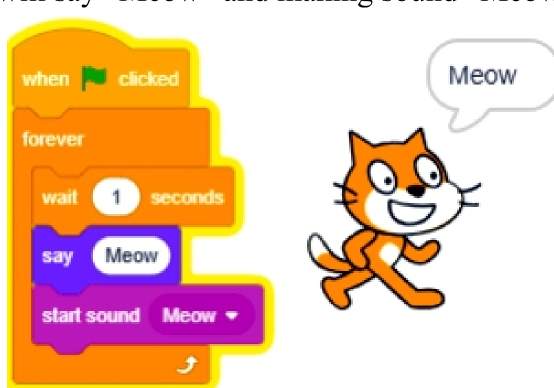


Figure 4.4 Repetitive statement (forever loop)

4.5.1 Types of Loops:

Loops are like a magic tool that repeats tasks automatically, saving you to perform the same thing repeatedly. In the control section of block code, there are three basic types of loops, each designed for a specific purpose.

- **repeat Loop** It takes a number input 'x' and repeats the code 'x' times. In the example shown, the loop runs 10 times because 'x' is set to 10.
- **repeat until Loop** needs a condition to stop. Here, we use a variable called 'counter' to set the stopping condition. The counter starts at 0 before the loop and increases by 1 in each iteration. After 10^{th} iteration, the condition becomes TRUE, and the loop terminates. If the 'counter' is mistakenly set to -1, the code will not work as expected, and the loop will run infinite time.
- **forever Loop** is used to repeat a set of actions indefinitely as long as the program is running. It is a useful tool when you want something to continue happening without needing to stop it manually.

Note: Loop struct should match according to the task, otherwise it may make the loop unnecessarily complicated.

For example, we can make the 'Giga' sprite move 10 steps, turn 15 degrees, move another 10 steps, and turn again. These steps will be repeated several times. Instead of repeating the code block here we can use different types of loops to do this.

Figure 4.5 (a) repeat loop

Figure 4.5 (b) repeat until loop

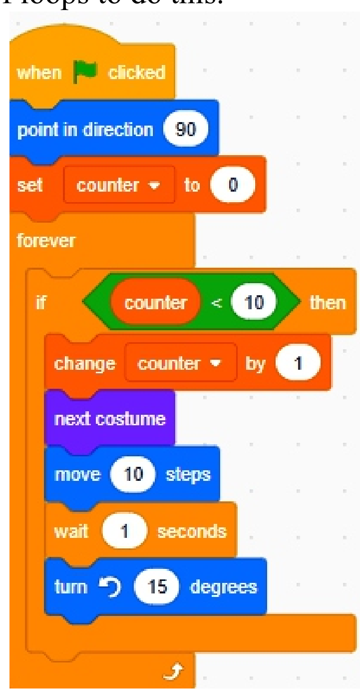
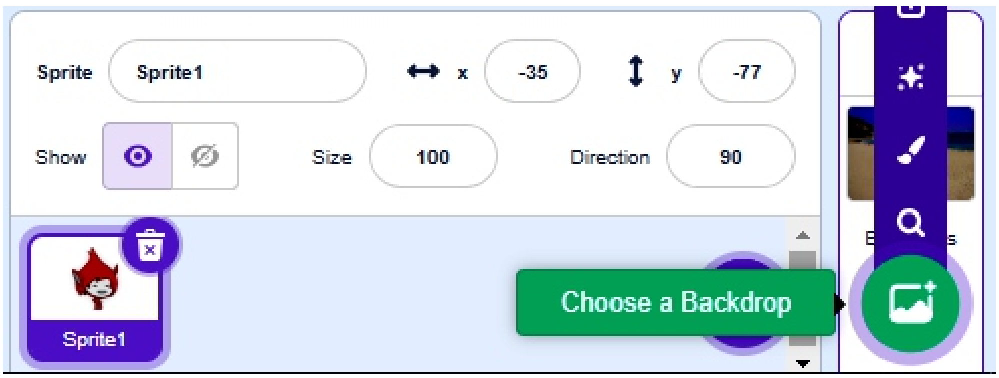


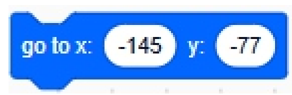
Figure 4.5(c) forever loop

4.6 Nested Loops:

Loops may contain other loops if needed which is called nested loop.
In the following example 'Giga' sprite start walking and the background changes one by one before Giga moves each time. Now we can create it step by step.

1. Choose Giga sprite and Choose at least 3 backdrops from Choose backdrop option.



2. From Motion block palette use go to block 

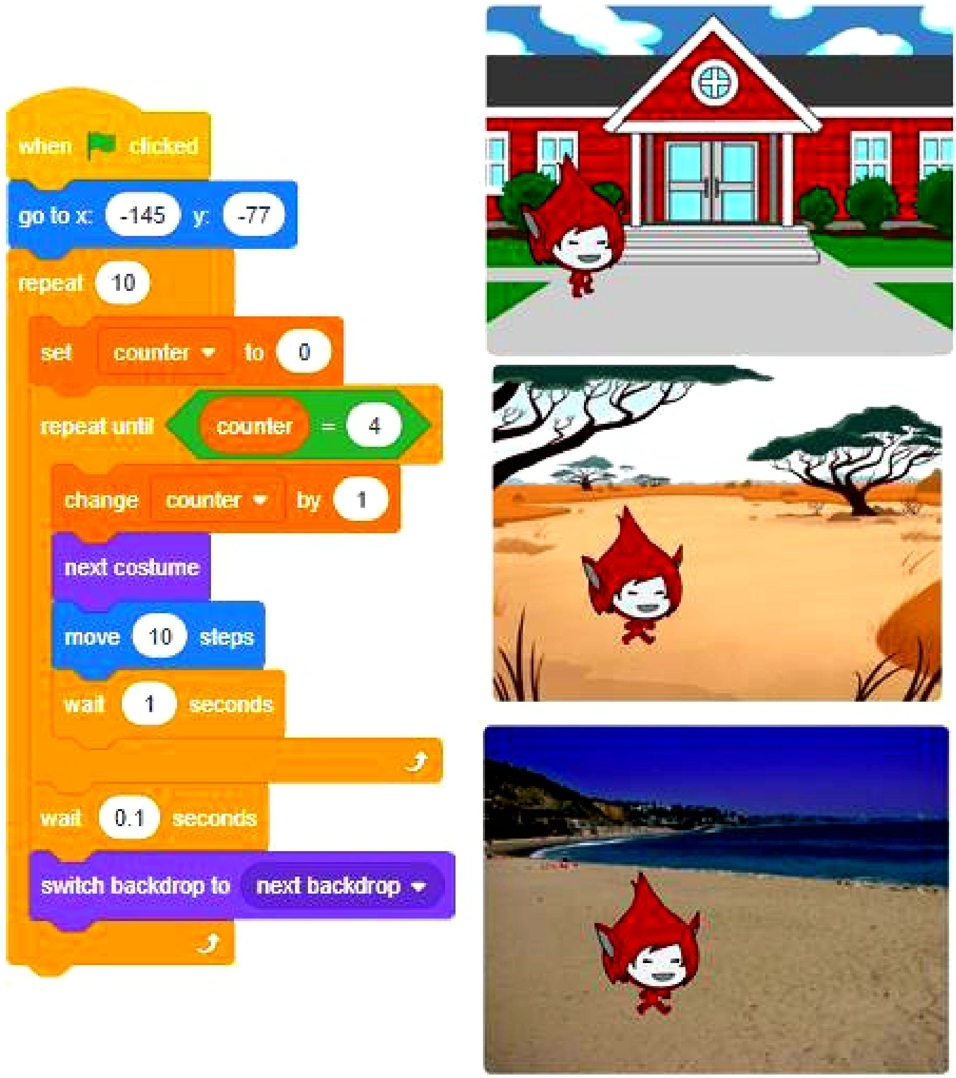
to set the position of the Giga sprite.

3. Add repeat block to iterate 10 times and uses a **counter** variable for **repeat until** loop which is nested in **repeat** loop and perform the Giga sprite to move 10 steps and changes his costume and wait 1 seconds.

4. After the **repeat until** loop there is **switch backdrop to** 

block is added to change the backdrop (that you already choose in step 1).

5. The complete code is shown in the figure below



4.7 Functions in Scratch:

In Scratch, functions are called custom blocks. They allow us to group a set of instructions into a single block, making our code cleaner, reusable, and easier to understand. Programming languages allow basic math operations like addition, subtraction, multiplication, and division. Scratch not only supports these but also includes custom function and some built-in functions.

4.7.1 Built-In functions in Scratch:

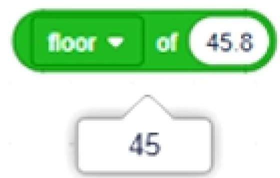
A built-in function in Scratch is a ready-made block provided by Scratch to perform common tasks. These blocks are part of Scratch and cannot be changed.

- **Generate Random Numbers:**
  A random number can be generated within a specified range. In this example, a random number between 1 and 10 is created and assigned to the variable 'counter'.

- **Abs() Function:**
  It ignores the sign of a number and only takes the positive value. For example, the absolute value of -9 is 9, as shown in the figure.

- **join() Function:**
  It is used to combine two pieces of text (or a mix of text and numbers) into one. It's a part of the Operators category and is helpful when you want to create or display a combined message.

- **Rounding off Numbers:**
  To round numbers, the round() function is used. For rounding down, the floor() function is applied, and for rounding up, the ceiling() function is used. These options are shown in the figures.

round()	rounds a number up if the decimal is greater than 4 otherwise, it rounds down.	
floor()	always rounds a number down.	
ceiling()	always rounds a number up.	

Here are some additional functions available in Scratch.

Function Name	Description
sqrt( )	to get the square root of a number.
type( )	to check/inquire the type of an object.
pow( )	to get the power of x in terms of y.
max( )	to get the maximum value from a set of number.
bool( )	to get the status of a boolean value, whether true or false.
format( )	to get the particular format of a value. e.g. display $ sign after the number.
help( )	to get the help about keywords and functions, etc.

4.7.2 Custom functions in Scratch:

A custom function in Scratch refers to the functions that you create yourself using the "**My Blocks**" feature. A custom function created by the programmer for a specific purpose in their project. Custom function created by using the "**Make a Block**" feature under the "**My Blocks**" category.

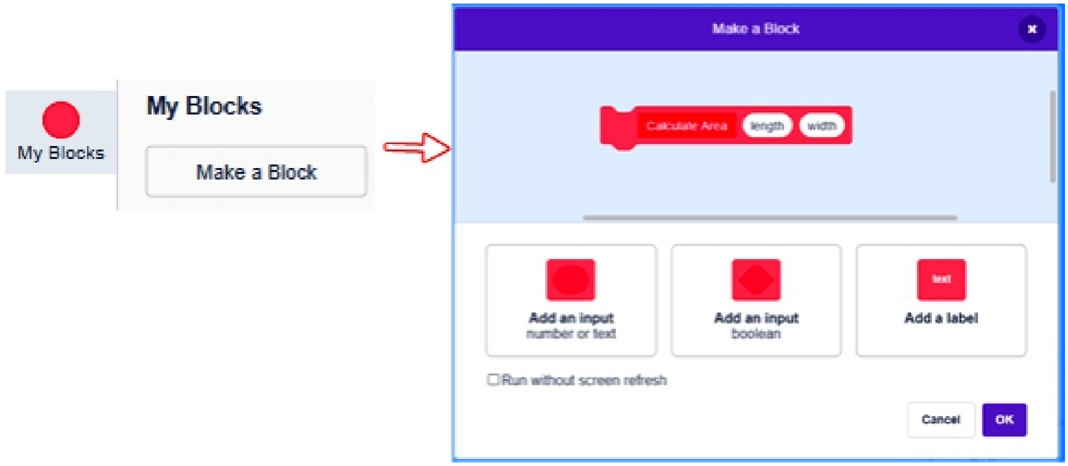


Figure 4.6 Creating Custom function in Scratch

When clicking on Make a Block button there will be a dialog box appear showing different option to create your block like adding an input (number, text or boolean) to pass data into the function or add a label. You can give the name of you block and click on OK button as showing in the figure. We added two input parameter and name it length and width and Named the block **Calculate Area**.

