Information and Communication Technology

Grade 10

Educational Publications Department

To obtain electronic textbooks, visit
www.edupub.gov.lk

First Print 2014
Second Print 2015
Third Print 2016
Fourth Print 2017
Fifth Print 2018
Sixth Print 2019

ISBN 978-955-25-0205-7

Published by Educational Publications Department
Printed by Vishwa Graphics (Pvt) Ltd.
No. 439/3/3, Hokandara Road, Pannipitiya.

The National Anthem of Sri Lanka

Sri Lanka Matha
Apa Sri Lanka Namo Namo Namo Namo Matha
Sundara siri barinee, surendi athi sobamana Lanka
Dhanya dhanaya neka mal palaturu piri jaya bhoomiya ramya
Apa hata sepa siri setha sadana jeewanaye matha
Piliganu mena apa bhakthi pooja Namo Namo Matha
Apa Sri Lanka Namo Namo Namo Namo Matha
Oba we apa vidya
Obamaya apa sathya
Oba we apa shakthi
Apa hada thula bhakthi
Oba apa aloke
Apage anuprane
Oba apa jeevana we
Apa mukthiya oba we
Nava jeevana demine, nithina apa pubudukaran matha
Gnana veerya vadawamina regena yanu mana jaya bhoomi kara
Eka mavakage daru kela bevina
Yamu yamu vee nopama
Prema vada sema bheda durerada
Namo, Namo Matha
Apa Sri Lanka Namo Namo Namo Namo Matha

අපි වෙමු එක මවකගෙ දරුවෝ
එක නිවසෙහි වෙසෙනා
එක පාටැති එක රුධිරය වේ
අප කය තුළ දුවනා

එබැවිනි අපි වෙමු සොයුරු සොයුරියෝ
එක ලෙස එහි වැඩෙනා
ජීවත් වන අප මෙම නිවසේ
සොඳින සිටිය යුතු වේ

සැමට ම මෙත් කරුණා ගුණෙනි
වෙළී සමගි දමිනී
රන් මිණි මුතු නො ව එය ම ය සැපතා
කිසි කල නොම දිරනා

ආනන්ද සමරකෝන්

ஒரு தாய் மக்கள் நாமாவோம்
ஒன்றே நாம் வாழும் இல்லம்
நன்றே உடலில் ஓடும்
ஒன்றே நம் குருதி நிறம்

அதனால் சகோதரர் நாமாவோம்
ஒன்றாய் வாழும் வளரும் நாம்
நன்றாய் இவ் இல்லினிலே
நலமே வாழ்தல் வேண்டுமன்றோ

யாவரும் அன்பு கருணையுடன்
ஒற்றுமை சிறக்க வாழ்ந்திடுதல்
பொன்னும் மணியும் முத்துமல்ல - அதுவே
யான்று மழியாச் செல்வமன்றோ.

ஆனந்த சமரக்கோன்
கவிதையின் பெயர்ப்பு.

Being innovative, changing with right knowledge
Be a light to the country as well as to the world.

Message from the Hon. Minister of Education

The past two decades have been significant in the world history due to changes that took place in technology. The present students face a lot of new challenges along with the rapid development of Information Technology, communication and other related fields. The manner of career opportunities are liable to change specifically in the near future. In such an environment, with a new technological and intellectual society, thousands of innovative career opportunities would be created. To win those challenges, it is the responsibility of Sri Lankan Government and myself, as the Minister of Education, to empower you all.

This book is a product of free education. Your aim must be to use this book properly and acquire the necessary knowledge out of it. The government in turn is able to provide free textbooks to you, as a result of the commitment and labour of your parents and elders.

Since we have understood that the education is crucial in deciding the future of a country, the government has taken steps to change curriculum to suit the rapid changes of the technological world. Hence, you have to dedicate yourselves to become productive citizens. I believe that the knowledge this book provides will suffice your aim.

It is your duty to give a proper value to the money spent by the government on your education. Also you should understand that education determines your future. Make sure that you reach the optimum social stratum through education.

I congratulate you to enjoy the benefits of free education and bloom as an honoured citizen who takes the name of Sri Lanka to the world.

Akila Viraj Kariyawasam
Minister of Education

Foreword

The educational objectives of the contemporary world are becoming more complex along with the economic, social, cultural and technological development. The learning and teaching process too is changing in relation to human experiences, technological differences, research and new indices. Therefore, it is required to produce the textbook by including subject related information according to the objectives in the syllabus in order to maintain the teaching process by organizing learning experiences that suit to the learner needs. The textbook is not merely a learning tool for the learner. It is a blessing that contributes to obtain a higher education along with a development of conduct and attitudes, to develop values and to obtain learning experiences.

The government in its realization of the concept of free education has offered you all the textbooks from grades 1-11. I would like to remind you that you should make the maximum use of these textbooks and protect them well. I sincerely hope that this textbook would assist you to obtain the expertise to become a virtuous citizen with a complete personality who would be a valuable asset to the country.

I would like to bestow my sincere thanks on the members of the editorial and writer boards as well as on the staff of the Educational Publications Department who have strived to offer this textbook to you.

W. M. Jayantha Wickramanayaka,
Commissioner General of Educational Publications,
Educational Publications Department,
Isurupaya,
Battaramulla.
2019.04.10

Monitoring and Supervision

W.M. Jayantha Wickramanayaka - Commissioner General of Educational Publications
Educational Publications Department

Direction

W. A. Nirmala Piyaseeli - Commissioner (Development)
Educational Publications Department

Co-ordination

Dakshina Kasturiarachchi - Assistant Commissioner
Educational Publications Department

Editor Board

Dr. Prasad Wimalaratna - Senior Lecturer, University of Colombo School of Computing, Colombo 07

Dr. Lochandaka Ranathunga - Head, Senior Lecturer, Department of Information Technology, Moratuwa University, Moratuwa

S.C. Premaratna - Senior Lecturer, Moratuwa University, Moratuwa

G.M. Niel Gunadasa - Director of Education, ICT Branch, Ministry of Education

K. G. S. K. Perera - Senior Lecturer, Department of Information Technology ,National Institute of Education, Maharagama

S. Dakshina Kasturiarachchi - Assistant Commissioner
Educational Publications Department

Writer Board

Malic Silva - Senior Lecturer, University of Colombo School of Computing, Colombo 07

Susil Maduwage - Director, Department of Information Technology, National Institute of Education, Maharagama

A. Sunil Samaraweera - Centre Manager, Zonal Computer Resource Centre, Kegalle

I.R.N.H. Karunaratna - Computer Instructor, Zonal Computer Resource Centre, Ke/ Sapugaskanda Maha Vidyalaya, Makola

D. Lakmini Delepola - Teacher Service, Dudley Senanayaka Central College, Tholangamuwa

W.C. Kothalawala - In-Service-Adviser, Zonal Education Office, Homagama

G.J.K. Kahagalla - Computer Instructor, Zonal Computer Resource Center, Janadhipathi Vidyalaya, Maharagama

W.C. Priyashantha - Project Assistant, University of Colombo School of Computing, Colombo 07

Jeewanthi Perera - Visiting Lecturer, Kelaniya University, Kelaniya

Subash Chandra Bowse - Project Manager/ Linguist

Language editing

K.D.D. Percival - Retired Senior Lecturer

Cover Page

Chaminda Hapuarachchi - Educational Publications Department

Technical Assistance

A. Asha Amali Weerarathna - Educational Publications Department

P.A.D. Nisansala Sandamali - Educational Publications Department

Index

1 Information and Communication Technology

In this chapter you will learn:

- how to identify data and information
- what a system is
- the systems we come across in our day to day activities
- characteristics of quality information
- Information and Communication Technology
- applications of Information and Communication Technology
- evolution of the computer

1.1 Data and Information

The numbers, words, images and symbols which do not bear a meaning, when standing alone are called data.While we can arrive at meaningful information by arranging and processing data, we can use them to make decisions also.

Example 1

It will be difficult to get an idea about the subjects and marks if names and marks are written separatly on term test results.

Ravi 78, 90, 79, 67, 76, 98 Rizwan 87, 70, 80, 75, 80, 80 Krishan 76, 78, 67, 80, 79, 76

But these names and marks can be tabulated as follows:

Name	Language	Mathematics	Science	History	Health	English
Ravi	78	90	79	67	76	78
Saman	76	78	67	80	79	76
Rizwan	87	70	80	75	80	80

This table shows some information about the marks of students. However, in order to arrive at some meaningful conclusion, this may not be sufficient:

Marks that were tabulated can be subjected to calculation.

Name	Language	Maths	Science	History	Health	English	Total	Average	Rank
Ravi	78	90	79	67	76	78	468	78	2
Saman	76	78	67	80	79	76	456	76	3
Rizwan	87	70	80	75	80	80	472	78.66	1

In this table, name and subjects such as language, maths are data and total, average and rank are information.

You can see that the teacher is able to get the required information using this table (i.e. the total score of each student, their average scores, individual skill of each student, the rank etc). The information gathered in this manner is useful for the teacher to take important decisions.

Example 2

To identify the difference between data and information, let us consider the following Figures;

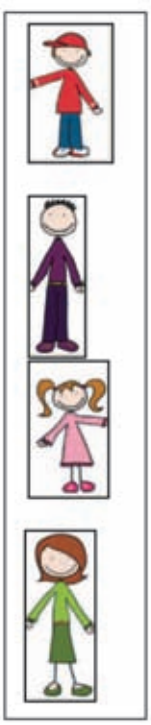


Figure 1.1 - Human figures

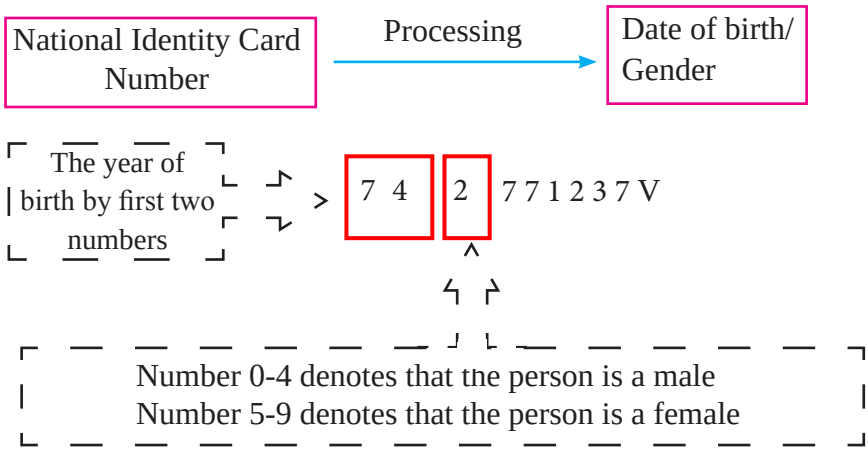
When we take each image separately, it does not convey a meaning. But when properly arranged as on the right hand side, one can understand that these are the members of one family.

Figure 1.2 - A family

Example 3

Analyzing NIC number

Take a look at the numbers in a National Identity Card. At once it looks as if it is just a number. But when you analyze it, you can obtain some meaningful information. When the NIC number is given one could find the person's age and gender.



Activity

Provide five other examples for data and information.

1.2 Information System

Once, man used to process data using a pen, pencil or other devices. But today the computer has become man's data processor. A system is a combination of components that work together to fulfil a task.

Submitting data for processing is called "Input" and the result we get after processing is called "Output." We can call the collection of all these components above a "Information System."

Storing data is an important task in information system. In some occasions, both input and stored data are used to obtain information.

Hence the purpose of a system is to receive data, process and store them and provide the results when required.

According to the figure 1.3 a computer processes the data that we input, according to the commands and provide us with the required information in the desired form. Therefore, we call the computer an ' Information System'.

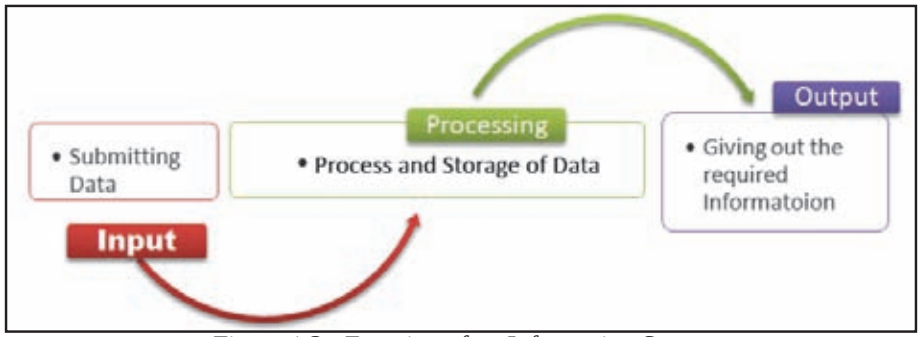


Figure 1.3 - Function of an Information System

We use many such systems in our day today activities. Let us consider some of the examples:

Example 1 - ATM Automatic Teller Machine

When the bank ATM card is inserted to ATM machine, data is processed and information regarding the account is given.