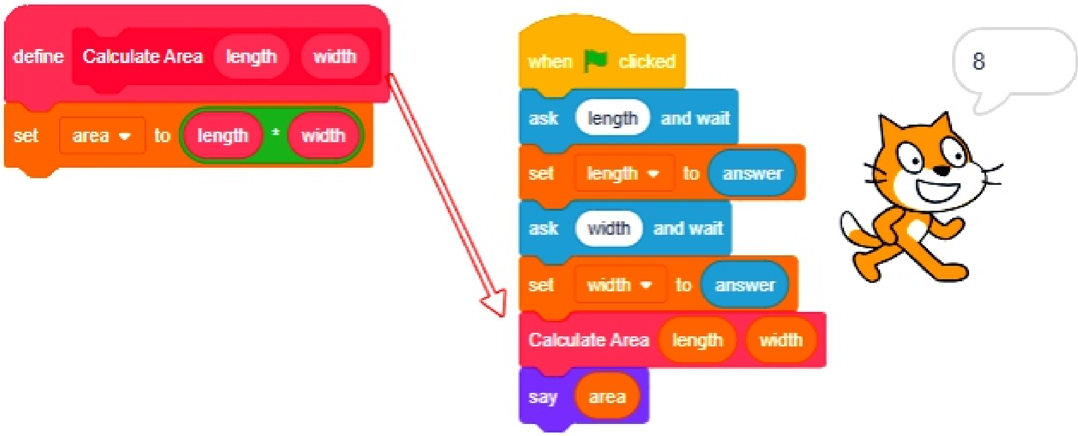


Figure 4.7 Custom function to calculate Area

4.8 Cloning a Sprite:

Cloning allows us to make dynamic copies of a sprite while project is running. Scratch allows us to duplicate a sprite multiple time, not just once. This is helpful when we want to create objects like a flying balloon and replicate it several times. Similarly, in a game, we can design a snowflake and create a snowfall effect by cloning it repeatedly.

From Control Palette use 

block to clone your object in a program. In the figure below, "create clone of a balloon" is used to make the balloon fly multiple times.

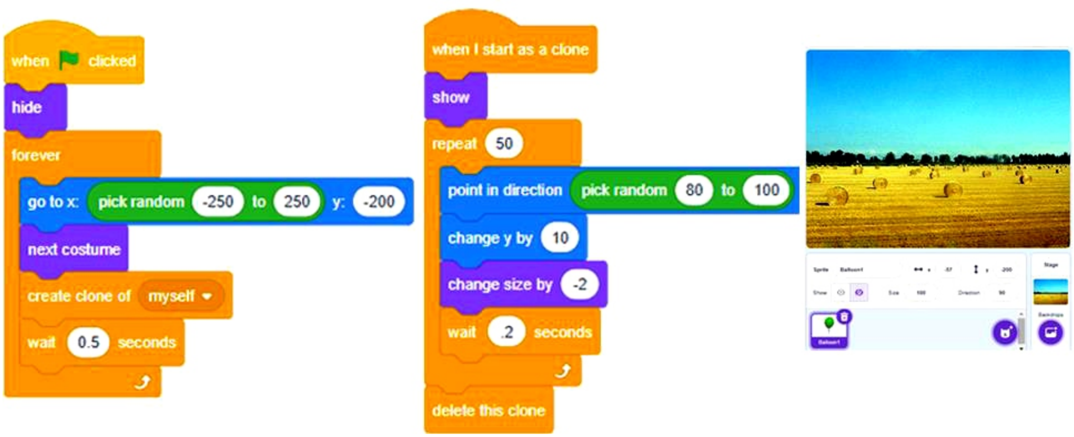


Figure 4.8 (a) Cloning a Balloon Sprite

Figure 4.8 (b) Output of the Cloning a Balloon Sprite

4.9 Game Design with Scratch:

4.9.1 Simple Maze Game:

To create a simple maze game, you first need a maze map. The additional steps are as follows

1. Create the Maze:
   - Design the maze using a backdrop or draw it yourself in the backdrop editor.
   - Use walls to create a path for the player to navigate.
2. Add a Sprite
   - choose or create a sprite (e.g., a ball or character) that will move through the maze.
3. Set Up Movement: click on the sprite and write the following code.

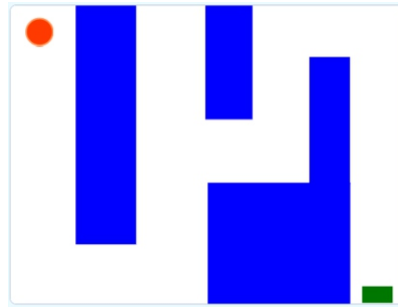
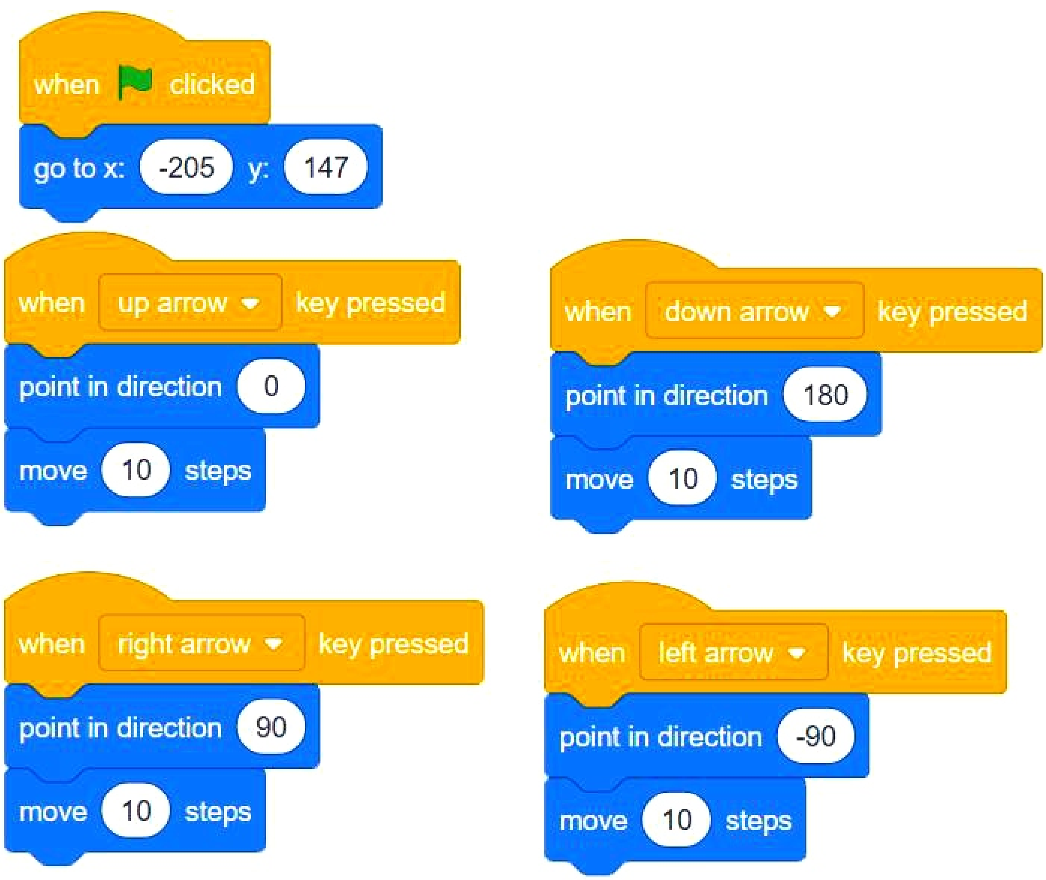
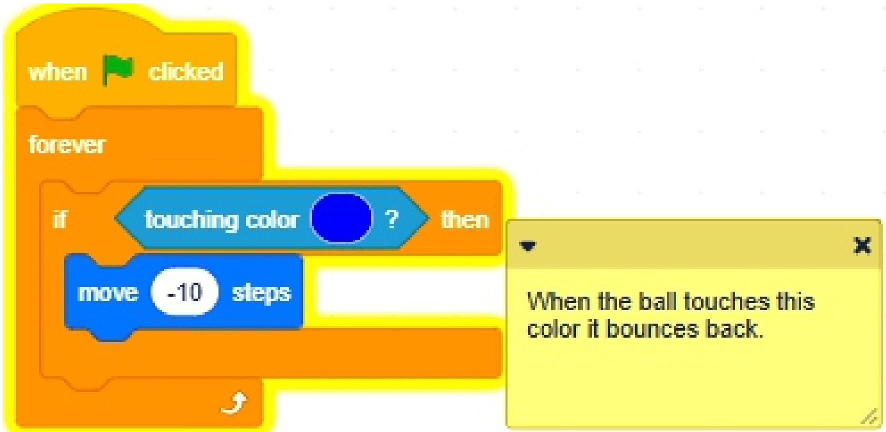


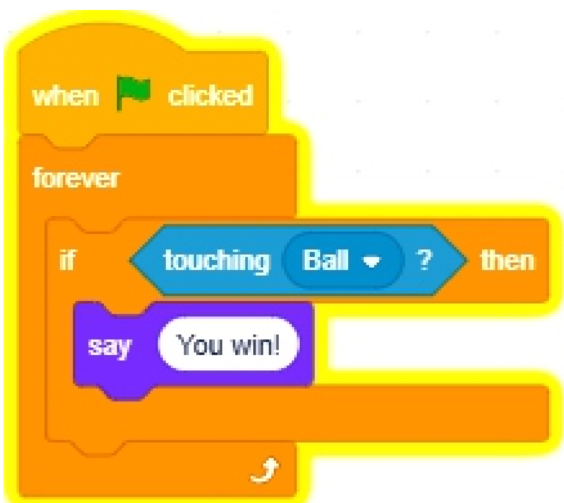
Figure 4.9 Simple Maze Game



4. Add a wall collision
   Make the sprite stop if it touches the walls: write the following on the same sprite after the above code (point 3).



5. Set the Goal:
   - Add another sprite (e.g., a star) as the goal.
   - Add code to check if the player reaches the goal. Click on the new sprite the you added and write the following code.

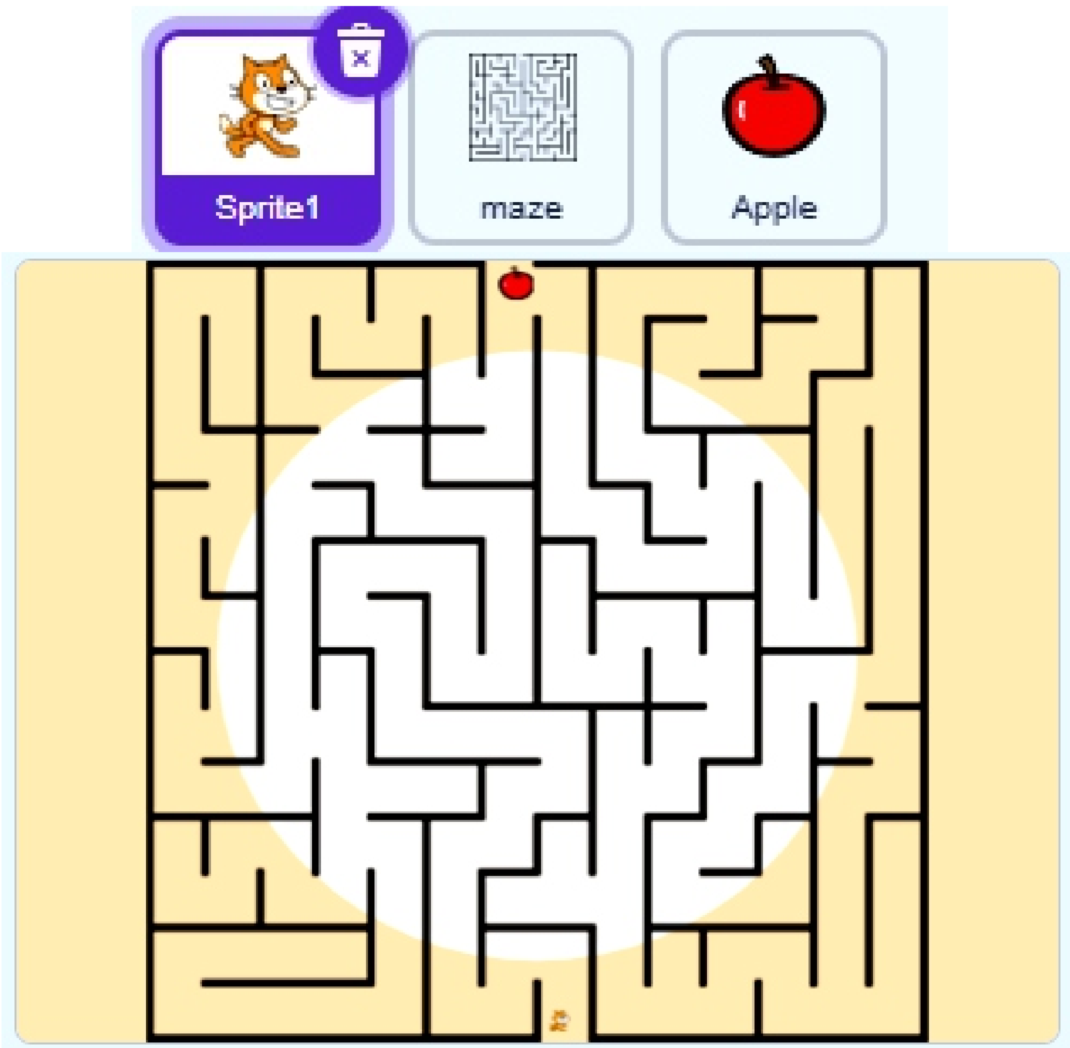


6. Execute Your Game:
   - Run the game and ensure the sprite moves correctly and the goal works as intended.

4.9.2 Advance Maze Game:

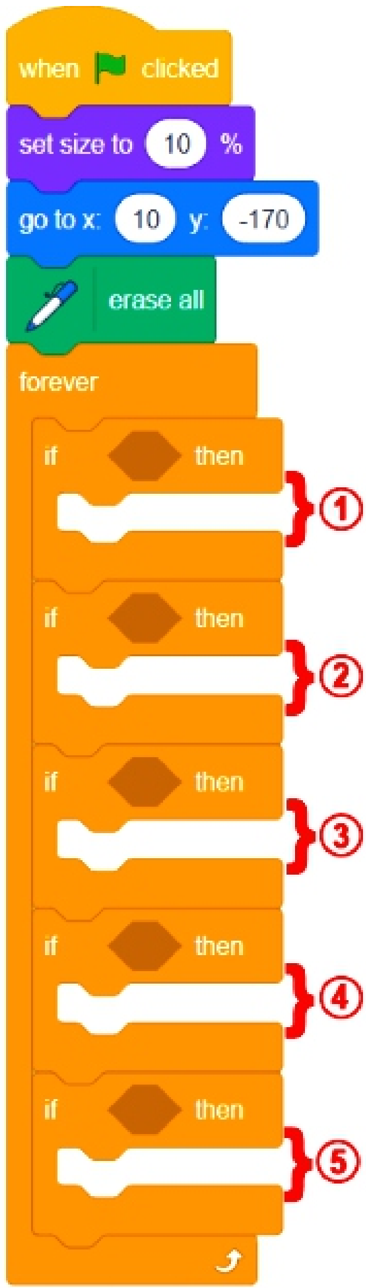
We can add levels with more complex maze in this topic. You may download different images of sprite, backgrounds to use in your game from this link (https://inventwithscratch.com/).

1. Set up the background and sprite
   - We use the cat sprite, a maze background and an apple image for final exit point.



2. Set up movement
   We will use different control blocks to set up the movement like Loops, If-else blocks etc.

- First, we select the Cat sprite and write the following code.



Code Blocks	Description
	When Green flag clicked the game will start.
	Set the size of sprite to 10%
	Move the sprite to the starting point x: 10 and y: -170 of the maze.
	Erase all block erase everything the pen has drawn on the stage.
	Forever block repeats the blocks inside it. We are going to use 5 "**if-then**" control blocks inside forever block that will check the 4 arrow keys (which key is pressed) and 5^{th} one for the final exit Apple. Replace each If block that we discuss later on its position to complete the program.

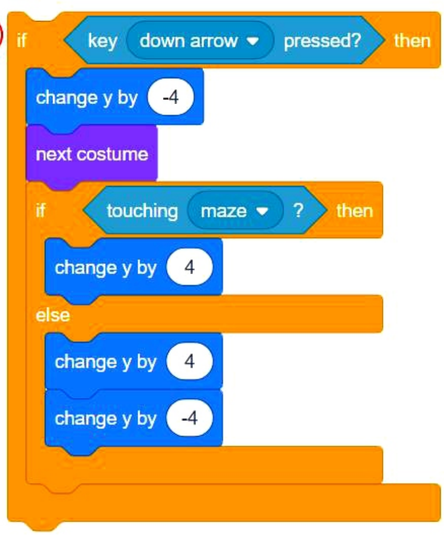
1

- This if block checks the Up-arrow key is pressed or not. We will use the sensing block (key pressed) 

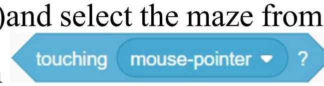
.
- If the Up-arrow key is pressed then the sprite will move its position to 4 points in Y axis and changes its costume.
- The nested if-else block checks either the sprite touches the maze or not. We will use the sensing block (touching)and select the maze from the dropdown 

.
- If sprite touches maze it will bounce back or else it will move 1 point on Y axis.

2



- This if block checks the down-arrow key is pressed or not. We will use the sensing block (key pressed) 

.
- If the down-arrow key is pressed then the sprite will move its position to -4 points down in Y axis and changes its costume.
- The nested if-else block checks either the sprite touches the maze or not. We will use the sensing block (touching)and select the maze from the dropdown 

.
- If sprite touches maze it will bounce back or else it will move -1 point down on Y axis.

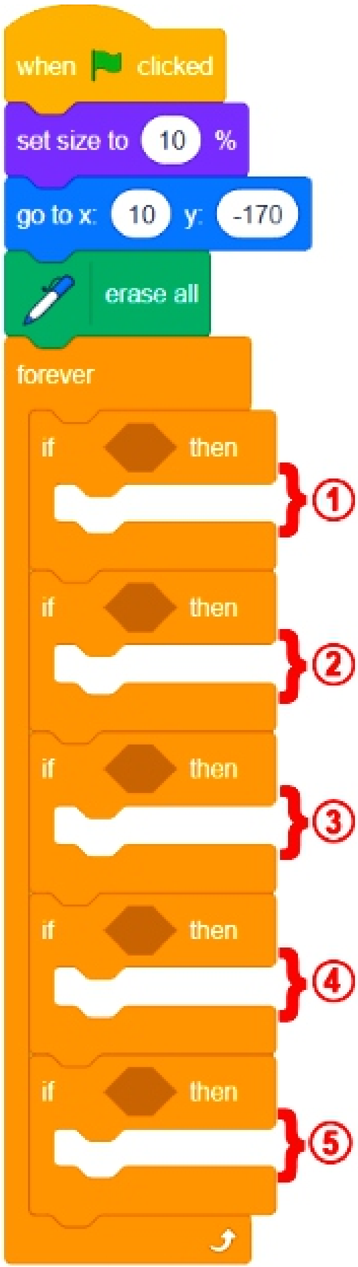
3

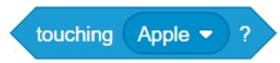
- This if block checks the right-arrow key is pressed or not. We will use the sensing block (key pressed) key right arrow pressed?.
- If the right-arrow key is pressed then the sprite will move its position to 4 points right in X axis and changes its costume.
- The nested if-else block checks either the sprite touches the maze or not. We will use the sensing block (touching)and select the maze from the dropdown touching mouse-pointer ?.
- If sprite touches maze it will bounce back or else it will move 1 point right on X axis.

4

- This if block checks the left-arrow key is pressed or not. We will use the sensing block (key pressed) key left arrow pressed?.
- If the left-arrow key is pressed then the sprite will move its position to -4 points right in X axis and changes its costume.
- The nested if-else block checks either the sprite touches the maze or not. We will use the sensing block (touching)and select the maze from the dropdown touching mouse-pointer ?.
- If sprite touches maze it will bounce back or else it will move -1 point right on X axis.

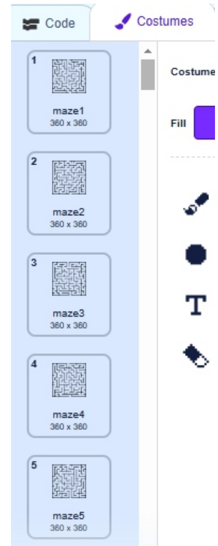
Code Blocks



- This if block checks the Sprite touches the Apple or not. We will use the sensing block (touching)  and select Apple in the dropdown.
- If the sprite will touch the Apple then Sprite will say “You Win” for 1 sec and move its position to starting point X: 10 and Y: -170.
- A broadcast block is used from Event palette  . It activates the script to change the maze and adds up the level and difficulty in the game.
- After the broadcast message we also add a receiver block code to receive the message and change the background so we add the following block code on the maze background to change the next costume. See Point 3.

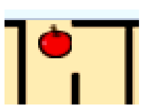
3. Select maze background and write the following code.

To Add Difficulty and levels

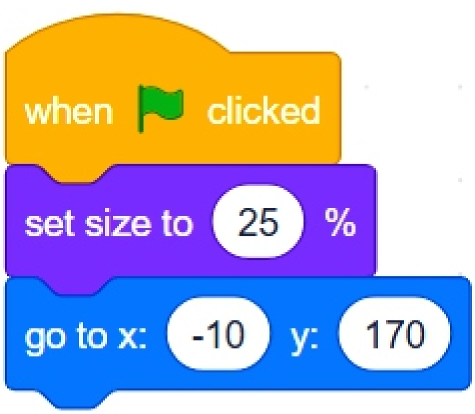


These are 100 backgrounds of maze to add levels and more difficulty in game.

4. Set the Goal:
5. We are using apple for finishing the game.



6. Click on the Apple and write the following code so it will place the apple to finishing point.



7. Execute the game
8. After setting up all the code press green button to start the game and enjoy.

Summary

- Statements in a program are executed in sequence. Like the code block in a scratch program is executed in sequence.
- A **Conditional** statement is a composite instruction that satisfies "if…then" provision. Conditions are simple check which are either true or false.
- **if statement** if the condition matches, then corresponding code is executed else skipped.
- **if-else** statement If the condition does not match, code in 'else' part is executed.
- **Loop** is a set of instructions which needs to be iterated repeatedly, to acquire a particular result.
- A **repeat loop** takes an integer input 'x' and iterates the code in it for 'x' times.

- A **repeat until loop** requires a matching condition such that as soon as the condition matches the loop terminates.
- The **forever loop** does not have a terminating condition rather has to be incorporated within the loop with a conditional statement.
- **Function** is a block of code that needs to be used by different sections of a program, rather than having multiple occurrences of the same code.

Exercise

1. Encircle the correct answers.

i. All are the construct of programming language except?
   a) Sequence b) Condition
   c) Loop d) Business

ii. Loop with in the loop is called
   a) Nested b) Next
   c) Newest d) Narrow

iii. A loop becomes infinite loop if a condition never becomes _____
   a) True b) False c) Null d) Zero

iv. Floor() functions always ___________ a number.
   a) Rounds down b) Rounds up
   c) Cycle down d) Cycle up

v. A function which returns the maximum value from a set of number is called.
   a) Highest() b) Max()
   c) Largest() d) Bool()

3. Provide the descriptive answers of the following questions.

i. What is Loop and how many types of Loops block are there in Scratch?
ii. Difference between if and if else statement?
iii. List down some built-in functions of Scratch programming with examples.

Instruction for Teachers:

- Teachers should motivate students to explore various resources and continue learning independently.
- Divide the class into group of 2 or 3 students.

i. A program that makes many sprites in a given number with different patterns by using loop. Also use nested loops.
ii. Divide students in groups and ask each group to use three different loops to make same program. Then see which code is efficient. Group shares their programs.
iii. To create a program that draws a square, you could use a repeat loop to repeat the block of code that draws a line four times.
iv. To create a program that bounces a ball, you could use a repeat until loop to repeat the block of code that moves the ball until it hits the edge of the screen.

Chapter 5

Digital Citizenship

Student Learning Outcomes (SLOs):

By the end of this unit, students will be able to:

- Identify the common uses of the Internet such as business, social networking, and information/news
- Describe possible dangers of the Internet and related security
- Identify steps to secure information and confidentiality
- Discuss cyber crimes and its different forms
- Describe the ways of combating against cyber crime
- Inquire about the support system to respond against cyber crime
- Discuss copyright, plagiarism, and piracy in detail

5.1 Introduction:

This chapter aims the importance of being a good digital citizen in today's tech-driven world. It covers how to communicate online, protect personal information, use technology responsibly, and respect others. By learning these skills, we can create a positive online environment for everyone.

5.2 Digital Citizenship:

Digital citizenship means following the rules for using technology in a good way. It involves using the internet properly, being respectful to others, and keeping personal information safe.

Figure 5.1: Digital Citizenship, a society of digitization where every one has connection with their community, groups etc.

5.3 Digital Ethics:

- **Ethics** helps us to understand right and wrong behaviour, while digital ethics applies these ideas to determine what is right and wrong online.
- Ethics includes important values like honesty, fairness, and responsibility, while digital ethics guides us to act with honesty and fairness in our online interactions.

5.4 Common Internet Uses:

The internet is essential for businesses today, providing various tools and applications that enhance operations and communication. The Internet has become an essential tool across various fields and domains, facilitating numerous activities. The following are common uses of the Internet: Business, Social Networking, and News & Information.