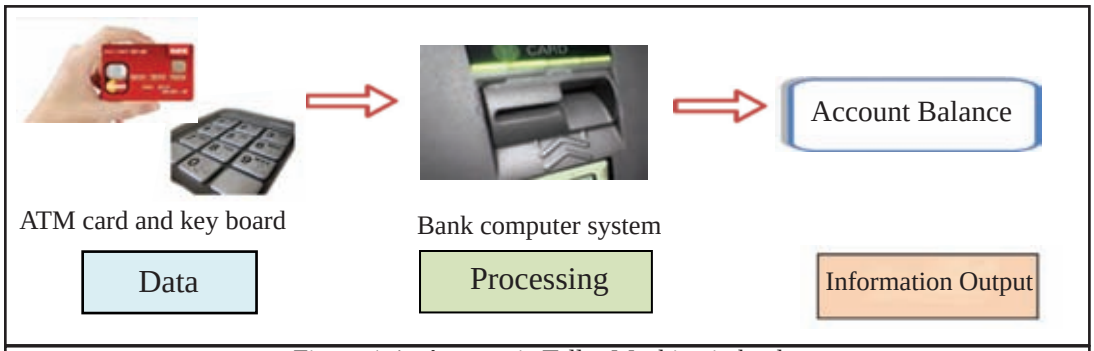


Figure 1.4 - Automatic Teller Machine in banks

Example 2 - Finger print reader to record the attendance of an organization

Figure 1.5 - Finger Print Reader

Example 3 - QR Code used to find information

After scanning the QR code by a smart phone and connecting to the internet, further information can be obtained from the website of the relevant item. QR code is used in newspapers, magazines and selling items.

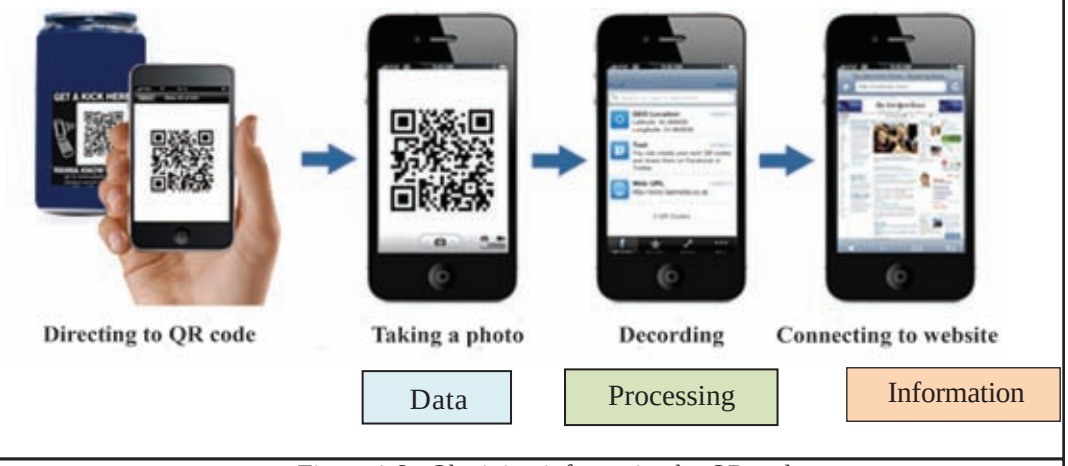


Figure 1.6 - Obtaining information by QR code

Example 4 - Processing business information

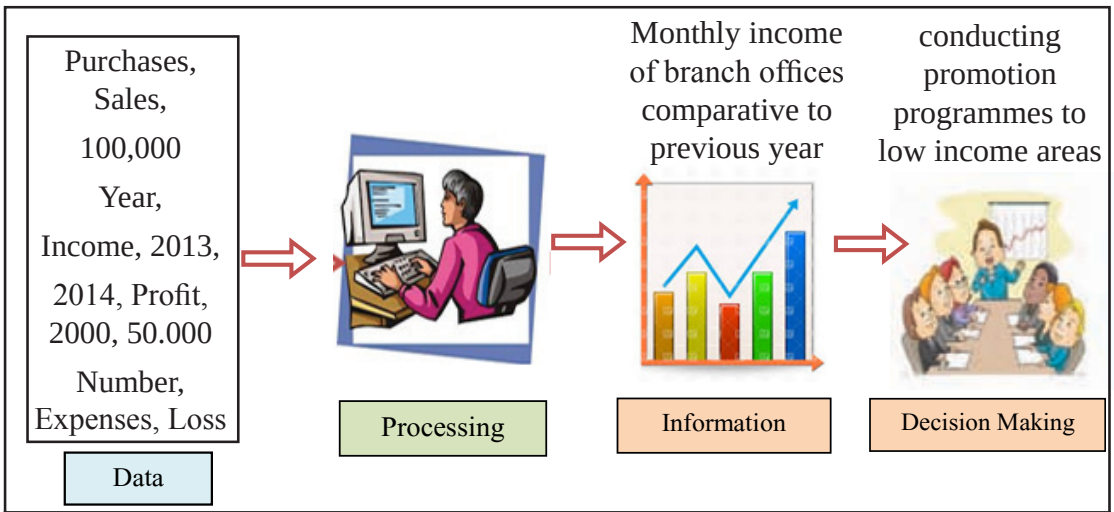


Figure 1.7 - Processing business information

-

Activity

Observe Images 1 and 2 below:

(A)

This is an image you could see on the items we buy at the market. This is called Barcode. This barcode is scanned at the cashier by a Barcode Reader. Observe how the bar code is used in different occasions.

Image 1

(B)

This image is seen at the back page of some books you buy. This is called ISBN Code.

Image 2

Meet the librarian and find out what information you can obtain by taking ISBN number as the input.

A computer or computerized equipment is used to process the data and we make decisions based on the information we get as output.

We understand that we can get information by processing data and this information can be used to arrive at decisions. However, not all information is suitable for making decisions. Information obtained should be of good quality. There are many characteristics of quality information. A few of them are given below:

Quality of information	Example
a) Relevancy 	It is not needed to submit all the academic information from Grade 1 onwards, when the requirement is to submit only the highest educational qualification.
b) Completeness 	Taking information from only a small group of people in order to arrive at the PCI (Per Capita Income) of a country is not sufficient. Incomplete information could lead to drawing wrong conclusions.
c) Accuracy 	If a doctor gets wrong information about the patient's health, it could be harmful to the patient.
d) Timeliness 	The information must always be updated. Today's weather report may not be suitable to decide on tomorrow's weather.
e) Cost Effectiveness 	If an organization spends money more than the profits to collect some information in order to increase profits, it would be a business loss to the organization.

Activity

Write another example each for the above (a) - (e).

1.3 Information and Communication Technology

We learnt that we can get information by processing data and that information can be used to make decisions and arrive at conclusions. When we exchange the information among different people or among different systems, it is called communication of information.

Man has been processing and exchanging information since ancient times. But he had to face many difficulties and obstacles in data communication. But today it has become an easy task with the advancement of technology.

Today, technology is used in various ways to convert data into information and then to exchange them. This is called Information and Communication Technology (ICT).

1.4 Applications of Information and Communication Technology

Today, you could hardly come across any person or a place that does not use information and communication technology in day to day activities. Some examples are illustrated below:

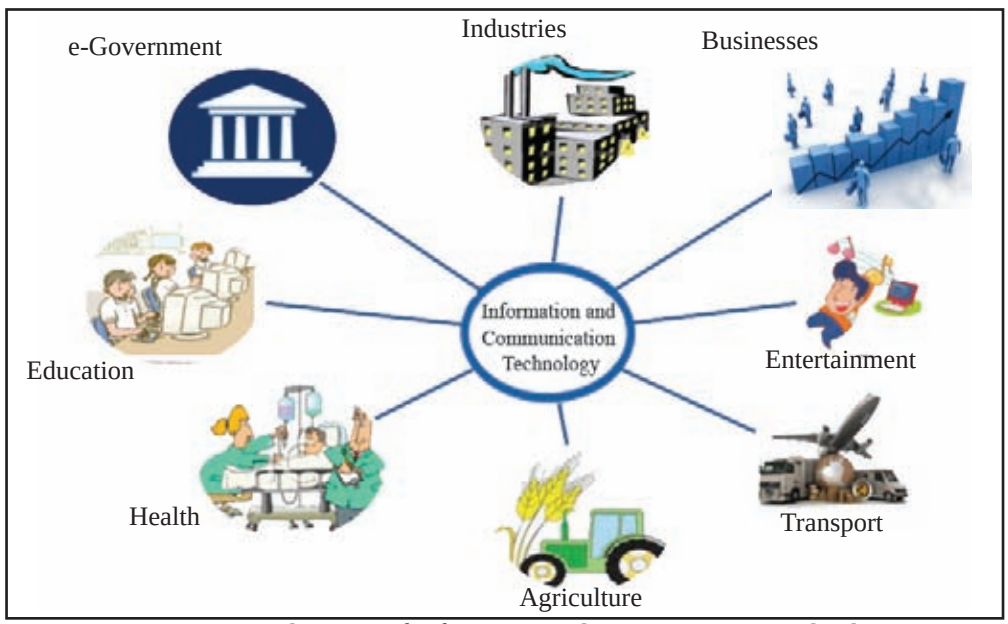


Figure 1.8 - Applications of Information and Communication Technology

1.4.1 e - Government

When a government communicates with its citizens, companies, Government and Non-Government Organizations and with other Governments (of different countries) using ICT, it is called e-Government.

There are numerous web sites such as official web portal of the government of Sri Lanka, Government Information Center, ICTA (Information Communication Technology Agency) etc for e-Government activities. The difficulties in communicating with the Government and obtaining Government information have been overcome by these.

E-Government Services (http://www.gov.lk/)

Figure 1.9 - e-Government Services

Activity

1. Visit the Government web sites such as the official web portal of Government of Sri Lanka, Government Information Center, ICTA (Information Communication Technology Agency) etc. Make a list of five valuable information and the services you could obtain yourself of as a citizen of Sri Lanka.
2. Make a list of e-government services that are provided by other countries mentioned below.
   Eg - Malaysia, Singapore, England

1.4.2 Applications in the field of education

Days are gone when we were stuck among piles of books in order to collect the required information. Today you have the luxury to see and gain knowledge about the entire world at your own convenience, due to all the advancements of ICT.

There are many ways as to how ICT helps you in your education. Let us look at some of them:

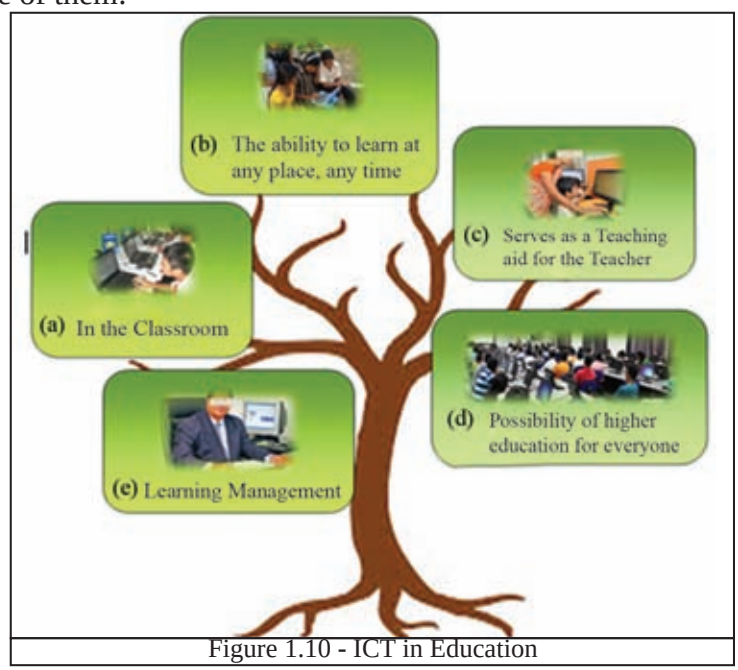


Figure 1.10 - ICT in Education

a) In the classroom

There are many ways the computer and the internet are used for education in the classroom:

- For presentations
- Videos on experiments
- Creation of images and video
- Desktop publishing of magazines, letters and documents
- Educational games (Edutainment)
- Learning using the CD-ROM media
- Gathering educational information on the internet

Figure 1.11 - Computer in the Classroom

b) Education - any where anytime

If you have a computer with internet connection, you can study while at home or any other convenient place. For this, you can use the following educational websites to do self study and improve your knowledge within your pace.

- www.schoolnet.lk
- www.nenasala.lk
- www.e-thaksalawa.moe.gov.lk
- www.vidumanpetha.com

You can contact with a teacher/trainer via internet. This is called WBT (Web based Training). While you can do further studies using WBT, it helps in minimizing the difficulties of travelling and related expenses also. At the same time, it helps save time and money.

Figure 1.12 - Education Anywhere any time

Activity

- Visit the Websites mentioned above and list the areas which you can use to support your knowledge.
- List three advantages compared to traditional teaching methods in studying Science, Mathematics and ICT by visiting G.C.E. (O/L) section on BBC Bitsize (www.bbc.co.lk/ education).

c) **Serves as a teaching aid for the teacher**

ICT can be used mostly as a teaching aid in schools.

- Using pictures, animations and audio-visuals to explain subjects that are difficult to explain.
- To make the lessons interesting using electronic presentations.
- To organize lessons using the computer.
- To obtain information relevant to the subjects.

Figure 1.13 - ICT as a teaching aid

d) **Learning Management System (LMS)**

In many countries it has become a common practice to use a Learning Management System to manage school system and higher education system. We need an internet connection to link with the LMS. A person has to register himself/ herself on the official website to access LMS of a school or any other educational institution. According to the picture 1.14, teachers and students can get many services from LMS.