5.4.1 Internet in Business:

Following are some key uses of the nternet in business, along with examples:

- **Online Shopping:** Businesses use the Internet to sell things directly to customers on websites like Amazon, Alibaba, AliExpress and Daraz.

- **Communication:** Companies use the Internet to send quick messages to clients and workers using email, like Gmail.

- **Marketing and Brand Awareness:** Businesses use social media to promote their products and services like Facebook, TikTok and Instagram to tell many people about their products.

- **Customer Service:** Businesses use the Internet with live chat tools on their websites to help customers right away.

- **Advertising:** Online Advertisements on platforms like Google Ads help businesses reach potential customers effectively.

5.4.2 Internet in Social Networking:

- The Internet uses social networking websites like Facebook and Twitter to help users connect with friends and family.

- The Internet provides access to social media apps for sharing ideas, photos, videos, and life updates with networks such as Instagram and Snapchat.

- People also create and share entertaining content, including short videos and memes on social media apps like TikTok.

5.4.3 Internet in News and Information:

- **Accessing News:** People use websites like Google News, Dawn News, and BBC to stay updated on various news and information.

- **Information Sharing:** The Internet allows quick sharing of news and updates, making it easier to stay informed about current events. For example, Twitter is used for news updates, while LinkedIn is popular for job searches.

- **Online Content:** The Internet provides access to online newspapers, magazines, podcasts, and audio content.

5.4.4 Understanding positive and negative online behaviour:

Positive Online Behaviour	Negative Online Behaviour
Sharing helpful information with others	Spreading false information or rumours
Using social media to stay connected with friends	Bullying or harassing others online
Accessing educational resources	Downloading or sharing pirated content
Respecting others' privacy and data	Hacking or invading others' privacy
Using secure passwords to protect accounts	Sharing passwords or using weak passwords
Shopping safely on verified websites	Engaging in online scams or fraud
Reporting suspicious activity to authorities	Ignoring security warnings or threats
Promoting positive and respectful communication	Posting hurtful or offensive comments

5.5 Internet Dangers:

The Internet is a helpful tool for learning, staying well, and connecting with friends. But it can also be dangerous, in this way we need to be careful. To stay safe online, it is important to use the Internet smartly. Following are some dangers and their possible solutions.

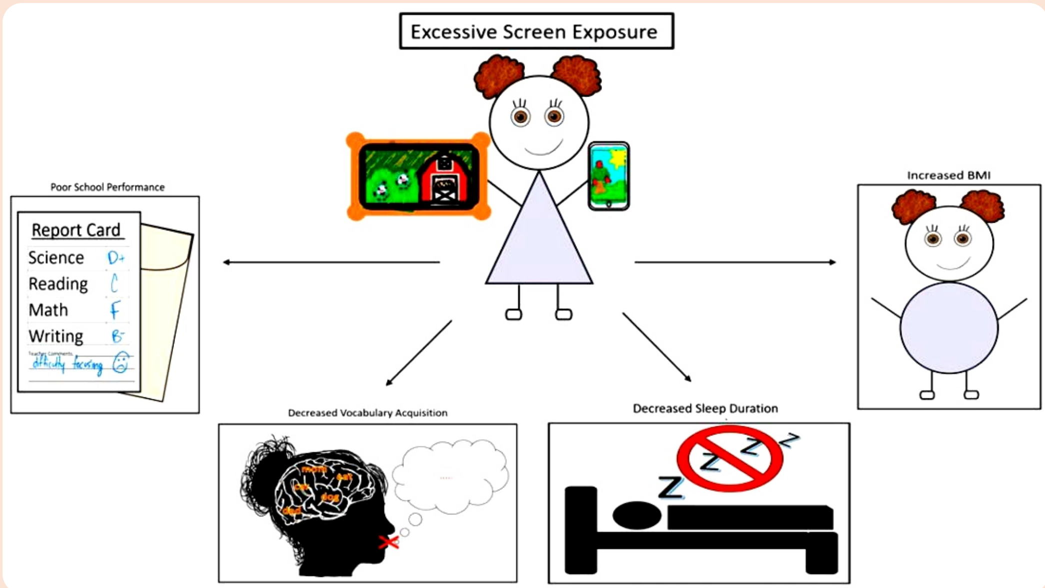
5.5.1 Health Dangers

5.5.1.1 Mental Health Risks:
Excessive use can lead to anxiety, depression, and social isolation, particularly among young people.

Possible Solutions:
Limit screen time, engage in offline activities, and seek professional help if needed

5.5.1.2 Physical Health Risks:

Positioning behaviour from prolonged screen time causes obesity and sleep disorders.



Possible Solution:

Promote regular physical activity, ensure breaks during screen time, and encourage healthy sleep habits.

5.5.1.3 Cognitive Impairments:

Too much information can negatively affect memory and decision-making abilities.

Possible Solution:

Practicing digital detoxes means taking breaks from digital devices and participating in activities that foster critical thinking.

5.5.2 Security Dangers

Cybersecurity Threats: Risks include identity theft, phishing scams, and data breaches.

Possible Solution:

Install antivirus software, use strong passwords, implement firewalls, and regularly update software protect against vulnerabilities

5.5.2.1 Online Predation:

Online predation refers to the exploitation of children by adults who use the **Internet** to manipulate and harm them.

Possible Solution:

Educate children about online safety, monitor their online activities, and use parental control software to limit exposure to harmful content.

5.5.3 Social Dangers

5.5.3.1 Impact on Social Skills:

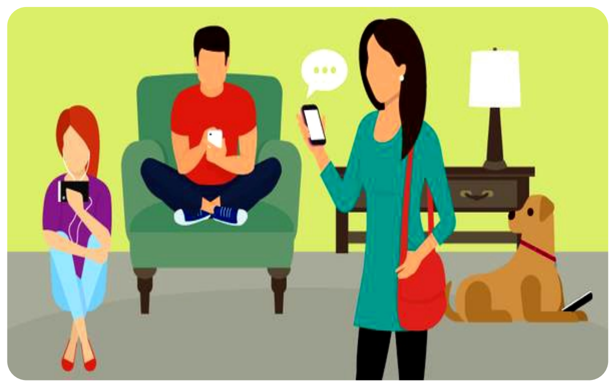
Excessive **Internet** use can hinder face-to-face communication and social interactions.

Possible Solution:

Encourage face to face interactions and set boundaries for online time to foster real-life relationships.

5.5.3.2 Family Dynamics:

Excessive screen time may weaken familial bonds as individuals prioritize online interactions over family time.



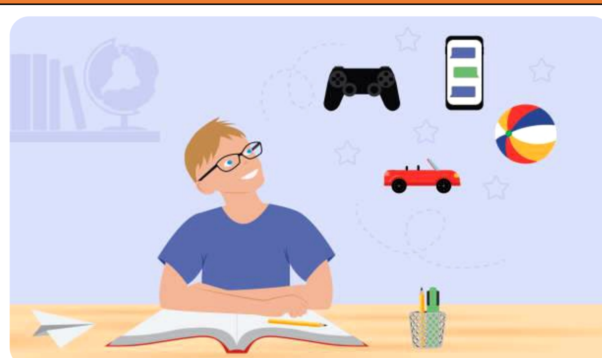
Possible Solution:

Establish family time without devices, promote shared activities that encourage bonding, and create technology-free zones in the home.

5.5.4 Impacts on Education

5.5.4.1 Distraction from Learning:

Students may be sidetracked by social media, affecting academic performance.



Possible Solution:

Use software application that block distracting websites during study time, create a dedicated study space free from distractions, and encourage time management skills.

5.5.4.2 Dependence on Online Resources:

Overreliance Encourage the use of diverse resources on digital tools can diminish critical thinking skills.

Possible Solution:

Promote books reading, discussions, critical thinking exercises, and limit reliance on search engines for answers.

5.6 Information Security and Confidentiality:

Information security and confidentiality mean keeping personal data safe from people who are not authorized to access it. Below are some techniques to secure and maintain the confidentiality of information.

- **Create Strong Passwords**

  Creating a strong password is the first step in securing your credentials. A strong password combines uppercase and lowercase letters, numbers, and special characters, and avoids common words or patterns.

  Tips for creating strong passwords:

  - Use at least 12 characters.
  - Avoid personal information (e.g., names, birthdays).
  - Mix character types and avoid common words such as "abc123"," qwerty", "football" etc.
  - Consider using a passphrase (e.g., "P@$$word2481").

Activity Time:
Creating Strong Passwords (10 minutes):
Step1: Instruct students to change their passwords by going to "Security and Login" in the settings of Facebook account.
Step2: Discuss the importance of strong passwords. Encourage them to create a new password that includes a mix of uppercase letters, lowercase letters, numbers, and symbols.
Step3: Have them write down their new password in a secure place for example dairy or any Notebook.

- **Enable Two-Factor Authentication:**
  Two-factor authentication (2FA) is a security method designed to keep your account or email safer. 2FA requires two Internet-enabled devices to ensure that only the authorized person can access the account. With 2FA, you log in by entering your password as usual, and then a unique code is sent to your phone. You enter this code to complete the login process.

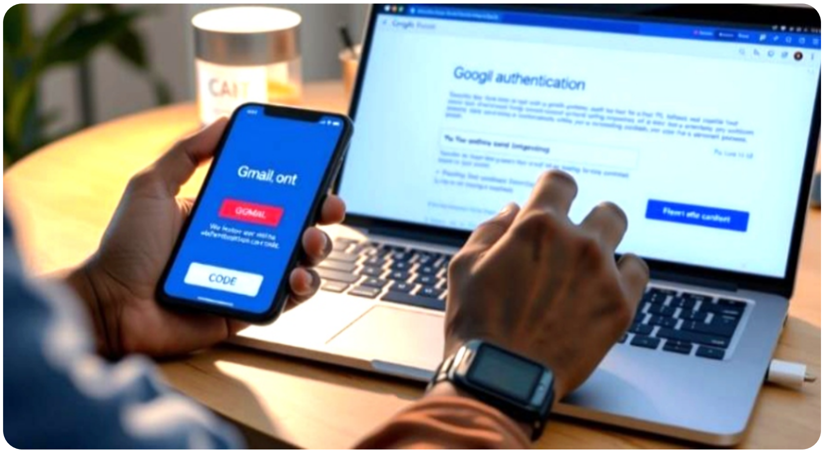
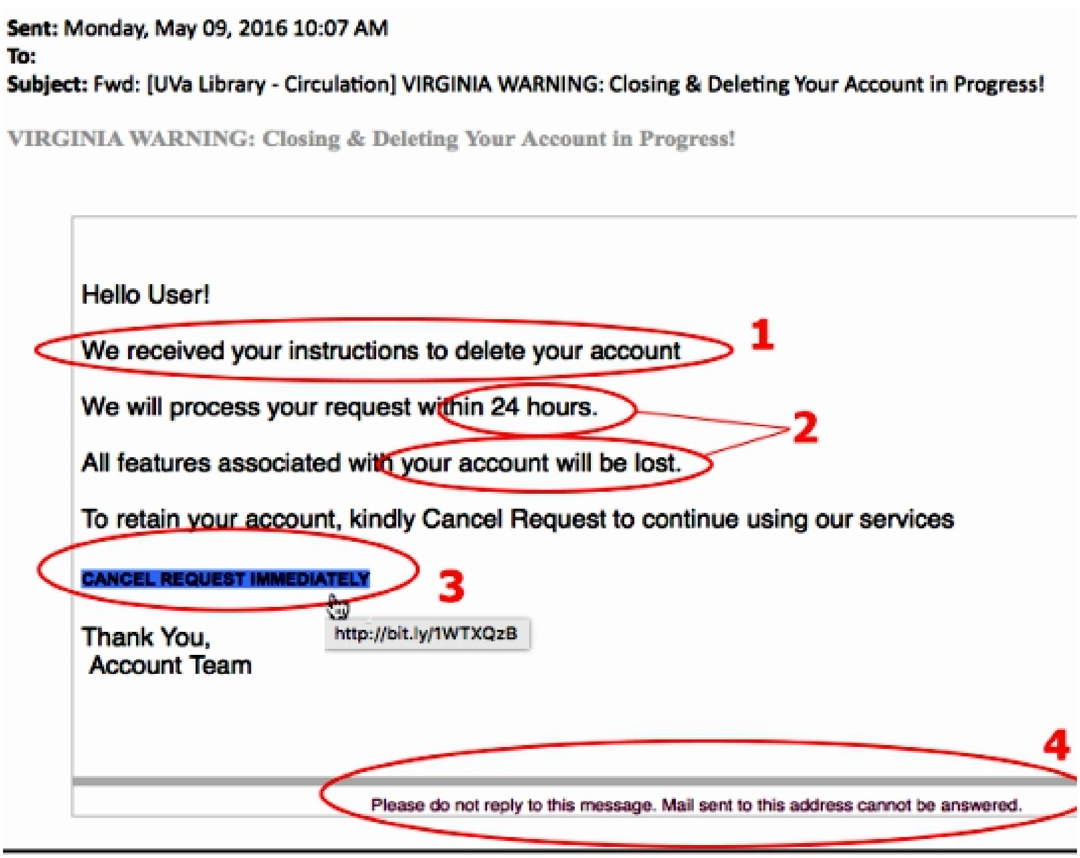


Figure 5.2: Order to maintain security use Two-factor authentication (2FA)

- **Keep Personal Information Private:**
  The way to keep your personal information safe, follow these simple tips:
  - Avoid sharing information like your address, phone number, or school with strangers online.
  - Learn about common scams to recognize them when they happen. Staying informed will help you stay safe and avoid becoming a victim of fraud.

Figure 5.3: In order to avoid sharing of personal information

- **Fraudulent Emails and Links:**
  This is the one of scamming trick, scammers use a few sneaky tricks to try and trick people into clicking bad links or giving away their personal information. They often repeat the same tricks over and over again to fool people.
  Following are some ways to recognize spam emails.
  - Look for generic greetings, spelling mistakes, and urgency in the message.
  - Be cautious of links that do not match the official website URL.
  - Always verify with the company directly through their official channels instead of clicking on links in suspicious emails.
  - spam email


Sent: Monday, May 09, 2016 10:07 AM
To:
Subject: Fwd: [UVa Library - Circulation] VIRGINIA WARNING: Closing & Deleting Your Account in Progress!

VIRGINIA WARNING: Closing & Deleting Your Account in Progress!

Hello User!

We received your instructions to delete your account

We will process your request within 24 hours.

All features associated with your account will be lost.

To retain your account, kindly Cancel Request to continue using our services

CANCEL REQUEST IMMEDIATELY

http://bit.ly/1WTXQzB

Thank You,
Account Team

Please do not reply to this message. Mail sent to this address cannot be answered.

Figure5.4: Do not click on suspicious email or link

- **Use of Secure Networks:**
  A secure network means a safe and trusted connection. When you use an authenticated network, it helps keep your information more secure, for

example, when you connect to your school's Wi-Fi that requires a password, it is a secure network. This means only people who know the password can access it, making it safer than using an open Wi-Fi network at a coffee shop, where anyone can connect and see your information.

Figure 5.5: Use of secure networks

- **Update Devices Regularly:**
  Keep your computer, phone, and apps up to date to safeguard against security threats. Below are the steps to update windows operating system.
  - **Windows OS:**
    Click the Start menu and select Settings.
    Go to Update & Security and click on Check for updates.

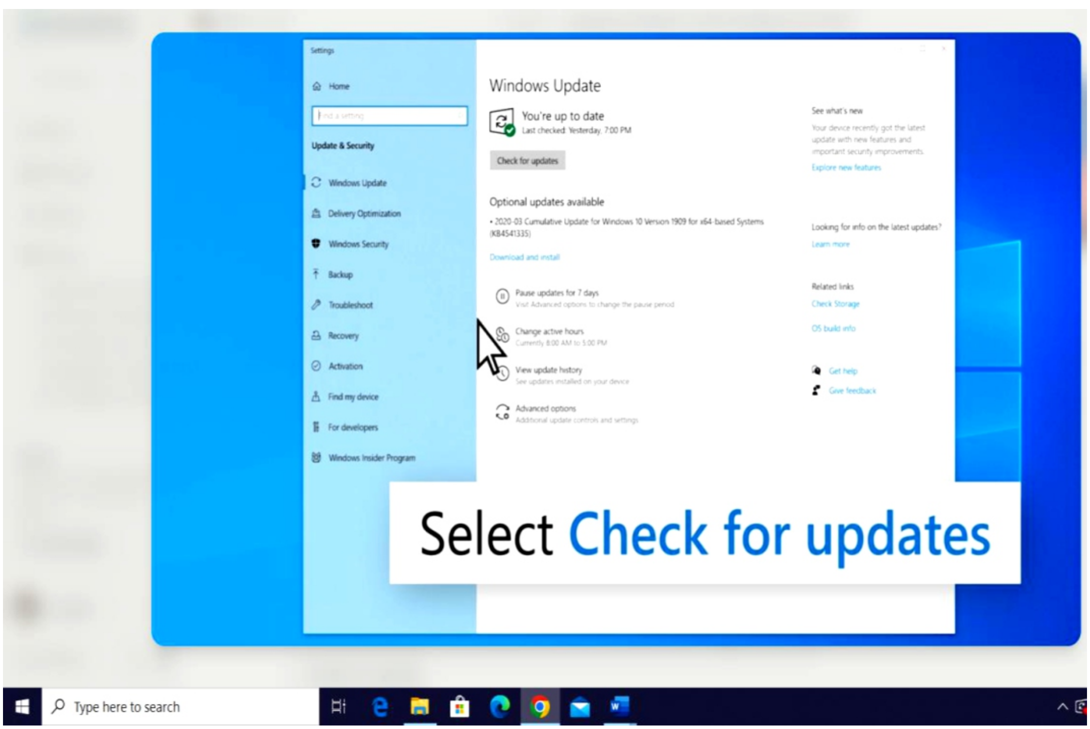
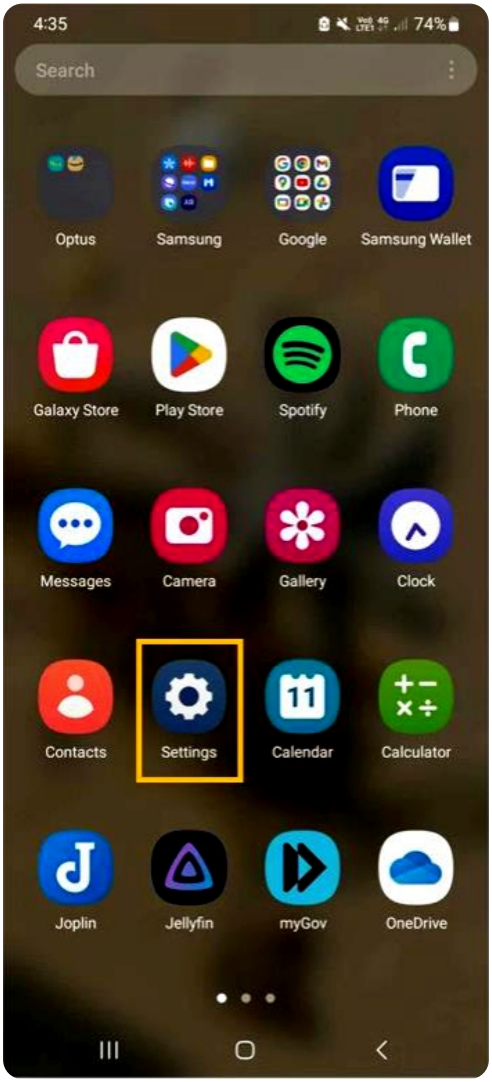


Figure 5.6: windows update process

- **Android OS:**
  Open Settings, tap on System, then select Software update.



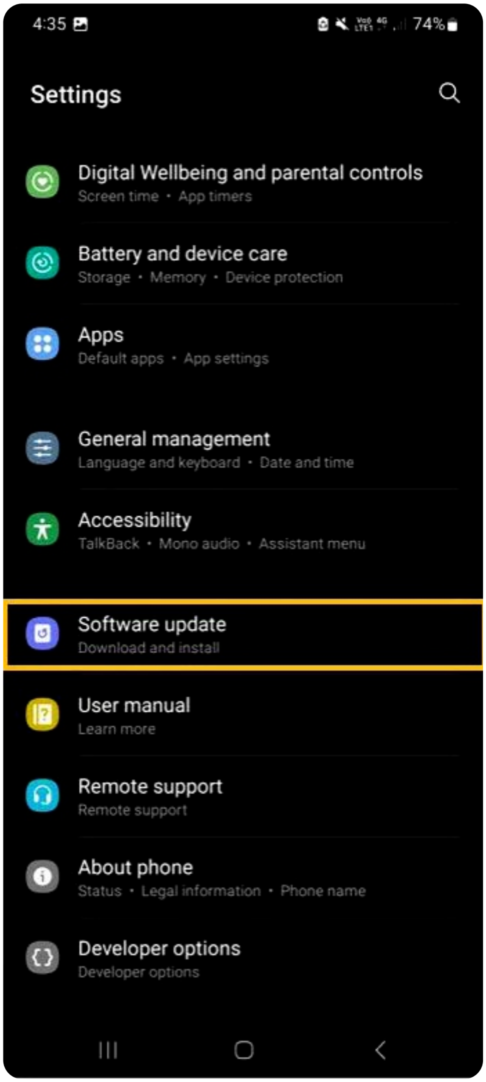


Figure 5.7: Android Update setting

- **Chatting Safely online:**
  Chatting safely online means being cautious in digital spaces like games and social media. Avoid sharing personal information, stay aware of strangers, and report uncomfortable interactions to a trusted adult. It's about protecting your privacy and ensuring secure, appropriate conversations.

5.7 Cybercrime:

Cybercrime means when people do illegal things using computers or the Internet. People who commit these crimes are called cybercriminals.

Cybercriminals want to:

- Steal money
- Access personal information
- Cause harm to others

Cybercriminals use various devices, including:

- Computers
- Laptops
- Tablets
- Smart TVs

Let's explore the various types of cybercrimes.

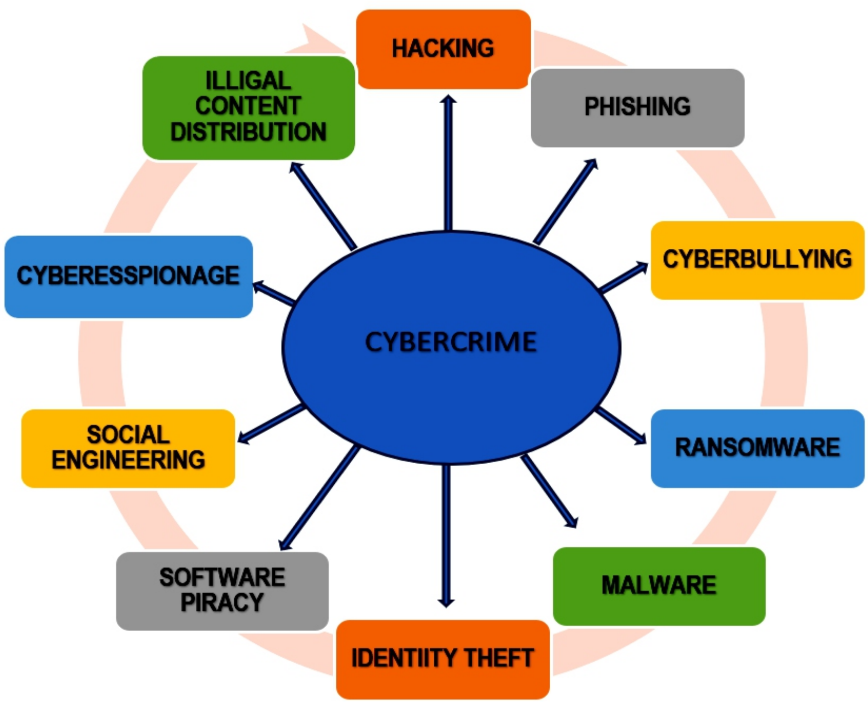


Figure 5.8: Types of Cybercrime.

5.7.1 Hacking:

Hacking is defined as the unauthorized access to computer systems or networks. Hackers exploit weaknesses in technology to gain access into someone computer and can use their computers and smartphones to perform certain actions.

5.7.2 Phishing:

Phishing is like fishing, but instead of catching fish, it's about stealing people's personal information. Cybercriminals make fake websites that look real to trick people into giving away Information like passwords, credit card numbers etc.

Figure 5.9: Phishing the other personal information through fake web page

5.7.3 Cyberbullying:

Cyberbullying is when someone uses technology to hurt or embarrass another person. This can happen with devices like smartphones or computers. Here are some ways it can occur:

- **Anonymous Messages:** Sending mean messages or comments that don't show who sent them.
- **Hurtful Posts:** Writing unkind things about someone on social media or in texts.
- **Fake Profiles:** Creating a pretend account online to bully or tease someone.
- **Sharing Without Permission:** Posting pictures or videos of someone without asking them first.

Activity:
Hands-On Activity: Reporting Spam on WhatsApp
Objective: Conduct an activity to teach students how to report spam on WhatsApp, particularly for instances of bullying.
Instructions:

1. **Open the Chat:** Navigate to the chat with the spam or bullying message.
2. **Tap on the Contact Name:** Click the contact's name at the top of the chat screen.
3. **Select "Report Contact":** Scroll down and choose "Report Contact."
4. Confirm Your Action: Follow the prompts to confirm the report.
5. Discuss Importance: Talk about why reporting is crucial for online safety.