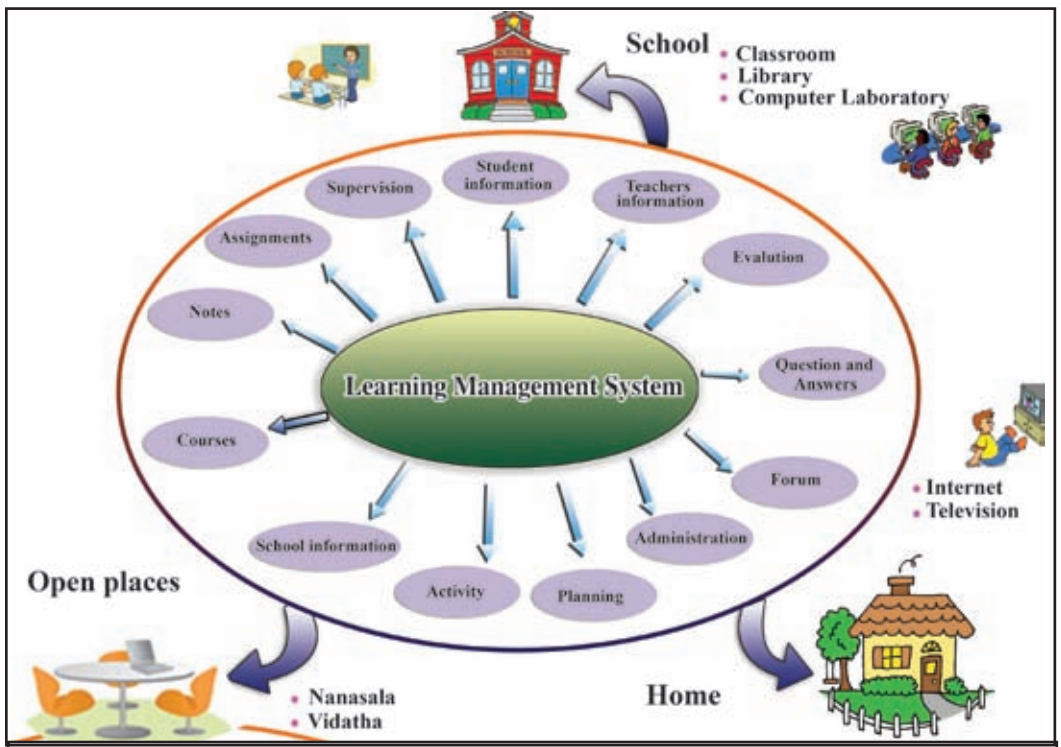


Figure 1.14 - Learning Management System

Some services provided by Learning Management System.

For a Student	For school Management
The ability to use the learning units at anytime and anywhere at school, at home or any other convenient place.	The ability to add quality learning materials
The ability to upload the assignments completed at home	Supervision of activities and publishing of results
The ability to submit queries, getting replies and submitting comments through Forums	The ability to maintain updated information of the students, teachers and school
Ability to participate in the co-curricular activities via video.	Submitting questions, getting replies and providing comments through Forums
The parents can monitor the progress of their children from home.	Sending and receiving necessary information by e-mail to parents, school development committees and other school officials.

e) Higher education for everyone

With the development of ICT, today a person from any country can connect with a university or any other learning center of his choice and pursue higher education at a considerably low cost. This is called Online Distance Learning.

Figure 1.15
Distance Learning

Features of Distance Learning:

- Within a flexible time frame, provide the facility to learn
- Digital library facility on joining a course.
- Online assignments and quizes.
- Contact with a teacher online.
- Easy to obtain teacher consultations.

1.4.3 ICT in Health Sector

Many of the difficult processes in the medical field have become efficient with through the use of modern equipment.

There are surgical devices with cameras which can record the surgical procedures while surgery is carried out.

Devices and appliances which are used in the practical training of doctors and nurses.

Devices used to analyse store and print medical records.

Figure 1.16 - Modern Health Equipment

There are plenty of areas where ICT is used in the health sector for our well- being. Let us consider some of them.

1. **Use of ICT in diagnosis**

Today, there are numerous high tech machines which help us in the diagnosis and treatment of diseases. Diseases can be diagnosed at the early stages and the patients can be given treatment accordingly. Some examples of these machines are:

Example 1 - CAT - Computerized Axial Tomography Machine

Using this machine three dimensional (3D) images of different parts of the body can be made. These images are helpful in the diagnosis of diseases.

Figure 1.17 - CAT Machine

Figure 1.18 - 3D Image

Example 2 - MRI (Magnetic Resonance Imaging Machine)

This machine can create digitalized images of internal organs of the body by using strong magnetic fields and radio waves. These images are very helpful in the detection and deciding on treatment of diseases.

Figure 1.19 - MRI Machine

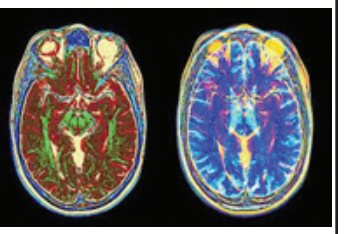


Figure 1.20 - Detailed Images

Example 3 - ECG - Electrocardiogram Machine

This machine is used to monitor the heart beat. When the heart pumps blood to different parts of the body some electrical impulses are produced. This machine records the electrical impulses.

Figure 1.21 - ECG Machine

Figure 1.22 - ECG Graph

Example 4 - Cardiac Screening Machine

This machine displays the physiology of the heart and it displays the movements inside the heart. Through this machine it is possible to diagnose problems of the heart such as thinning of vains and then recommend treatment.

Figure 1.23 - Cardiac Screening Machine

Figure 1.24 - Cardiac Screening Display

Example 5 - EEG (Electro-encephalography)

This machine is used to record the activities of the brain. The small electrical probes attached to the head receive the electrical impulses of the brain and display them on a computer screen. This device can retrieve the data in both states where a patient is awake or asleep.

Figure 1.25 - EEG Machine

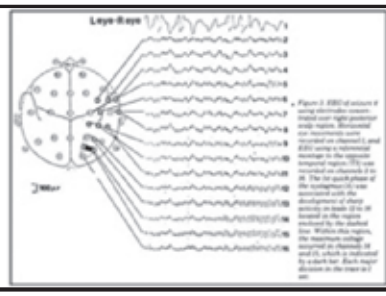


Figure 1.26 - EEG Display

Example 6 - Blood Sugar Testing Machine

This device would analyze a sample of blood and determine the blood glucose level.

Figure 1.27 - Blood Test

Example 7 - Blood Pressure Measuring Machine

This device which is worn as wrist band can measure the blood pressure of a person at rest and when he/she is involved in some physical activity.

Figure 1.28 - Measuring Blood Pressure

2. Telemedicine

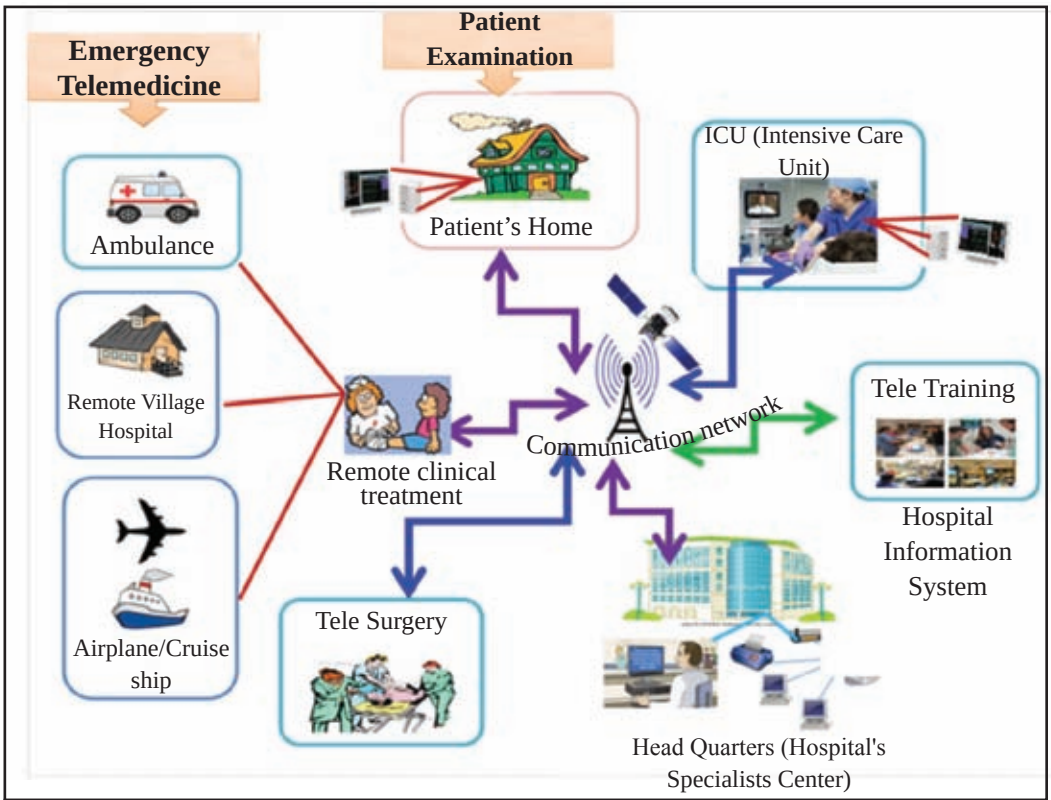


Figure 1.29 - Telemedicine

The use of Information Communication Technology to examine and or provide healthcare to a patient who is far away from the hospital is called Telemedicine. This is made possible by remotely connecting the patient with hospital's specialist unit or specialist doctors. Telemedicine has several advantages such as:

Example 1 - Emergency Telemedicine

Emergency telemedicine is the process of providing emergency care by a trained person in consultation with a specialist in a hospital via telecommunication network and treating him when a patient (who lives in a remote village or flying in a plane or cruising in a ship) can not reach a hospital.

Figure 1.30 - Telemedicine

Example 2 - Home health medicine

Keeping the patient at home and monitoring his/her condition using networked home monitoring system. The home monitoring of the health condition helps to decide when to transfer the patient to hospital.

Figure 1.31 - Home Health Medicine

Example 3 - Telemedicine Consultation

Seeking medical consultation of a specialist at the Emergency Treatment Unit (ETU) when he/she is not physically available in hospital.

Figure 1.32 - Medical Consultation

Example 4 - Telesurgery (Remote Surgery)

Remote surgery is the ability of a doctor to perform surgery on a patient in consultation with a specialist (who is not physically present at the same location but in a far away town or abroad) by the use of Telecommunication Technologies.

Figure 1.33 - Telesurgery

Example 5 - Medical Teletraining

Specialists' consultation and training can be used to obtain the services of a medical professional at a remote place by the use of telecommunication technologies. In training hospital staff, specialist consultation and training from a resource person in a foreign country or town can be attended, using telecommunication technologies in a nearby training centre.

Figure 1.34 - Medical Teletraining

1.4.4 ICT in Agricultural Industry

ICT has created a new revolution in the field of agriculture. Today ICT is extensively used in agriculture, animal husbandry and fisheries industries.

ICT for farming:

A range of automatic machines are available today to ease the work of the farmer who worked hard in the field. These machines not only ease the work of a farmer but also enables him to produce high quality yields.

Below are some of the machines used for agriculture in developed as well as developing countries.

Example 1 - Meteorological Devices

These devices are helpful in assessing the weather, climatic changes, rainfall, wind direction etc. Such data are useful in deciding on the crop cultivation and harvesting times.

Figure 1.35 - Meteorological Devices

Example 2 - Automated Insect Control Devices

With the help of this device we can minimize the harmful effects caused by insects. It displays on screen the direction and the density of insect population, its growth and movement.

Figure 1.36 - Automated Insect Control Devices

Example 3 - Field conditions measuring devices

These devices help in measuring various parameters such as fertility and humidity levels of soil which aid in the determination of cultivation activities.

Figure 1.37 - Field conditions measuring devices

Example 4 - Drip irrigation

These devices control the supply of water as per the data fed. Wastage of water and destruction of crops due to lack of water supply are minimized by the use of these devices.

Figure 1.38 - Automated Water Supply Systems

Example 5 - Automatic Weed remover

This machine runs through the field and removes the weeds as per instructions provided by identifying crops and weeds separately.

Figure 1.39 - Automatic Weed Remover

Example 6 - Seedlings planter using Robotics

These robotic machines are used in large fields to carry seedlings across the field and to plant them in an orderly manner.

Figure 1.40 - Seedlings planter using Robotics

Example 7 - Crop harvesting using Robots

Robotic machines are used to monitor plant growth levels, record them and harvesting in large scale farm lands. These machines help us overcome difficulties in managing large farm lands.

Figure 1.41 - Crop harvesting using Robots

Example 8 - Greenhouse

The Greenhouse is the best solution to protect crops from natural disasters (too much sun shine, rain, heat, cold, pests, epidemics etc). ICT is used to control light, moisture and air inside the greenhouse. Hence, farmers are able to make high quality products of rare crops to the market.

Figure 1.42 - Greenhouses

1.4.5 ICT in management of farmhouse

Example 1 - RFID – Radio Frequency Identification Device

The RFID help in identifying and counting the number of animals and also in locating the animals in a large area.