Quick Tip:

How to preventing from cyberbullying

- Reporting options such as Parents, school authority and law Enforcement.
- Cybersecurity software tools Bully Block, Bully Button etc.

5.7.4 Ransomware:

Ransomware is a type of cybercrime that involves harmful software designed to lock and encrypt a person's files. Cybercriminals use this malware to make the victim's data inaccessible, and then they demand payment to unlock it.

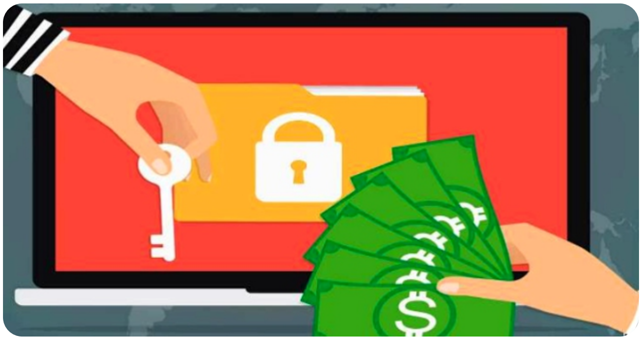


Figure 1.10: Cybercriminal demands Ransomware amount for freeing theft information

5.7.5 Malware:

Malware refers to any program created to harm computers or steal information. It often spreads into computers through unsafe websites, emails, or downloads. Malware can damage files, slow down systems, and cause various problems. below are types of malwares.

- **Viruses** are programs that attach to files and spread when the infected file is opened.
- **Worms** are programs that can copy themselves and spread through networks without needing a file to attach to.
- **Trojans** are programs that pretend to be helpful but are actually harmful and can damage your device.
- **Spyware** is software that secretly collects personal information from your device without you knowing.
- **Adware** is software that shows unwanted ads on your device, often when you download free programs.

5.7.6 Identity Theft:

Identity theft is a type of cybercrime where someone takes your personal information and uses it for their own benefit. This can involve stealing money from you or committing crimes in your name, making it seem like you are the one responsible.

Figure 5.11: Identity theft

Activity:

Exploring Privacy Settings (10 minutes):

Step1: Ask each student log into their Facebook account.

Step2: Instruct them to navigate to their privacy settings by clicking the downward arrow in the top right corner, selecting "Settings & Privacy," then "Settings," and finally "Privacy."

Step3: Ask them to review their current privacy settings and adjust them to limit who can see their posts and personal information.

5.7.7 Software Piracy:

Software piracy is the illegal use or distribution of software without the owner's permission. This includes downloading cracked versions of programs or sharing licensed software without authorization.

Did you know?

A "cracked version" is a modified software that has been changed to bypass security features like licensing and digital rights management (DRM). This alteration is usually done illegally.

5.7.8 Social Engineering:

Social engineering is a way cyber criminals trick people into giving secret information. They do this by lying, like acting as someone they're not (pretexting) or offering fake prizes (baiting).

5.7.9 Cyberespionage:

Cyber espionage is when cyber criminals secretly break into computers to steal important information from governments, businesses, or people. These attacks can cause big problems for safety and privacy.

5.7.10 Illegal Content Distribution:

Illegal content distribution refers to the unauthorized sharing or selling of copyrighted materials, including movies, music, software, and other digital content. This activity can lead to significant financial losses for creators and industries.

5.8 Combating against Cybercrime:

Combating against cybercrime means taking proactive steps to ensure safety and avoid cybercrime.

5.8.1 Cybercrime Laws:

Law is a set of rules created by governments or societies to guide how people should behave. It helps maintain order and protect people's rights. In Pakistan, specific laws are designed to combat online crimes, such as the **Prevention of Electronic Crimes Act (PECA) 2016**. This law addresses issues like hacking, stealing personal information, and cyberbullying. Understanding these rules is important for staying safe online.

5.8.2 Cybercrime and Punishments:

Cybercrime	Punishment	Fine (PKR)
Damage to Data	Up to 3 years	300,000
Electronic Thievery for example identity theft.	Up to 7 years	700,000
Forgery of Electronic Documents (Copyright, Plagiarism, Piracy etc.)	Up to 7 years	700,000
Malicious Code/Virus	Up to 5 years	500,000
Unauthorized Access (Hacking)	Up to 3 years	1,000,000
Electronic Fraud	Up to 5 years	500,000

5.8.2 Good Practices to Stay Safe:

- Avoid clicking on links from unknown sources, as they might lead to scams or viruses.
- Use Strong passwords that are hard to guess. Avoid using easy-to-guess details like your name or birthdate.
- Keep your details private, do not share your address, phone number, or passwords with strangers.
- If someone facing problem like online bullying or theft of personal information, you can report it to the ***Cyber Crime Wing of the FIA (federal Investigation Agency)***.
- Collect Evidence, if an incident occurs, take screenshots or save messages as proof. This will make it easier to report and investigate the situation.
- Schools and workplaces often provide information about staying safe online. Participate in workshops or classes to learn more about cybersecurity.

Did you know?

CHAPTER II, OFFENCES AND PUNISHMENTS
No.11. Hate speech. -Whenever prepares or disseminates information, through any information system or device that advances or is likely to advance interfaith, sectarian or racial hatred. shall be punished with imprisonment for a term which may extend to seven years or with fine or with bot
Website Reference for PECA 2016 cybercrime law is (https://www.nr3c.gov.pk/law.html).

5.8.3 Cyber Scout:

Cyber Scouts is a team of well-trained cybersecurity experts who fight against cybercrime. Their job is to help keep people safe online by looking out for problems and stopping cybercrimes like hacking, bullying, and scams.

The URL for cyber scout is "https//csop.pk/cyber-scouts".

5.8.4 How Cyber Scouts Helps Individual:

- **Spotting Dangers:**
  Cyber Scouts monitor if someone is trying to trick others or if a website isn't safe.
- **Reporting Problems:**
  If someone becomes a victim of cybercrime, cyber scouts help by informing the school and parents before reporting the incident to the authorities.

- **Teaching Safe Habits:**
  Cyber Scouts share tips with others about how to stay safe.

- **Spreading Kindness:**
  Through training sessions, cyber scouts encourage everyone to be nice online and avoid saying bad things.

5.9 Support Systems for Responding to Cybercrime:

If someone becomes a victim of cybercrime, there are various support systems available to help them recover and navigate the aftermath. These resources provide essential assistance, guidance, and emotional support to victims facing the challenges that come with cybercrime.

5.9.1 Federal Investigation Agency (FIA) and Cyber Crime Wing (CCW):

The Cybercrime Wing (CCW) of FIA works under the PECA 2016 law to fight against cybercrimes. Started in 2007, it stops misuse of technology in society. Its task is to handles cybercrime cases and punishes cybercriminals.

5.9.2 National Response Centre for Cyber Crime (NR3C):

The National Response Centre for Cyber Crime (NR3C) is a specialized law enforcement agency in Pakistan, established to combat cybercrime effectively. It operates under the Federal Investigation Agency (FIA), The website reference for National Response Centre for Cyber Crime is https://www.nr3c.gov.pk/law.html.

5.9.3 Pakistan Telecommunication Authority (PTA):

The PTA regulates telecommunication services, addresses online harassment, and promotes safer Internet usage by blocking harmful content, the website for PTA complaint management system is https://complaint.pta.gov.pk/registercomplaint.aspx

5.9.4 Guide to Taking Action Against Cybercrime Complaints in Pakistan:

If you become a victim of cybercrime in Pakistan, it's important to know how to report it. The step-by-step guide below will help you through the process.

Step 1: Collect Evidence

Save all proof of the cybercrime, like screenshots, messages, and links. Write down what happened step by step, including names, places, and details. Keep it simple and focused on the crime.

Step 2: Report to Authorities

Send your report to authorities like **FIA, Police, or PTA.** Note the date you submitted it and get a receipt or reference number.

Step 3: Follow Up

Follow up or checking your case regularly. If nothing happens, ask higher officials or go to the Wafaqi Mohtasib. You can also take legal action in court if needed.

5.10 Copyright, Plagiarism, and Piracy:

Copyright, plagiarism, and piracy are types of cybercrime that hurt creators. These happen when someone uses or shares another person's work, like a story, picture, or video, without asking for permission.

5.10.1 Copyright:

Copyright is a special right that protects creators of original works like books, art, music, and images. This protection starts as soon as the work is created in a tangible form.

For example, when an artist paints a picture, they automatically own the copyright. This means no one can copy or sell the painting without the artist's permission. If someone does so without consent, they are breaking copyright laws.

5.10.2 Plagiarism:

Plagiarism means the act of presenting someone else's work or ideas as your own without permission. This occurs when you include their material in your work without properly acknowledging the original source, for example A student copies a paragraph from an online article about climate change and includes it in their report without any acknowledgment of the source.

Following are various online software tools for plagiarism checking.

Quetext: Uses DeepSearch to detect plagiarism with free and paid options.	Quetext
Turnitin: Online plagiarism detection tool, widely used by schools, with a vast academic database.	turnitin
Copyscape: Online available tool to find duplicates on the web.	Copyscape
SmallSEOTools: Free tool for basic plagiarism checks across online content.	SmallSEOTools
Unicheck: Scans for similarities in a large database, popular in academia.	UNICHECK
Scribbr: Uses Turnitin's algorithm, offers detailed reports for students and academics.	Scribbr

5.11 Piracy:

Piracy is when someone copies and sells another person's work without permission. This illegal act usually offers lower prices for items like movies, music, or books. For example, you might find a pirated movie online for less price than the official version. However, buying pirated products is unfair because the original creators do not get credit or money for their work.

Summary

- **Common Uses of the Internet:** The Internet is used for business communication, social networking, and accessing news, connecting people globally.
- **Digital Citizenship:** This concept focuses on using technology responsibly, promoting respectful communication and protecting personal information.
- **Digital Ethics:** Digital ethics involves principles like honesty and respect that guide responsible online behaviour.
- **Risks and Dangers of the Internet:** Overuse can harm health and lead to cybersecurity threats like phishing and hacking; awareness is crucial.
- **Information Security:** Online safety includes using strong passwords, two-factor authentication, secure networks, and being cautious about personal information.
- **Cybercrimes:** Cybercrimes such as hacking and identity theft disrupt lives by stealing data and causing financial losses.
- **Combating Cybercrimes in Pakistan:** Pakistan addresses cybercrime through laws like PECA 2016, with organizations like FIA helping report incidents.
- **Copyright, Plagiarism, and Piracy:** Copyright protects creators' rights; plagiarism is using others' ideas without credit, while piracy involves illegal copying of materials.
- **Role of Cyber Scouts:** Cyber Scouts monitor cybercrimes, teach safe Internet habits, and promote positive online interactions.
- **Support Systems for Cybercrime Victims:** Victims in Pakistan can seek help from agencies like FIA's Cybercrime Wing by documenting incidents.
- **Social media and its Impact on Society:** Social media changes communication but can also lead to issues like cyberbullying and misinformation.
- **Online Privacy:** Online privacy involves controlling personal information shared on the Internet; awareness is essential.
- **Cyberbullying:** This involves using digital platforms to harass others, leading to serious effects like depression; prevention requires community effort.
- **Ethical Use of Technology:** Ethical technology use means respecting rights and adhering to guidelines to create a responsible digital environment.
- **Ethical Use of Technology:** Ethical use of technology involves using digital tools responsibly, respecting others' rights, and adhering to legal and moral guidelines.

Exercise

1. Encircle the correct answers.

1. **What is Digital Citizenship?**
   a) The use of technology in businesses
   b) The responsible use of technology and online behaviour
   c) Playing online games
   d) Watching online videos

2. **Which of the following is an example of positive online behaviour?**
   a) Spreading false rumours
   b) Using social media to stay connected with friends
   c) Hacking others' accounts
   d) Sharing pirated content

3. **What is one of the health dangers of excessive Internet use?**
   a) Improved memory
   b) Anxiety and depression
   c) Better physical fitness
   d) Increased energy levels

4. **What is phishing?**
   a) A type of malware
   b) A method of stealing personal information via fake websites
   c) A social media platform
   d) A tool for online shopping

5. **What is one way to maintain information security?**
   a) Use weak passwords
   b) Share passwords with friends
   c) Enable two-factor authentication
   d) Avoid updating software

2. Fill in the blanks with appropriate words.

i. Digital citizenship promotes ___________ behaviour online.
ii. ___________ helps secure online accounts by requiring an extra code for access.
iii. Cybercrime includes illegal activities performed using ___________.
iv. One way to keep your information safe online is by creating a ___________ password.
v. The act of using someone else's work without giving credit is called _________.

3. Provide the descriptive answers of the following questions.

i. What is digital citizenship?
ii. What are the common uses of the Internet?
iii. What is cybercrime?
iv. What are the dangers of the Internet?
v. Define any two ways to keep information secure online.

Important points to remember

- **Digital Citizenship:** The responsible and ethical use of technology to engage positively online.
- **Digital Ethics:** Principles guiding what is right and wrong in behaviour, both online and offline.
- **Cybercrime**: Illegal activities performed online, such as hacking and identity theft.
- **Cyberbullying:** The act of using the Internet to harass, threaten, or harm others.
- **Phishing:** A method of tricking people into revealing personal information through fake emails or websites.
- **Two-Factor Authentication (2FA):** A security measure that requires two steps to verify a user's identity.
- **Identity Theft:** The act of using someone's personal information without permission for personal gain.
- **Ransomware:** Malware that locks data until a ransom is paid to the attacker.
- **Social Networking:** Using online platforms to connect with friends, family, and communities.
- **Social Engineering**: A tactic used by cybercriminals to trick people into giving up confidential information by exploiting trust.
- **Cyber Scout**: An individual trained to promote cybersecurity and recognize online risks, helping create safer online spaces.

- **Secure Network**: A network that protects information by restricting access to trusted users, often using passwords.
- **Plagiarism**: The act of copying someone else's work or ideas without proper acknowledgment, considered unethical.
- **Digital Footprint**: The trail of data a person leaves online through their digital activities, which can be tracked or analysed.
- **Software Piracy**: The unauthorized copying, distribution, or use of software, depriving creators of fair compensation.

Instruction for Teachers:

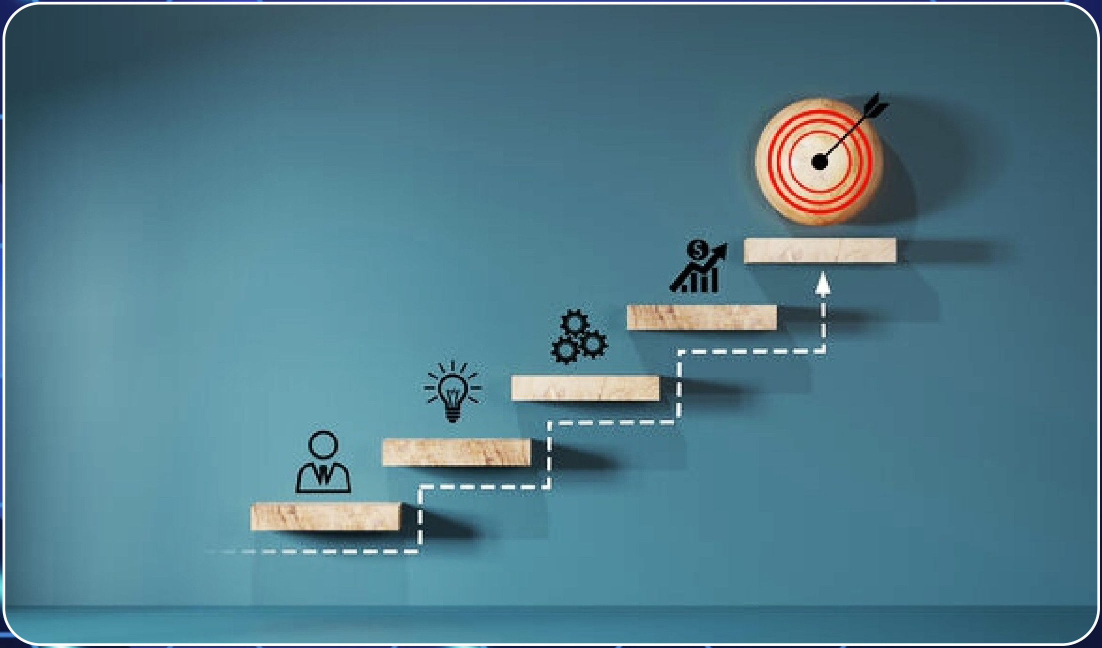
i. The teacher should have access to the Internet either on a mobile device or in the lab.
ii. The teacher should utilize images, diagrams, or videos to enhance understanding and maintain student engagement.
iii. The teacher should include activities such as group discussions, brainstorming, or problem-solving tasks to actively involve students.
iv. The teacher should connect the topic to real-life scenarios to make the learning experience more relevant and practical.

Chapter 6 Entrepreneurship

Student Learning Outcomes (SLOs):

By the end of this unit, students will be able to:

- Define Business Plan and its components.
- Describe the basics of the components of a business plan, i.e. market need, product design, costing, operations, and marketing.
- Understand the difference between payment and transactions; choose safe transaction methods.
- Apply the tools and techniques used for digital marketing.
- Design and develop a digital marketing plan and its component.
- Discuss Search Engine Optimization (SEO), using social media websites such as Instagram, Twitter, and blogs.
- Discuss the importance of project management and media literacy as a tool for a business plan



6.1 Introduction:

This chapter covers key parts of a business plan and tools from digital marketing, project management, and media literacy to ensure success. In entrepreneurship, a business plan acts as a roadmap, guiding the launch, operation, and growth of a business in today's fast-paced world.

6.2 Entrepreneurship:

Entrepreneurship means starting and managing a new business or innovative idea. It involves coming up with new ideas, making plans, and putting in the effort to grow and succeed. Entrepreneur is someone who knows how to sell and promote products, both in traditional ways and online. They can sell things on websites like Daraz, Amazon, YouTube, and Instagram.

6.2.1 Idea:

An entrepreneur must be able to generate innovative or new business ideas. For example, in order to start a cupcake business that sells unique and innovative idea is to offer a **"fun cupcake"** for special occasions such as birthdays and weddings.

6.2.2 Business Plan:

A business plan is a series of steps used to turn an idea into a business. For example, to turn the "Fun Cupcake" idea into a business, the business plan could look like this:

- **Market Research:** Find out if people are interested in buying unique fun cupcakes.
- **Target Customers:** Identify who would buy the cupcakes, like families, friends, or people planning events.
- **Marketing:** Use social media and websites to promote the fun cupcakes.
- **Cost:** Figure out how much money is needed to make the cupcakes and how much money can be earned.

6.2.3 Action:

An action refers to the implementation of a business plan, The following actions can be done for "**fun cupcake"** business.

- Set up a small space to bake **"fun cupcakes"**.
- Start selling "**fun cupcakes"** and take orders.
- Use social media to share your **fun cupcakes** and get customers.
- As orders grow, plan to expand your business.

6.3 Business Plan and its Components:

A business plan is a document that outline a business's goals and how to achieve them. It includes important parts like how to get money, manage spending, and plan for future. Every entrepreneur should write down and follow these goals or steps to start or run a business successfully.

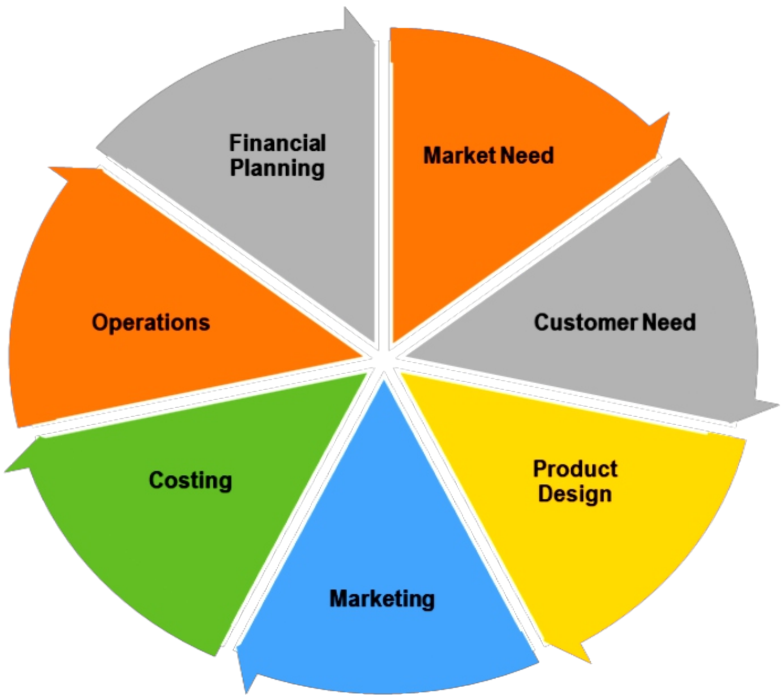


Figure 6.1: Components Business Plan

6.3.1 Market Need:

Market need is a situation in the market or business when a product is sold in large quantities. For example, if many students want to buy a "Parker Pen," that represents a market need, and the company should produce more "Parker Pens."

6.3.2 Customer Need:

Customer need refers to something that a person wants or desires. For example, if you are thirsty, you may want to drink water or juice.

6.3.3 Product Design:

Product Design is a process of making new items or improving old items to look better. For example, if you make a new toy, children might be more interested in playing with it.

6.3.4 Marketing:

Marketing is how companies inform people about their products, services, or items to buy or use. For example, if you tell your friend that ‘Parker Pen’ is good and your friend also buys it. You did marketing of ‘Parker Pen”.

Below are the 4Ps of marketing:

- **Product:**
  Product is anything that is made to be sold or used. It is something that people want and companies create it. For example, selling ice cream, in order to offer product’s different flavours, like chocolate or vanilla.

- **Price:**
  Price refers to the cost of the product. It should be set at a level that is affordable for customers while also ensuring a profit for the business. For example, the ice cream cost is 50 rupees per cone, that’s the price you set to make money and attract buyers.

- **Promotion:**
  Promotion involves informing people about your product through methods like advertisements, discounts, or social media posts. For Example, offering a "Buy 1 Get 1 Free" deal on ice cream to encourage more people to buy it.

Figure 6.2: Using poster for promotion.

- **Place:**
  Place is area or shop where product is to be sold. For example, selling ice cream at a shop near a park.

6.3.4.1 Difference between Online Marketing and Physical Marketing:

Table#6.1 shows the key difference between online and physical marketing

Online Marketing	Physical Marketing
It uses the Internet, like social media or websites, to reach people.	It uses stores, billboards, and flyers to reach people.
It can be done at any time and from anywhere.	It happens in specific places, like stores or streets.
It can show ads to many people around the world.	It reaches people in nearby areas, like a local community.
It’s usually cheaper and easier to start.	It may cost more to create and distribute things like posters.
You can track how well your ads are doing online.	It’s harder to see how many people saw your flyers or posters.
For examples, Content Marketing, Social Media Marketing, Search Engine Optimization, Pay-Per-Click (PPC) Ads and Online Marketplaces.	For examples, Word of Mouth, Print Advertising, Radio and TV Ads, Billboards and Posters and Product Samples or Free Trials.

Table 6.1

6.3.5 Costing:

Costing is the process of calculation how much money is needed to make a product or service. For example, the costs include the money, time, and people needed to make and sell the lemonade.

6.3.6 Operations:

Business operations are all the activities a company does to sell or buy items, products, services. Operations are making the product, delivering it to customers, managing money, and working with employees. These activities help the business run smoothly and succeed.

6.3.8 Finance Planning:

Financial Planning means making a plan for how to use money. It is like deciding how much money shall be spent on buying items and how much money to save. In businesses, financial planning is done for how much money to use for expenses and how much money can be saved.

6.4 Understand the Difference Between Payment and Transaction:

A transaction is when you exchange something, like money, for a product or service and Payment is the act of giving money in exchange for something. Following table shows difference between payment and transaction.

Characteristic	Payment	Transaction
Definition	The act of transferring money in exchange for goods, services, or to settle obligations.	The overall process of exchanging goods, services, or assets between two parties.
Scope	Primarily concerned with the transfer of money.	Includes all elements of the exchange, such as agreements, delivery, and payments.
Timing	Happens at a specific point in the transaction process.	Encompasses the entire process from start to finish.
Key Components	Amount, payment method, payment confirmation.	Parties involved, terms of exchange, delivery, and payment details.
Impact	Directly affects financial accounts.	Affects the transfer of ownership, completion of agreements, and financial transactions.
Methods Involved	Cash, card payments, digital wallets, bank transfers.	Includes payment, as well as logistics, legal agreements, and customer satisfaction.
Documentation	Receipt or proof of payment.	Includes invoices, contracts, and payment receipts.
Example	Paying 100 Rupees for groceries using a credit card or You take out a 100 rupee note from your wallet and give it to the cashier.	The entire process of purchasing groceries, from selection to payment and receipt.