Figure 1.43 - Radio Frequency Identification Device

Example 2 - Automated milking and examination of cows

This automated machine is helpful in monitoring the health status of the cows, milking and the quality of milk.

Figure 1.44 - Automated milking and examination of cows

Example 3 - For Security (Closed Circuit TV CCTV)

CCTV is employed to protect farm from the animals and thieves. When the cameras are connected by Wi-Fi (Wireless Fidelity) the farm can be monitored far away from the farm.

Figure 1.45 - Closed circuit TV

Example 4 - Farm Management

Today's farmer uses various computer applications in portable computers such as laptops, tabs, smart phones to keep track of information on his farm; to calculate profits and losses, to save employees salary details etc. Using this portable device which has internet connectivity, he is capable of monitoring the market rates, get updated on latest business information and exchange information.

Figure 1.46 - Computer in Managing the Farm

1.4.6 In Fishing Industry

Sensors are placed in different parts of the sea. These sensors convey information on fish concentration in the sea to the computers in fishing trawlers via internet.

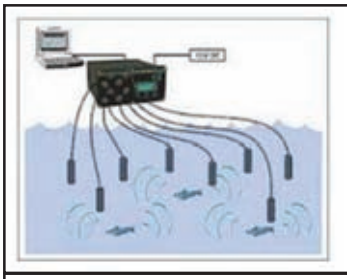


Figure 1.47 - Sensors under sea

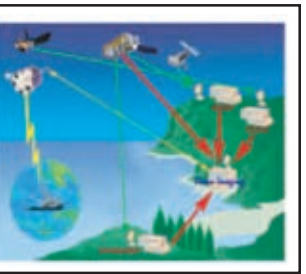


Figure 1.48 - Transfer of information

1.4.7 ICT in Manufacturing Industry and Business

ICT is used in manufacturing high quality products and reduce the cost of production by minimizing the use of human labour in many industries and businesses. Since high quality products are manufactured at low cost, people can buy good quality products at a relatively low price.

Let us see how technology is used in manufacturing;

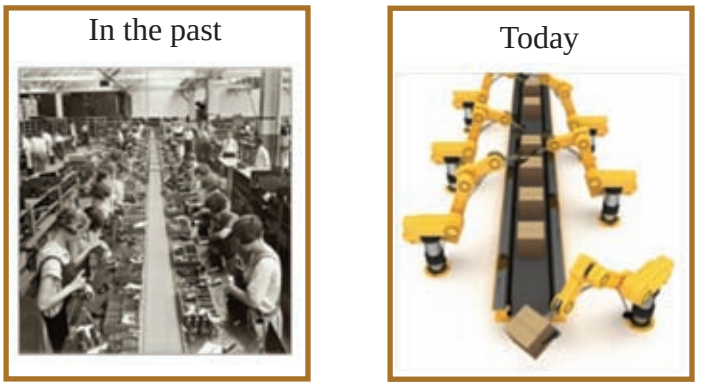


Figure 1.49 - Use of ICT in industry

In the past decades a high level of human labour was needed in the manufacturing industry. Today most of the work performed by the human hands are performed by robots.

Uses of robots;

24 hour service, Never get tired, Efficiency, Accuracy, Hygiene

Following pictures show how robotic technology is used in production

Figure 1.50 - Computer Manufacturing

Figure 1.51 - Manufacture of Packaging material

Figure 1.52 - Packaging

Figure 1.53 - Car Production

Figure 1.54 - Labeling

Figure 1.55 - Filling bottles

Example 1 - Video Conferencing

This technology has enabled different business communities who are geographically separated to convene face to face meetings while in at their own premises. The advantages of this technology include the following. Convening at a special venue is unnecessary and saves time, effort and cost spend on travelling.

Figure 1.56 - Video Conferencing

Example 2 - Human Resource Management

The administration of employee activities has become an easy task due to finger print scanner (used to register attendance) and Card Reader (Identity Management). These devices help in recording the time of employees moving in and moving out of the office premises, preparing salaries accordingly, keeping records of leave taken etc. Today, the above devices are used not only in the private sector but also in the public sector in Sri Lanka.

Figure 1.57 - Finger Print Scanner

Figure 1.58 - Card Reader

Example 3 - e-Banking System

e-Banking has helped both the business community and all of us to do convenient banking. They are:

- The ability to withdraw cash anytime anywhere at ATM (Automatic Teller Machines) points.
- Since banks are connected via internet, inter banking or transactional activities are made possible even within Sri Lanka or abroad.
- When you are registered in a banking network, it gives one the opportunity to pay utility bills, inter-banking transactions, checking the account balance, using mobile phones.

Figure 1.59 - e-banking System

Example 4 - Online Shopping

Figure 1.60 - Online Shopping

Online shopping known as electronic commerce which allows foreign or local company to sell its products or services and the ability for a consumer to buy goods and services via internet. A buyer can order goods or services of his/her choice from a convenient place. The advantages of online shopping include:

- One can select any global commercial organization which is on the internet.
- Open 24 hours.
- Ability to see things and order at one's convenient place.
- The ability to pay using the electronic payment methods such as credit cards.
- Home delivery of goods or services, thus saving time, transport cost and avoid unnecessary travel related exhaustion.

1.4.8 ICT in Transport

We can quote some of the systems which are used to enhance the road traffic by minimizing traffic jams.

Example 1 - Closed Circuit TV (CCTV)

This system which uses the CCTV (Closed Circuit TV) is helpful in monitoring the road traffic, accidents, illegal activities and take appropriate actions accordingly.

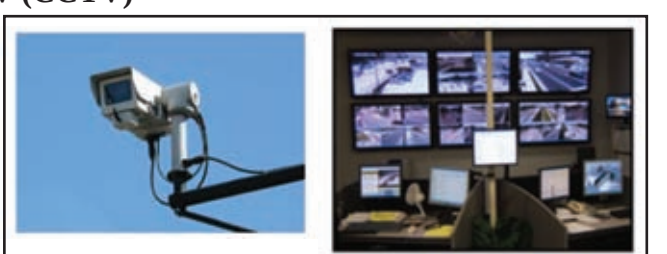


Figure 1.61 - Closed Circuit TV

Example 2 -Traffic Light Control System

These automated lights are positioned at road junctions. These lights help in minimizing accidents by controlling the vehicle traffic and pedestrians.

Figure 1.62 - Traffic Lights Control System

Example 3 - Parking identification placard

This is an entrance pass which is stuck on the windshield of a vehicle. When the vehicle comes close to the gate of the parking space, the sensors read the placard and only open the gates if the vehicle is already pre-registered. Due to its quick processing ability, this automated system also helps to avoid building up of traffic at the gate.

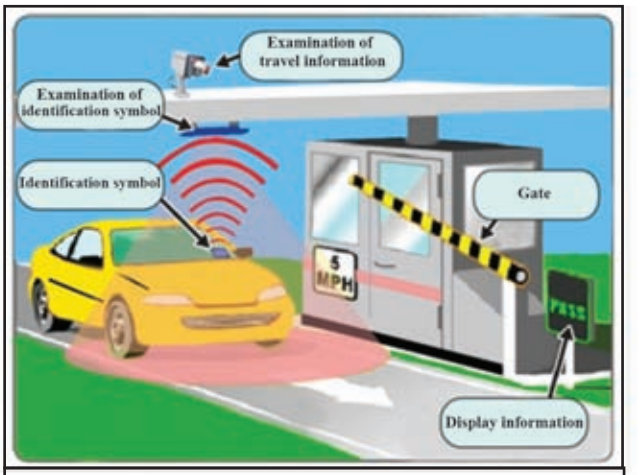


Figure 1.63 - Parking identification placard

Activity

Observe three instances where ICT is used in business and manufacturing and write report.

1.4.9 ICT in Entertainment

Various ICT devices and equipment have been invented to provide some peace of mind to human beings who are spending a busy and restless life today. These devices enable us to:

- ⋆ listen to music to overcome a monotonous life,
- ⋆ watch missed TV programmes or movies of own choice through the internet,
- ⋆ exchange information between friends and relatives who live abroad or whom we have lost touch through social media,
- ⋆ watch high definition video using technology,
- ⋆ surf the internet. This helps children to do learning activities and play games during the free time at home,
- ⋆ read e-books on internet and
- ⋆ take photographs of interesting places and store them in the computer.

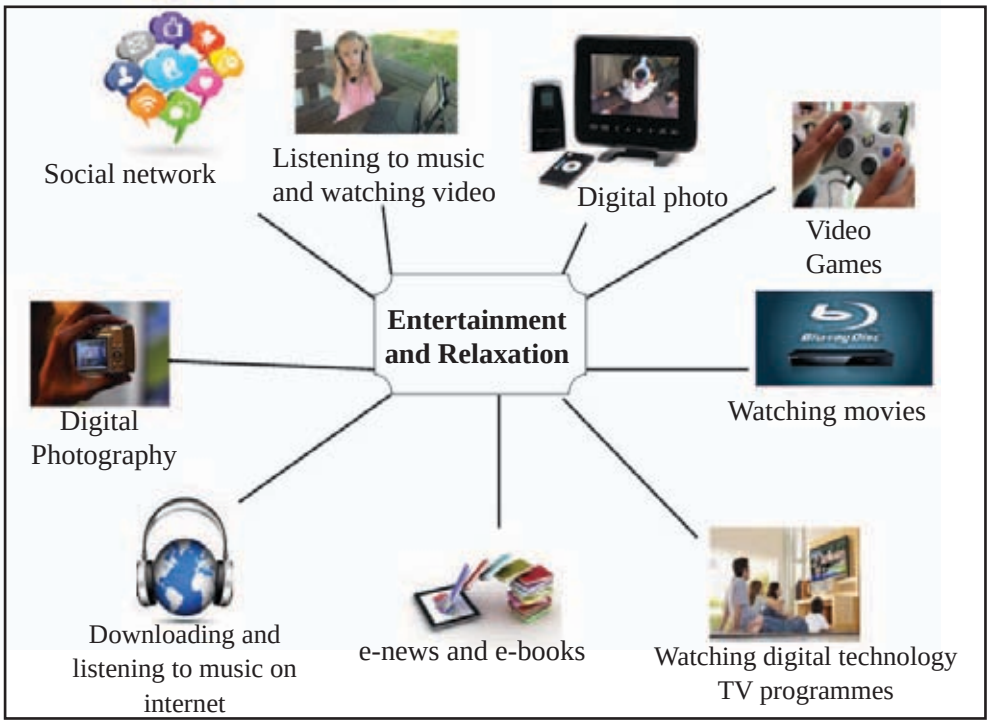


Figure 1.64 - ICT in Entertainment

In day - to - day life, there are instances where you use computer systems by knowing or unknowing. For example, a modern car consists of a lot of computer systems. Moreover, a modern ticketing machine in a bus, washing machine, indicating the distance that can be travelled by the existing fuel in a vehicle can be cited as examples.

1.5 Demerits of ICT

Not only does ICT help us as enabler to perform our day today activities, it has become a close companion also. However, if you associate this companion in an undue manner it may bringforth undesirable effects to you as well to the entire society. The following are some of them.

- Addiction – A student or any other person who immerses himself/herself in the excessive use of computer or who plays games on internet without a limit, may lose the track of education and/or end up with ailments such as sore eyes, back pain, headache etc.
- Building unsuitable friendships through social media.
- When the computer is infected by virus due to improper use of internet, it may not function properly or go out of order.
- Mental disorders may affect a person causing harm to himself/herself and to society by visiting improper websites.
- Publishing of distorted photographs and videos of individuals affecting their personal lives.

- Obesity due to less exercise
- isolation
- violating copyrights

There is an opinion that ICT has negative impacts on human society due to issues mentioned above. But we have understood that the systems made by ICT make most of man's usual work easy. Therefore, it is our responsibility to use ICT in a responsible manner.

1.6 Evolution of the Computer

By now you would have understood that computers assist us in converting data into information. Even though at present, there are automated computer systems, the computer too has undergone a similar evolution process as human beings and has reached the advanced stage today.

The computer was born in the attempt to make an adding machine. In order to add numbers, a device called Abacus was invented around 5000 years ago.

In due course many new inventions were made. The followings are few of them:

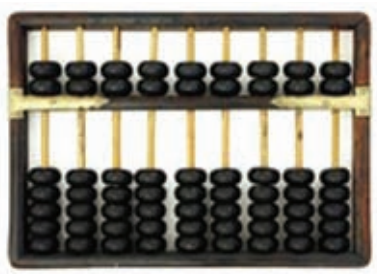


Figure 1.65 - The Abacus

- In 1642, Blaise Pascal invented a machine called the Adding Machine. This was the world's first ever mathematical machine.
- In 1674, Gottfried Wilhelm Von Leibnitz improved the machine invented by Pascal. With these improvements the machine was able to perform multiplication and division too.
- A French Scientist named Joseph Jacquard invented a mechanical loom using Punch Card System.
- Charles Babbage started to make his Analytical Engine using the Punch Card System concept. This machine was based on the concepts input, process, output and store. Since this concept helped in the development of the computer, Charles Babbage is called the father of computing.
- Madam Ada Augusta Lovelace is considered as the first programmer since she tried to write programmes for the Analytical Engine.
- In the year 1944, a man named Howard Aiken invented the machine called Automatic Sequence Control Calculator at the Harvard University with the assistance of his companions and IBM Company. This was named MARK 1.

All the versions of early computers were mechanical in nature. From the time when the computers became automated they were categorized into various 'Generations' as below:

Generations	Major Hardware Technology	Software Used	Characteristics	Systems invented
First Generation Computers 1940-1956	• Vacuum Tubes • Punch Cards are used for input, process, output and storage of data	• Machine language • Assembly language • Stored Program Concept	• High Heat Generation • Slow in processing • Large in size • Not Portable • Consumes a lot of electricity • Expensive	ENIAC EDVAC EDSAC UNIVAC IBM 701
Second Generation Computers 1956-1963	• Transistors • Tape • Floppy Disk, Tape for Secondary Storage	• High-level Programming language • Use of Assembly Language	• Smaller in size. • Less heat Generation • Low power consumption • Comparatively faster than the first generation • Expensive	• Honey well 400 • IBM 7030 • CDC 1604 • UNIVAC LARC

Generations	Major Hardware Technology	Software Used	Characteristics	Systems invented
Third Generation Computers (1964-1975)	• Integrated Circuits (IC) • High capacity disks for secondary storage • Keyboard and mouse for data input	• birth of Operating Systems (OS) • Well developed Programming languages • high level computer languages for coding	• Smaller in size • Less heat Generation • Comparatively faster than the second generation • Expensive • Low power consumption	• IBM-360/370 • PDP-8 • PDP-11 • CDC 6600
Fourth Generation Computers (1975-1989)	• LSIC (Large Scale Integrated Circuits) and VLSIC (Very Large Scale Integrated Circuits • Microprocessor • Palm Tops • High Capacity hard disks • Floppy disk • Optical disk • Personal computers (PC) • Faster computer networks	• OS with GUI (Graphical User Interface) • UNIX OS	• Very small in size • Portable • Upgradable	• IBM PC • Apple II

Generation	Major Hardware Technology	Software Used	Characteristics	Systems invented
Fifth Generation Computers (1989 to present)	• ULSI (Ultra Large Scale Integration) • Very High Capacity Hard disks and optical disks • Internet	• Operating Systems with GUI (Graphical user Interface) • Internet and multi-media applications • Voice recognition based on AI (Artificial Intelligence) • Character recognition • Hand-writing recognition systems	• Portable • Less Expensive • Smaller in size • Easy operation • High reliability • High efficiency	• IBM notebooks • Pentium PCs • SUN workstations

Activity

Find information on computer history and make a report as a group activity.

Summary

- Images, words, numbers or symbols which do not convey a meaning when standing alone are called data.
- Information is obtained by processing data. Information is used to make decisions.
- Computer is a system.
- Computers and computer based systems are used to process data.
- Providing data is called 'input' while extracting information is called 'output'
- Quality of information is important, (relevancy, completeness, accuracy, timeliness, low cost)
- Data input, processing and data output are components of a system.
- Technology is used to exchange the processed data. This is called ICT.
- Applications of ICT have made man's life easy. There are many applications such as e-Government, education, health, agriculture, business,transport, entertainment etc.
- The advent of computing dates back to 5000 years. Computing is categorized into many generations from the period of automation.

2 Fundamentals of a computer system

After studying this chapter you will be able to understand;

- features of a computer,
- classification of computers,
- functions and devices of a computer system,
- basic components of a computer,
- computer ports and,
- computer network.

2.1 What is a computer?

First chapter described how computer systems can make day-to-day work efficient.

A computer can be described as an electronic device, which accepts or collects data, processes them according to the given instructions and produces the desired output.

Computer has become an essential device in our lives. Some of these features of a computer can be described as follows;

Speed	A computer takes only a few seconds to perform calculations. It executes more than one million instructions per second.
Accuracy	A computer provides correct output when correct instructions and data are given.
Efficiency	A computer never gets tired. It can work round the clock with the same level of accuracy.
Versatility	A computer can be used to perform many tasks simultaneously. This is one of the special features of a computer.
Storing and Retrieving	A computer is used to store large number of data and information in a relatively small unit and we can retrieve them easily and quickly when needed.

2.2 Classification of computers

As described in the first chapter, a computer can be used to perform various tasks such as preparation of documents, control machineries or check your illnesses. Hence you may understand that a computer always may not take the same physical form.

The computers that we use can be divided into different types. There are various classifications of computers according to the size and the technology used. Hence, computers can be classified as follows;

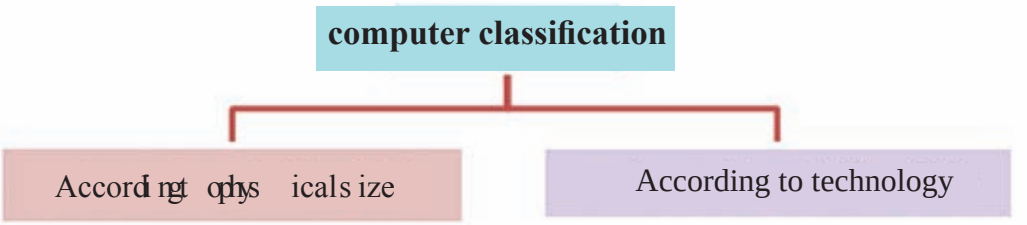


Figure 2.1 - Computer types

2.2.1 Classification according to physical size

(i) Super Computers

These computers have higher computing power. Computing power means the tasks that can be completed within a specific time period. They are large in size, expensive and rare. (Figure 2.2) These are used for scientific and engineering functions and to solve complex mathematical problems. For example, these computers are used in institutes like NAZA, large scale businesses and for military purposes.

Figure 2.2 - Super Computers

(ii) Mainframe Computers

These have relatively less physical size, computing power and are less expensive than the super computers. In mainframe computers, a number of users get connected to one computer using a number of terminals sharing, saving and retrieving data. (Figure 2.3 and 2.4) These are used in large scale businesses, in e-business and with super computer transactions done using internet. This type of computers are used even today in some large commercial institutions.

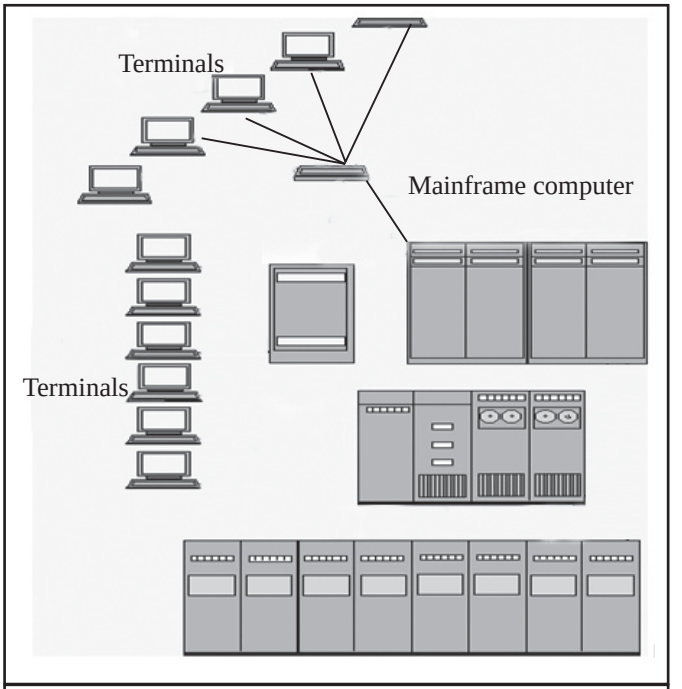


Figure 2.3 – Mainframe Computer Design

Figure 2.4 - Mainframe Computer

The words "Mainframe" and "Mini" are distancing from usage and those are now called as Server computers.

(iii) Mini Computers

These are lower in physical size, less powerful and less expensive than Mainframe computers and are also called common purpose computers. These are easy to use. A few users get connected to the central computer and through a few terminals share data and information. These computers are used in medium scale institutions such as banks. (Figure 2.5 and 2.6)

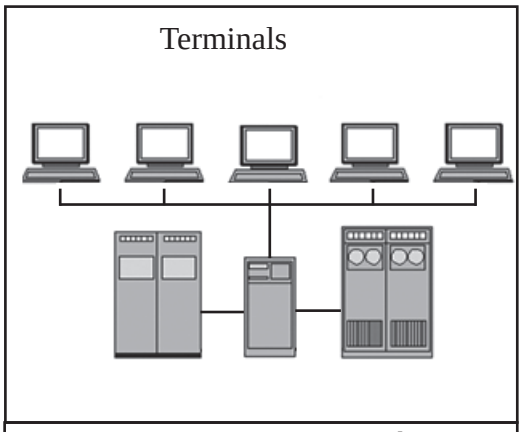


Figure 2.5 – Mini Computer design

Figure 2.6 - Mini Computer

(iv) Micro Computers

This is a small computer meant for personal use. This consists of a small memory capacity, smaller in size, less speedy and is less expensive. Further, this consumes little electricity (Figure 2.7).

Laptop, hand held, smart phones are some examples for this category.

Figure 2.7 – Personal Computers

2.2.2 Classification according to technology

Computers can be classified according to the technology used. These are,

(I) Analog Computers

These computers use analog signals such as environmental parameters (speed, pressure, and temperature). Speedometers, road lamps with sensors and meteorological machines can be given as examples. (Figure 2.8)

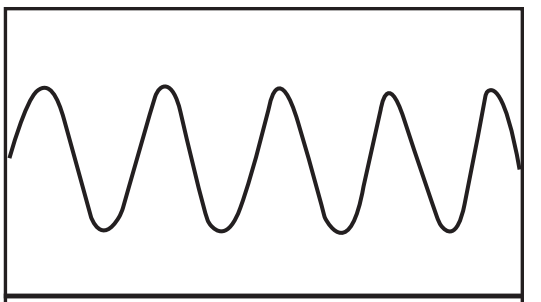


Figure 2.8 - Analog signals

(II) Digital Computers

The computers used by us in day-to-day life are called digital computers. These computers use digital signals. (Figure 2.9)

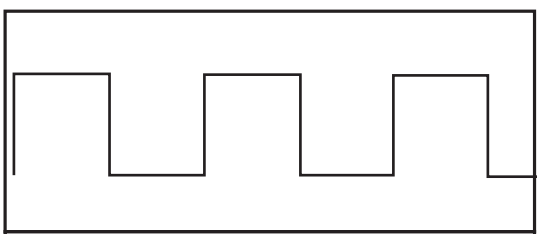


Figure 2.9 - Digital signals

(III) Hybrid Computers

This is a combination of analog and digital computers. The ECG machine used in hospitals to check the function of the heart is an example for hybrid computers. This machine identifies the function of the heart beat which is an analog signal. Then it is converted to a digital signal and these converted signals are printed by this machine.

2.3 Function of a Computer System

The main functions of a computer system is to input data, process and store data, and to produce information when needed. Several components are used for such functions. The following is the function of a computer system;

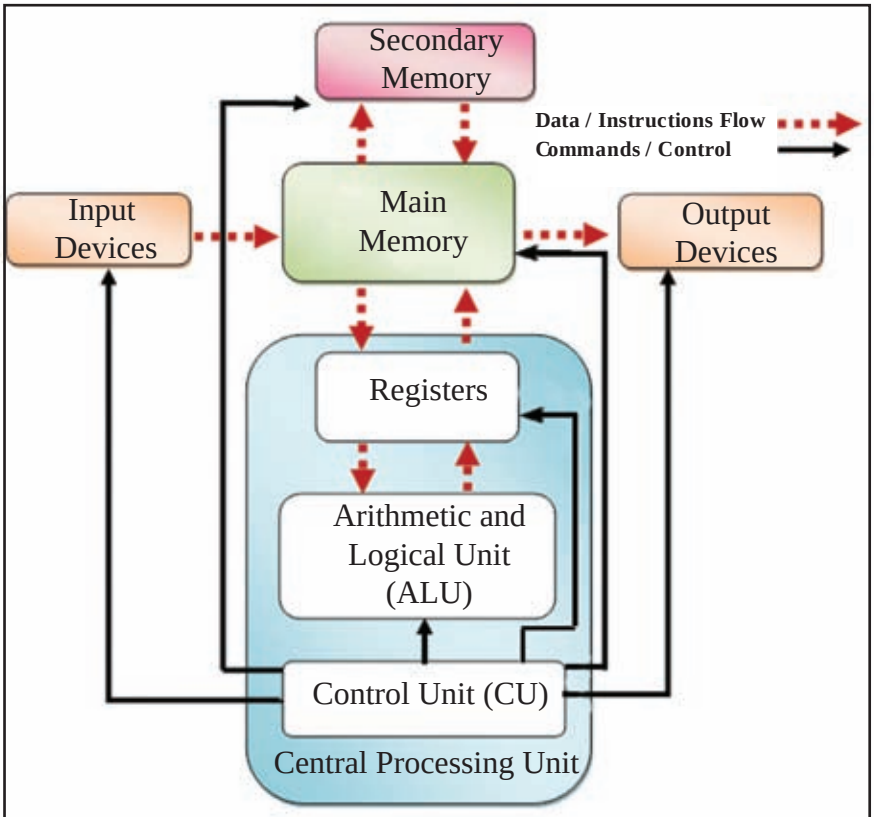


Figure 2.10 - A Computer System

Data and instructions fed to the computer via an input device first go to the Primary Memory. Then those are sent to the CPU for processing. The processed data stored in the Primary Memory as information is sent to the output device. The data and information which are to be stored are sent to the Secondary Storage Device. The stored information can be sent to an output device through Primary Memory. Control Unit sends the control signals to all the devices attached to the computer system. Computer memory contains data and instructions. When a computer programme works, the relevant data and instructions are sent to CPU.