Table 6.2

6.4.1 Safe Transaction Methods:

Safe transaction Method is way to exchange something securely. Choosing a safe transaction method means picking a way to pay that keeps your money and personal information secure. There are traditional methods means older ways, Innovative methods mean newer and smarter ways to make transactions safe.

6.4.2 Traditional Methods:

- **Cash Payments:** Paying with physical money like coins or paper bills. This is easy but may be lost or stolen.

- **Credit Cards:** This is when you use a card, like a bank card, to pay for things. It is safe and convenient, especially for larger amounts, because you don't need to carry a lot of cash. However, if someone gets your card information, they might misuse it.

6.4.3 Innovative Methods:

- **Digital Wallets:** Using apps like easypaisa or Google Pay to send money. It is fast and keeps your card details safe.

- **Biometric Verification:** This process uses your facial features or fingerprint to verify your identity when making a payment, ensuring that no one else can steal your money.

- **Two-Factor Authentication (2FA):** This is a method to verify your identity by asking for a password or a one-time code sent to your phone or email, for example OTP code.

- **Smart Contracts:** Digital agreements that automatically do what both people agreed on, like sending money when goods are delivered.

Do you Know

OTP stands for **One-Time Password**. It is a security feature used to verify your identity. An OTP is a temporary, unique code sent to your phone or email, and it can only be used once to complete a transaction or login. It adds an extra layer of protection to your account or transaction.

6.5 Social Media Platform and Websites:

Social media is an effective way to support a website get noticed online by using platforms like Instagram, Twitter, and blogs. It improves the website's SEO (Search Engine Optimization) and expands its search results in the following ways:

- **Share Fun Posts:** Post nice pictures and stories about **"fun cupcakes"**.
- **Use Hashtags:** Add hashtags like **#CupcakeLovers** so more people can see the posts.
- **Link to the Website:** Put a link to the website in the posts so people can visit easily.
- **Talk to Followers:** Answer comments to be friendly with customers.
- **Work with Influencer:** Team up with popular people to show off the fun cupcakes.

6.5.1 Digital Marketing Tools and Techniques:

Digital Marketing or Online Marketing is the use of internet tools like social media platforms (e.g., Facebook), search engines (e.g., Google), websites, and emails to connect with customers. Following are tools used in digital marketing.

Figure 6.3: Digital marketing Tools

- **Website Designing:**
  A website is an online place where businesses or people share information and sell things.
  - A blog is a section of a website where new information, stories, or helpful tips are shared regularly with readers.

- **Email Marketing:**
  Email marketing means sending messages to people's inboxes to share news, promotions.

- **Social Media Marketing:**
  Social media refers to online platforms, like Facebook, Instagram, or X.com, where people can talk, share pictures, and post messages. It is also a key tool in digital marketing for promoting products and services.

- **Online advertising:**
  Online advertising means showing ads on websites or apps, targeting specific groups of people through digital marketing techniques like Google Ads or social media ads.

- **Content Marketing:**
  Content marketing means creating useful or fun content, such as videos or articles, to attract and keep people interested through digital channels.

- **Mobile Apps:**
  Mobile apps are small programs for phones and tablets. They are used for chatting, learning, playing games, or shopping. These apps can be downloaded from app stores like the Google Play Store.

- **Search Engines Optimization:**
  Search Engine Optimization (SEO) is a digital marketing tool that helps improve search results. It uses the best techniques to make products easier to find and sell online.

6.5.2 Developing a Digital Marketing Plan:

Developing a digital marketing plan involves using the internet to promote a business's products or services. It helps a business set goals and monitor progress. Here's an example of what a digital marketing plan might look like for a business selling **"Buy phone accessories online"**.

Component	Details
Market Need	Mobile phones are widely used, people need affordable, trendy and quality accessories such as cases, chargers, headphones are in demand.
Customer Need	• Customers look for quality accessories that match their devices. • Customers prefer online shopping with quick delivery. • Customers want affordable and stylish phone accessories.
Product Design	• **"Buy phone accessories online"** Offer a variety of accessories such as phone cases, chargers, power banks, etc. • Ensure accessories are compatible with popular mobile brands such as Samsung, iPhone, etc. Design trendy, durable, and affordable products.
Operations Plan	• Create an e-commerce website of "**Buy phone accessories online"** or sell on platforms like Instagram, Facebook, eBay etc. • Ensure quick stock updates and efficient shipping methods.
Marketing Plan	• **Social Media Marketing:** • Use Instagram and Facebook to showcase new arrivals and promotions of **"Buy phone accessories online"**. Run targeted Ads for mobile users looking for phone accessories. • **Influencer Marketing:** • Partner with local influencers to promote products through social media. • **Content Marketing:** • Post blogs or videos about phone care tips, trending accessories, and unboxing. • **SEO:** Optimize website for terms like **"Buy phone accessories online"** or "best phone case for iPhone."
Finance Plan	• Set a budget of **"Buy phone accessories online"** for Advertisement, website development, and influencer marketing. • Keep track of product cost and set competitive pricing for better margins. • Monitor cash flow regularly and focus on boosting online sales to increase income.

Table 6.3

6.6 Search Engine Optimization (SEO):

Search Engine Optimization (SEO) is a process of making websites easier for people to find when they search using search engines (e.g. Google). SEO helps websites or webpages to appear as top results with search engines. Following are types of Search Engine Optimization.

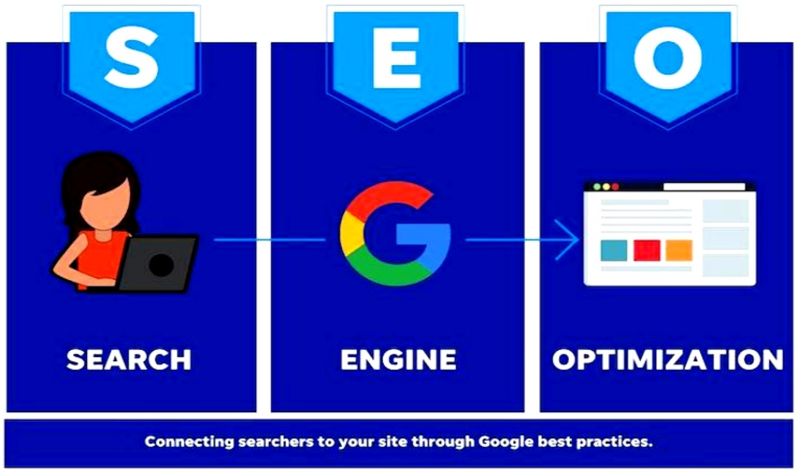


Figure 6.4: Search Engine Optimization

6.6.1 On-Page SEO:

On-page SEO refers to the actions taken directly on your website, such as using appropriate keywords like "Yummy Pizza" for product promotion and creating content that is helpful for quick searching.

6.6.2 Off-Page SEO:

Off-page SEO refers to actions taken outside your website, such as getting other websites to link to it and promoting your products on social media platforms like Facebook and Instagram to increase product marketing.

6.6.3 Selling Fun cupcakes *SEO Steps:*

Imagine a website selling **"Fun cupcakes"**. You want more people to find your website when they search for " *Fun cupcakes*" online.

1. ***Use Keywords:*** *Add words like "* ***Fun cupcakes***, *" "fresh cakes in Pakistan," and "order cakes online" to your website.*
2. ***Page Titles:*** *Create website page title to* ***"Order Fun cupcakes Online in Pakistan".***
3. ***Descriptions:*** *Write a short text for search results:* ***"Order fresh, Fun cupcakes"***. ***"We deliver across Pakistan."***

4. ***Mobile-Friendly:*** *Make sure your website is easy to use on phones, as many people search using their phones.*
5. ***Good Content:*** *Write posts about cake recipes or birthday cake ideas to bring more people to your site.*

6.7 Project Management and Media Literacy in Business Planning:

Project management organizes tasks to ensure work is completed on time. A business plan outlines the steps to achieve business goals. Media literacy helps people use tools like social media to share ideas and promote a business. Together, by following these, the business remains organized, focused, and easy to promote. The following are examples of project management and media literacy in business planning.

Figure 6.5: project management and media literacy in business planning

- **Project Management:** Imagine a small business project for ***"my_unique_arts"*** on YouTube channel. Project management helps plan and organize the tasks, such as creating art, filming, editing, and uploading videos. It also schedules time for each action to ensure everything stays on track and is completed on time.
- **Business plan:** A business plan for the ***"my_unique_arts"*** YouTube channel includes steps such as selecting the types of crafts to create, setting prices for art and craft products, deciding how to post new crafting videos, and scheduling time for each business action to stay on track.
- **Media Literacy:** Media literacy helps to share art and craft promotion videos and pictures on platforms like Instagram and Facebook to showcase work and attract more viewers to the ***"my_unique_arts"*** business.

Summary

- **Entrepreneurship:** Starting new businesses using creative ideas and marketing skills on platforms like Daraz, Amazon, YouTube, and Instagram.
- **Payment & Transactions:** Payments mean giving money, and transactions include exchanging goods or services.
- **Safe Transaction Methods:** These include cash, credit cards, digital wallets, fingerprint verification, and smart contracts.
- **Digital Marketing:** Promoting businesses online using social media and websites to reach more people and grow brands.
- **SEO (Search Engine Optimization):** Making websites easier to find on search engines by improving content, mobile use, and links from other websites.
- **Project Management & Media Literacy:** Planning tasks and using social media to make business plans work well and connect with people.
- **Business Plan:** A plan showing goals, strategies, and finances, focusing on customer needs, product design, daily operations, marketing (4Ps), and money plans.
- **Social Media Marketing:** Advertising products, talking to customers, and building brands on platforms like Facebook and Instagram.
- **Traditional Marketing:** Using billboards, flyers, and other physical ways to promote products locally.
- 4Ps of Marketing: The main parts of marketing are Product (what you sell), Price (cost), Promotion (telling people about it), and Place (where you sell it).

Exercise

1. Encircle the correct answers.

i. **What is the primary purpose of a business plan?**
a) To increase product prices
b) To guide the launch, operation, and growth of a business
c) To attract customers without marketing
d) To analyse the competition only

ii. **Which of the following is NOT a component of a business plan?**
a) Market Need
b) Product Design
c) Celebrity Endorsements
d) Marketing

iii. **What does 'SEO' stand for in digital marketing?**
a) Social Engagement Optimization
b) Search Engine Optimization
c) Sales Enhancement Option
d) Standardized Equipment Order

iv. **Which of the following is an example of an innovative payment method?**
a) Cash Payments
b) Credit Cards
c) Digital Wallets
d) Barter System

v. **Which of the following platforms is commonly used for content marketing in digital marketing?**
a) Radio Ads
b) Billboards
c) Social Media Platforms
d) Flyers

2. Fill in the blanks with appropriate words.

i. _______________ is essential for understanding customer needs and wants.
ii. A ___________ outlines a company's goals and how it plans to achieve them.
iii. ___________ helps make a website easier to find by optimizing it for search engines.
iv. In ___________ marketing, businesses use platforms like social media to reach customers.
v. Safe payment methods ensure ___________ in transactions by protecting personal information.

3. **Provide the descriptive answers of the following questions.**

i. What is a business plan and its components?
ii. What is the difference between payment and transactions? How can we choose safe transaction methods?
iii. What tools and techniques are used in digital marketing?
iv. What is a digital marketing plan?
v. What is Search Engine Optimization (SEO), and how is it used on social media like Instagram and Twitter?

Important points to remember

- **Entrepreneurship** - Starting and running a new business.
- **Target Customers** - Specific group of people a business aims to serve.
- **Finance** - Money needed for business expenses.
- **Marketing** - Promoting a product or service to attract customers.
- **Promotion** - Activities to make customers aware of a product/service.
- **Transaction** - An exchange between a buyer and seller.
- **Payment** - The act of giving money in exchange for goods or services.
- **SEO (Search Engine Optimization)** - Techniques to improve website visibility in search results.
- **Project Management** - Organizing tasks and resources to complete a project efficiently.
- FIA is involved in maintaining national security, enforcing laws, preventing crime, and ensuring justice in Pakistan.

Instruction for Teachers:

i. The teacher should have access to the Internet either on a mobile device or in the lab.
ii. Teacher Use Relatable Examples like "Fun Cupcakes" or "Buy Phone Accessories Online" to explain entrepreneurship and digital marketing. *(Resource: Printed visuals or a mobile phone)*
iii. **Teacher must use Visual Aids**, draw diagrams or flowcharts to explain the steps of business planning.
iv. Teacher demonstrates students with Digital Tools (Tools given book topic) to Show students how to optimize keywords for a business website using SEO techniques. *(Resource: Computer lab or shared screen)*
v. **Teacher must** Simulate transactions where students take on the roles of entrepreneurs and customers.
vi. (Resource: Play money and simple props)

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