The flow of the data and instruction is indicated by a dotted line and the control signals are indicated by a solid line in the diagram above.

2.4 Basic Physical Components of a computer system

Certain devices are essential for the function of the computer system.

2.4.1 Input Devices

Data and instructions are fed to the computer system using input devices. There are many input devices. The following are some of them.

(I) Keyboard

This is the most common input device. Though it is designed with the format of a conventional type writer, it provides keys for additional functions.

Normally keyboards come in two sizes. That is from 101/102 keys to 104/108 keys. The functions of the keys in the keyboard are given below in Figure 2.11.

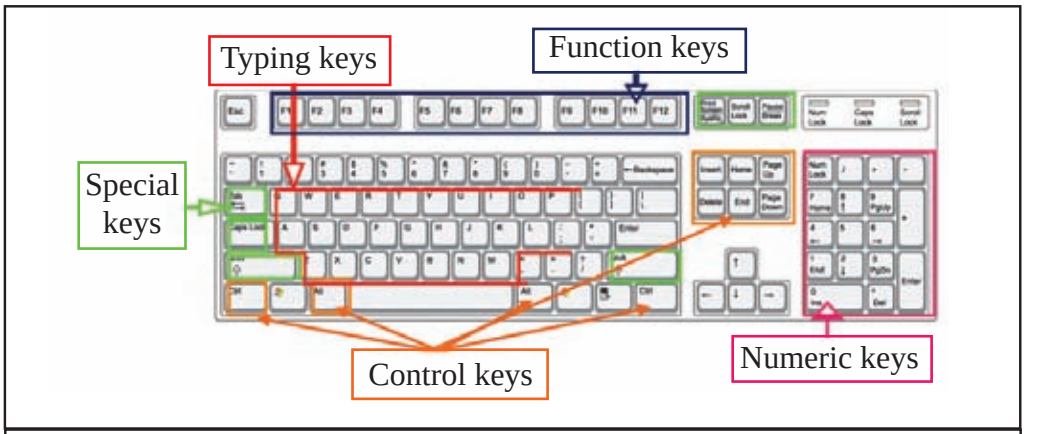


Figure 2.11 - Keyboard

(II) Pointing Devices

Example 1 - Mouse

This is the most popular pointing device used. Mouse provides input via buttons. The mouse contains a left button and a right button. Mouse has a wheel to roll up and down in the screen. Laptop computers use, a touch pad or a mouse as the pointing device. (Figure 2.12)

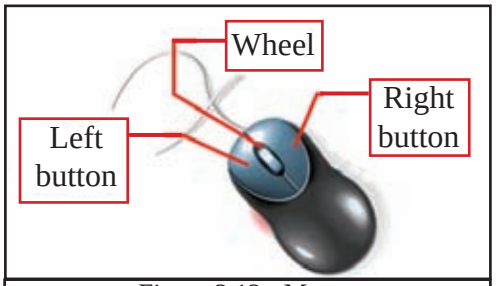


Figure 2.12 - Mouse

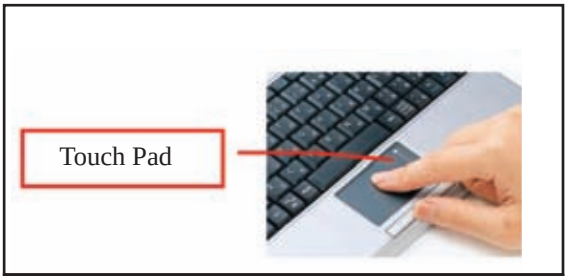


Figure 2.13 - Touch Pad

Example 2 - Touch screen

This is the input and output device in the modern computers and mobile phones. Data is fed by touching the screen. It also acts as a pointing device. (Figure 2.14)


Figure 2.14 - Touch Screen

Example 3 - Joy Stick

This is also a pointing device used in computer games which can move the cursor. (Figure 2.15)


Figure 2.15 - Joy Stick

Example 4 - Light pen

Light pen is used to select menu items on the screen or to draw/write on the screen. (Figure 2.16) The appearence is similar to a normal pen. This is mostly used in Computer Aided Designs (CAD).

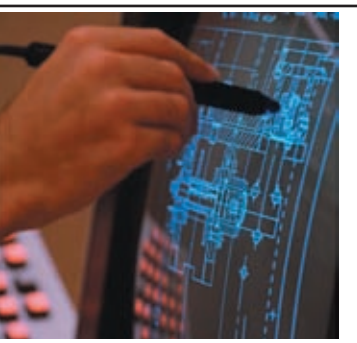


Figure 2.16 - Light Pen

(III) Imaging and Video Input Devices

Example 1 - Digital Camera

This is the input device used to input photographs and videos to the computer. Display screen serves as the output device of the camera. (Figure 2.17)

Figure 2.17 - Digital Camera

Example 2 - Webcam

The webcam is used to view a user connected to the computer through internet or to capture videos. (Figure 2.18) It is positioned on top of the laptop monitor, and for desktop computers, can be connected externally.

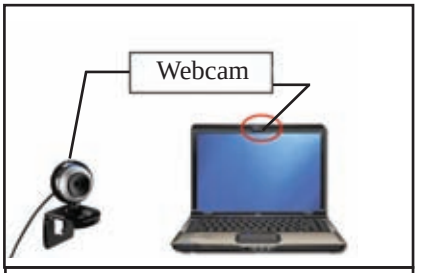


Figure 2.18 - Webcam

Example 3 - Closed Circuit TV (CCTV)

The images or videos captured by cameras are fed as input to the computers. (Figure 2.19) CCTVs are commonly used to maintain road safety and the security of premises.

Figure 2.19 - CCTV

(IV) Scanners

Example 1 - Flatbed Scanners

This is an input device which functions like a photocopying machine. The scanned image or document is captured by the laser beams and converted to digital data. The scanned picture / document can be saved in the computer. (Figure 2.20)

Figure 2.20 - Flatbed Scanner

Example 2 - Bar Code Reader

This device is used to read the bar codes. (Figure 2.21) The bar code is converted to an alphanumeric value by the bar code reader and is fed to the computer connected to it.

Figure 2.21 - Barcode Reader

Example 3 - Magnetic Ink Character Reader - MICR

This is available in banks. It is used to check the accuracy of a cheque. This device reads numbers printed at the bottom of the cheque, its data such as bank code, bank account number and feed them to the computer. (Figure 2.22)

Figure 2.22 - MICR

Example 4 - Optical Character Recognition - OCR Device

This is used to capture text in a document and to edit that captured text in the document. (Figure 2.23) This is commonly used in libraries and in government institutes.

Figure 2.23 - OCR

Example 5 - Optical Mark Recognition - OMR Device

This is an input device which recognizes marks made using a pencil or a pen. It is commonly used to check forms filled in pen or pencil, correct MCQs of exam papers. It can read the marks and feed that data to the computer. (Figure 2.24)

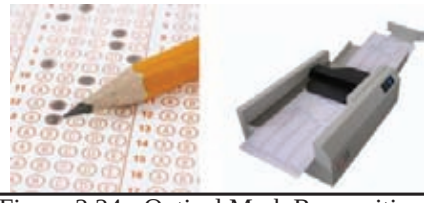


Figure 2.24 - Optical Mark Recognition

Example 6 Automated Teller Machine - ATM

ATMs have made bank transactions convenient for customers. (Figure 2.25) ATM machine reads the numbers in the debit or credit cards inserted into the machine and connect to the computer. Once the bank account number is read through the ATM, one system connects with the bank's computer for processing the transaction.

Figure 2.25 - Automated Teller Machine (ATM)

(v) Microphone

Microphone is used to feed sound to a computer. (Figure 2.26)

Figure 2.26 - Microphone

2.4.2 Output Devices

There are several methods of producing the processed information by a computer system. Some of them are,

(i) Soft copy
(ii) Hard copy
(iii) Sound

(i) Soft Copy

The output on the screen is called a soft copy. The soft copy output can be provided on the following devices.

- **Monitor/ Screen**

This is also called Visual Display Unit (VDU). There are several types of monitors available today.

A - Cathode Ray Tube (CRT) Monitor

This type of monitor, is large in size and **consumes more electricity**. (Figure 2.27)

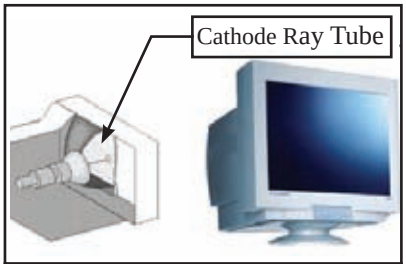


Figure 2.27 - Cathode Ray Tube with screen

B - Liquid Crystal Display - LCD

This is a flat screen type technology. LCD displays utilize two sheets of polarizing material with a liquid crystal solution between them. (Figure 2.28) LED **consumes less electricity.**

Figure 2.28 - Liquid Crystal Display

C - Light Emitting Diode - LED

LED screens are designed using light emitting diodes. (Figure 2.29) LED displays have better brightness and they are used for symbols, billboards and name boards in common places and roads. This has become a popular medium today due to its **low electricity consumption.**

Figure 2.29 - Light Emitting Diode

- **Multimedia Projector**

This is the device used to get information output to a wide screen so that several people can view it at the same time. This can be used as a visual aid by a teacher to display presentations, to conduct business meetings or to watch videos for entertainment. (Figure 2.30)

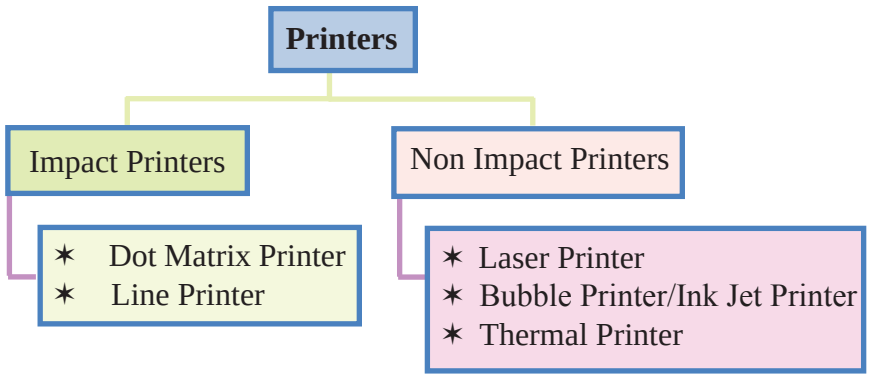
Figure 2.30 - Multimedia Projector

(ii) Hard Copy

Hard copies are tangible computer outputs. The following are devices which provide hard copy output.

❖ Printers

There are two main types of printers. These are,



1. Impact Printers

Impact printers are a primary level device in the printing technology. Impact printer refers to a class of printers that have a head or needle which strike against an ink ribbon to make a mark on the paper. Its function it is noisy. However, since the ink ribbon used is not expensive, this is used in banks and shops for printing receipts etc. The following are some of the impact printers.

Example 1 - Dot Matrix Printer

Letters are printed on the paper as small dots here when the printer's head strikes on the inked ribbon with needle like tips. (Figure 2.31)

Figure 2.31 - Dot Matrix Printer

Example 2 - Line Printer

This is a fast printer which prints one row at a time. This can print about 3000 lines per minute. (Figure 2.32)

Figure 2.32 - Line Printer

2. Non Impact Printers

Non impact printers does not operate by striking a head against a ribbon. Hence, it is not noisy. The printouts are better quickly**.** Running cost of these printers are more expensive than impact printers. The following are some of the non impact printers.

Example 1 - Laser Printers

In a laser printer, the toner (dried ink) in a cartridge is applied on the paper to produce the printout. (Figure 2.33 and 2.34)

Both black and white, as well as colour laser printers are available. The laser printer produces clear and quality printouts.

Figure 2.33 - Laser printer

Figure 2.34 - Cartridge

Example 2 - Bubble/Ink Jet Printer

Liquid ink stored in tanks is kept in the cartridge and ink is deposited on paper through small nozzles and produce the print. (Figure 2.35)

Figure 2.35- Ink Jet Printer

Example 3 - Thermal printers

Heat is used to print the document. It is commonly used in businesses to print receipts in devices such as like ATM, and in printing labels (Figure 2.36).

Figure 2.36 - Thermal printers

Example 4 - Plotter

This is commonly used in computer based planning (architectural designs, town planning, designing sailing boats etc). A plan is drawn by moving a pen on the paper.

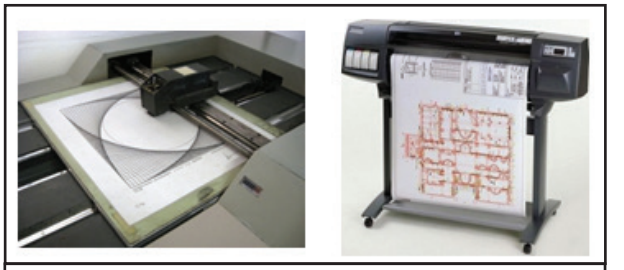


Figure 2.37- Plotter

(iii) Sounds

The device which gives a sound output is called speaker. Speaker devices are designed for personal and common purpose.

Figure 2.38 - Speaker and head phones

2.4.3 Central Processing Unit - CPU

This is the main component of a computer system. It is also called the brain of the computer as well as it functions according to the given commands. CPU manages the operating system and application software. CPU consists of three main components. The functions of those are as follows;

1. Arithmetic and Logical Unit (ALU)	Perform all mathematical and logical functions.
2. Control Unit (CU)	Controls all devices of a computer system.
3. Memory Registers	Temporarily stores data needed for the function of ALU and the information produced by ALU.

Main Components of Central Processing Unit

Computer Speed

The unit used to measure clock speed of a computer is Hertz (Hz) and the units used to measure computer speed are Megahertz (MHz) and Gigahertz (GHz).

2.4.4 Computer Memory

Several computer memory or storage devices are used to store data and information and the functions of each are different. Computer memory can be classified as follows.

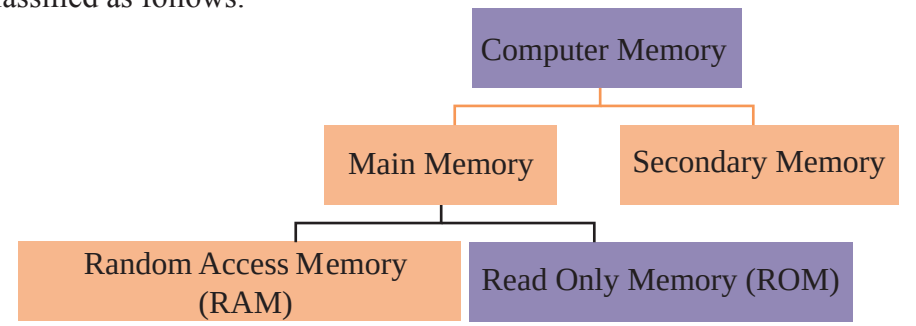


Figure 2.39 – Computer Networks

Random Access Memory (RAM) is often referred as Main Memory.

(I) **Primary Memory**

The memory that can be directly accessed by the Central Processing Unit is called primary memory/storage. There are three types of Primary Memory.

* **Random Access Memory (RAM)**

This memory temporarily stores data. (Figure 2.40) The data stored in RAM will be deleted when the computer is switched off. Therefore this is also called volatile memory. Data coming from input devices as well as data sent to output devices are held in RAM. When comparing to ROM, which is discussed after this, RAM has both read-write facility.

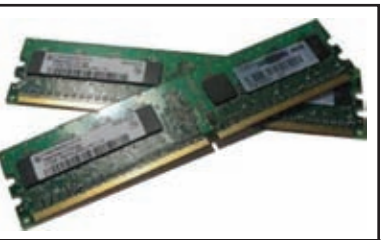


Figure 2.40 - Random Access Memory

* **Read Only Memory (ROM)**

The data in Read Only Memory is not erased when the computer is switched off. Therefore it is a Non-volatile Memory. The commands required for booting up a computer are stored in ROM.

These commands are called BIOS (Basic Input Output System). Computer Manufacturing companies store these commands in a ROM with a smaller capasity and is connected to the mother boars (Figure 2.41).

Figure 2.41 - Read Only Memory

* **Cache Memory**

Though this is smaller in capasity than other memory, it is faster. This is also called CPU Memory. This acts as the mediator between CPU (Central Processing Unit) and Primary Memory. The data frequently used by are stored here. (Figure 2.42)

The Central Processing Unit checks cache memory first to see whether the required data is available for processing. However, if the required data is not available then the data is fetched to cache memory from RAM for processing.

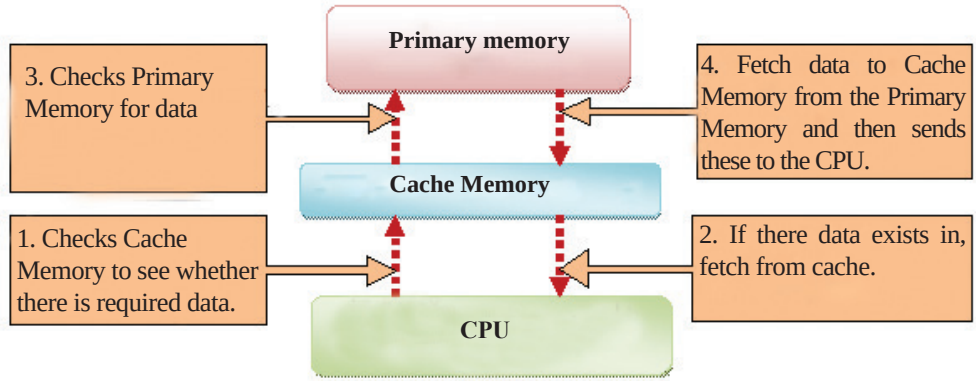


Figure 2.42 - Cache Memory

(II) **Secondary Memory**

Secondary Memory or the Secondary Storage is the device which stores data and information permanently. This is also called External Storage. There are internal storage devices as well as external portable secondary storage devices. Secondary memory is called non-volatile memory since it does not erase when electricity is not available. (Figure 2.43) These can be classified as follows.

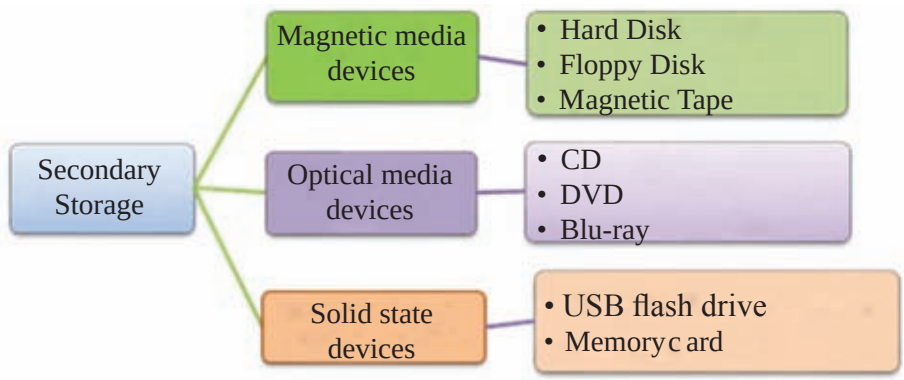


Figure 2.43 - Secondary Memory

1. **Magnetic Media Devices**

Data is stored here by using magnetic field.

Example 1 - Hard disk Drive

The Hard Disk Drive (HDD), which is commonly used to store data and information, is located inside the computer. However, there are external hard disks as well. Today there are hard disks with large capacity due to the development of the technology. The user can read and write the data stored in HDD. Therefore, this medium is called Read / Write Memory. The capacity of a hard disk ranges from 250 GB to 4 TB. The maximum capasity will increase with technological development.

Hard Disk is made of several components.

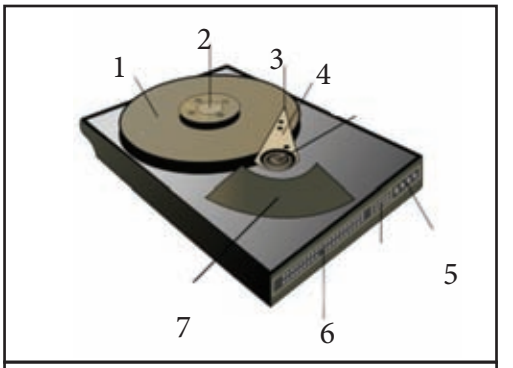
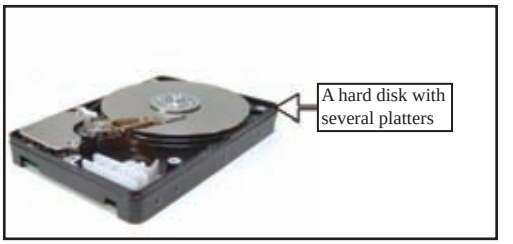


Figure 2.44 - Hard Disk

1. **Platter** – This is a metallic, aluminum or ceramic disk and data can stored on both sides using magnetic media. There can be several platters in a hard disk.

2. **Spindle** – Holds the platter and rotates it.

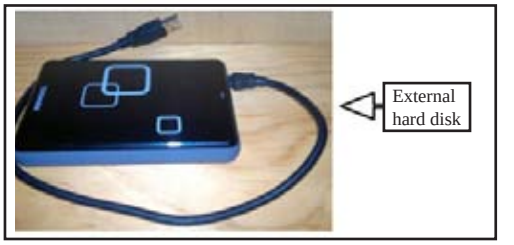
3. **Head** – Reads the magnetic data in the platter and writes on the platter. There are two heads for a platter; one on top and one on bottom.



4. **Actuator arm** – Moves the head. Enables reading and writing data anywhere in the platter.

5. **Power connector** – Connects the Hard Disk to power which is needed for its function.

6. **IDE connector** – Transmits data to the platter



7. **Actuator** – An electronic device which moves the arm connected to it. This is operated by a motor.

Example 2 - Magnetic Tape

Used mostly in sever computers for back up due to its larger storage capasity. But tape is not used in day today life as it is slow in reading and writing (Figure 2.45).

Figure 2.45 - Magnetic Tape

Example 3 - Optical media

Since data stored digitally on a disk is read and written by laser beam, it is called optical media. Optical media is commonly used to carry data and information and there are several types. The followings are some of them;

Device	Type	Size	Image
CD-ROM (Compact Disc Read Only Memory)	Used only to read, written data and instructions	650 - 900 MB	
CD-R (Compact Disc -Write once)	Can be used to write data and information once until the capacity is filled.		
CD-RW (Compact Disc Re-Writable)	Data which is written on the disk can be erased and re-written.		
DVD-ROM Digital Versatile Disc - Read Only Memory	Used only to read, written data and instructions	4.7 - 9.4 GB	
DVD-R (Digital Versatile Disc - Write Once)	Can be used to write data and information once until the capacity is filled.		
DVD – RW (Digital Versatile Disc - Rewritable)	Data which is written on the disk can be erased and re-written.		
Blue ray Disc (BD) R (Recordable)	Can be used to write data and information once until the capacity is filled.	25 - 128 GB	
Blue-ray RE (Recordable Erasable)	More data can be re-written many times until the capacity is filled.		
Blue - ray 3D	Used to record video.		

3. Solid State Devices

Since these devices contain solid parts and does not contain moving parts they are called Solid State Devices. They are used to read and write data and information.

Example 1 USB Flash Drive

This has become a very popular secondary storage device due to its easy portability and the ability to read and write data fast.

Figure 2.46 - USB Flash Drive

Example 2 Memory Card

This has the same function of USB flash drive. However, the method of connecting to the computer is different and it is smaller in physical size. This is used in digital cameras, mobile phones and computer gaming devices.

E.g. - SD Card (Secure Digital Card)

Figure 2.47 - Memory Card

Activity

1. Write advantages and disadvantages of Magnatic media, Optical adia and Solid state media.
2. Find a discarded hard disk, open it with the help of your teacher and observe the parts inside.

2.5 Computer Ports

The interfaces which connect computer with its devices or with other computers are called ports. (Figure 2.48) Ports are positioned in the front or back of the computer. There are symbols to identify posts. All the ports are connected to the motherboard.

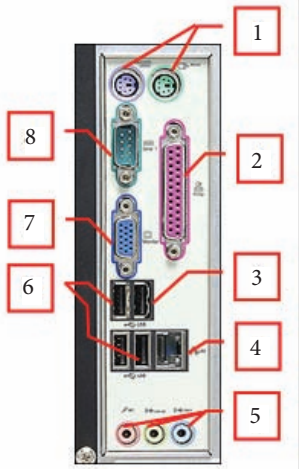


Figure 2.48 - Ports

Figure 2.49 - How ports are connected to the Motherboard

1. PS/2 ports	5. Audio ports
2. Parallel port	6. USB port
3. HDMI port	7. Video port
4. RJ 45 port	8. Serial ports

1. PS/2 Port

Used to connect the keyboard and the mouse to the computer system. The purple port is for the keyboard and the green port is for the mouse. (Figure 2.50) However, USB port is mostly used today to connect the keyboard and the mouse to the computer system.

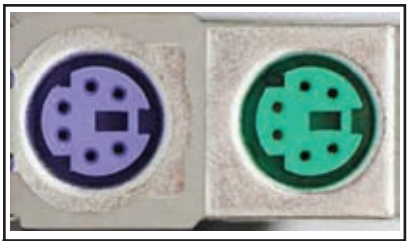


Figure 2.50 -PS/2 Ports

2. Parallel Port

Used to connect the printer to the computer system. This consists of 25 holes. (Figure 2.51) However, USB port is mostly used today to connect printers to computer systems.

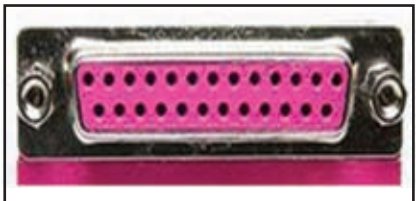


Figure 2.51- Parallel Port

3. **HDMI (High - Definition Multimedia Interface) port**

This port can be seen especially in laptops. (Figure 2.52) It connects the monitor, multimedia projector, digital TVs, and digital speakers to the computer.

Figure 2.52 - HDMI Port

4. **RJ 45 Port**

This port connects computer of a computer network to the network router, network switch. (Figure 2.53)

Figure 2.53 - RJ 45 port

5. **Audio Ports/ Jacks**

This port connects audio media like microphones, speakers and head phones to the computer system. (Figure 2.54)

Blue – Line In
Green – Line Out, Head Phone
Pink – Microphone

Figure 2.54 - Audio Ports/ Jacks

6. **USB (Universal Serial Bus Port)**

This port is used to connect many types of input and output devices to the computer. (Figure 2.55)

Figure 2.55 - Universal Serial Bus Port

7. **Video port - VGA (Video Graphics Adaptor)**

This is also called the Graphic Port. This connects the monitor, or multimedia projector to the computer system. (Figure 2.56) The port consists of 15 holes.

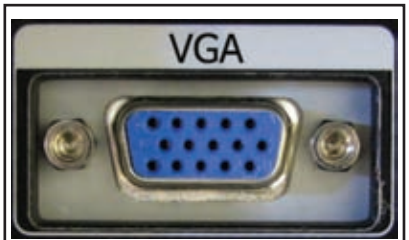


Figure 2.56 - Video port

8. Serial port

This port connects devices such as modem to the computer. Today, USB port is used instead of the serial port. (Figure 2.57)

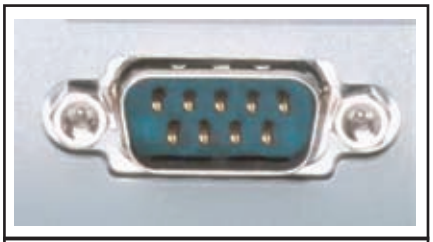


Figure 2.57 - Serial Port

Activity

Observe and identify the ports in the computer in the laboratory.

2.5 Data Communication

Transmitting data and information is called data communication. Data transmission can be carried out between two or more computers or devices such as printers.Data transmission needs a connection between a sender and a receiver. Creating such a connection is called networking.

2.5.1 Basic components required for data communication

The following are the basic components that are needed for data communication.

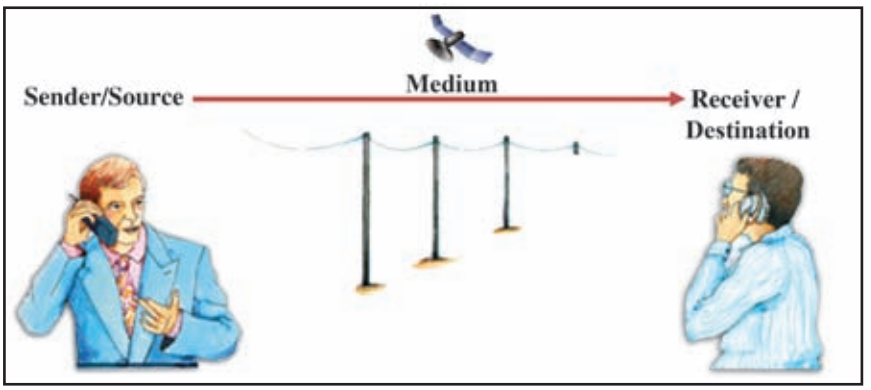


Figure 2.58

- Sender / Source – the person or the object which sends data
- Medium – medium used to transmit data (telephone wires / wireless)
- Receiver/ destination – the person or the object which receives data

2.5.2 Data Transmission Modes

There are several modes of data transmission between sender and receiver.

1) Simplex Mode

Data is transmitted from the sender to the receiver only. Getting print outs, watching television, and listening to radio can be given as examples

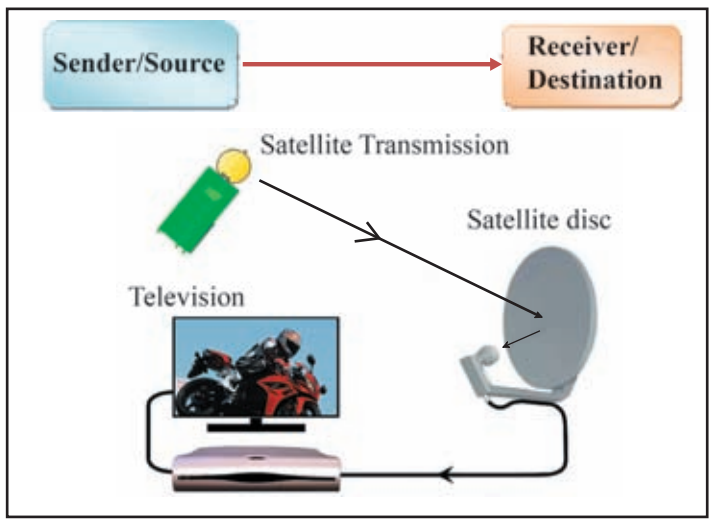


Figure 2.59 - Simple mode communication

2) Half- duplex Mode

Here, data is transmitted to one direction at a time. This means after data is transmitted from sender / source to the receiver, the receiver can transmit data back to the sender / source. Browsing internet to get information and walkie-talkie used by security forces can be given as examples.

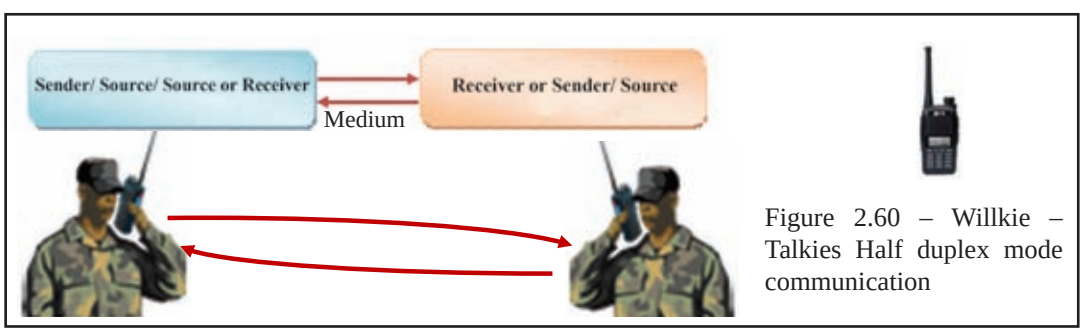


Figure 2.60 – Willkie – Talkies Half duplex mode communication

3) Full Duplex Mode

Data is transmitted to both sides at the same time is called Full duplex. Telephone conversation is an example for full duplex mode communication.

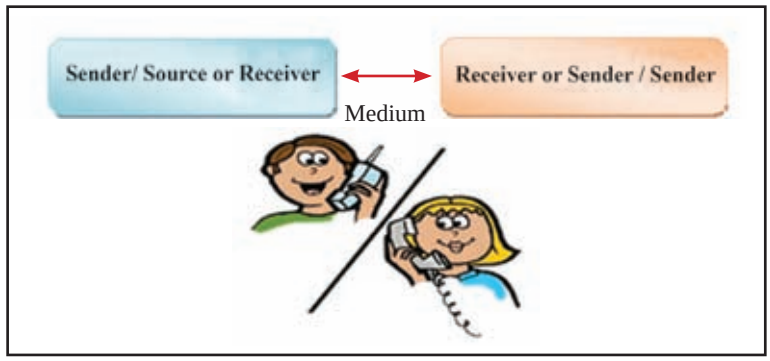


Figure 2.61 - Full Duplex Mode communication

2.5.3 Data Transmission Media

This is another important feature when creating connections among systems. There are two types of data transmission medium. Those are called Guided/Wired and Unguided/Wireless. The following are some examples. (Figure 2.62)

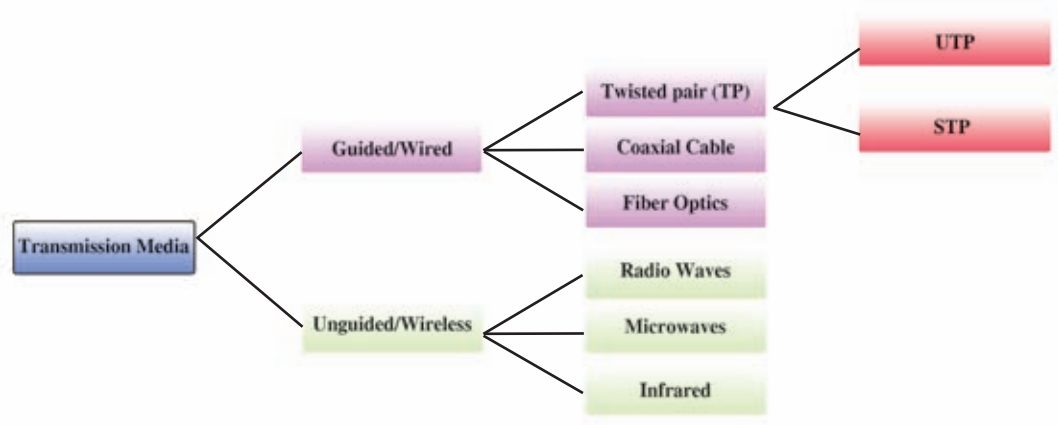


Figure 2.62 - Data Transmission Medium

(i) Guided / Wired

If the medium used for data transmission is a physical medium, it is called guided or wired.

Example 1 - Twisted Pair

Pairs of twisted copper wire are used for data transmission. There are two types.

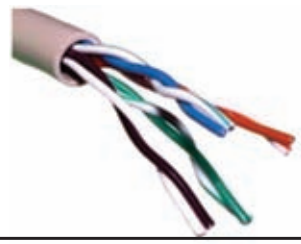


Figure 2.63 - Unshielded Twisted Pair

1. **Unshielded Twisted Pair (UTP)**

The twisted copper wire pairs used for telephone connections. These are very flexible and low-priced. However, it is difficult to transmit data for a long distance through UTP wires. It is suitable for maximum of 100 meters.

2. **Shielded Twisted Pair (STP)**

STP is a better quality and secure data transmission medium. However it is expensive. (Figure 2.64)

Figure 2.64 - Shielded Twisted Pair

Example 2 - Coaxial Cable

This consists of an electronic cable pair. The outer cable which is like a braided copper net produces electromagnetic field around the central cable. These two cables are separated by a plastic shield. These cables are expensive and used for TV antenna and CCTV.

Figure 2.65 - Coaxial Cable

Example 3 - Fiber Optics cable

Fiber Optics cable consists of a pair of an cables. There is a plastic jacket to separate the two cables. Core is a glass tube and there is glass cladding around it. (Figure 2.66). The data transmission is carried out by while reflecting light. These are used in modern telephone networks. The cable is relatively more expensive. This is the fastest data transmission media at present.

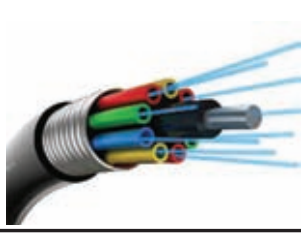


Figure 2.66 - Fiber Optics

(ii) Unguided/Wireless Media

Data is transmitted as signal through the air without using physical medium is called unguided/wireless media.

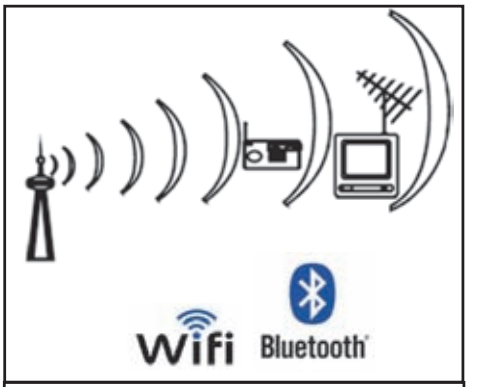


Figure 2.67 - Radio waves

Example 1 - Radio waves

Data transmission is performed using radio waves. Wifi and Bluetooth are examples for radio waves based communication.

Example 2 - Microwaves

Microwaves travel in a linear mode. (Figure 2.68) Transmission center is positioned facing each other. The distance between centers are decided based on geographical factor of the area.

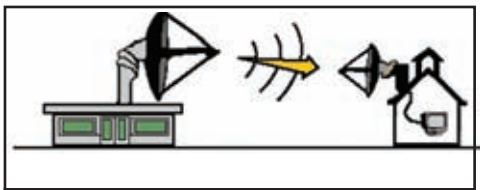


Figure 2.68 - Micro waves

Microwaves are used in Satellite communication to transmit data as transponders. (Figure 2.69) Satellite centers, which are positioned in the sky above 36000 km, capture data transmitted as microwaves through satellite towers positioned in the Earth and then transmit the data back to the required tower. Using this method, data can be transmitted to any distance. This is also used in internet communication.

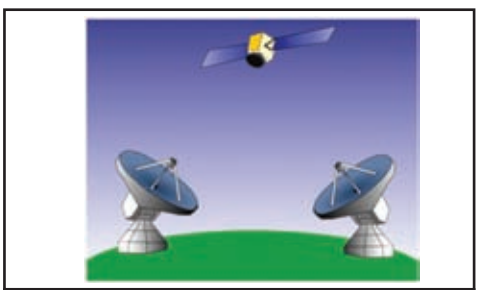


Figure 2.69 - Satellite Communication

Example 3 - Infrared

Infrared data transmission is used in TV remote controllers, wireless keyboards and mouse etc.

Figure 2.70 - Infrared

Activity

1. Write down advantages and disadvantages of copper wire and optical fiber.
2. Considering the factors such as speed, distance and price in data transmission, organize a discussion to decide the suitable media in different occasions.

2.5.4 Computer network devices

There should be two or more computers to build a computer network. Connection devices used to connect computers with each other.

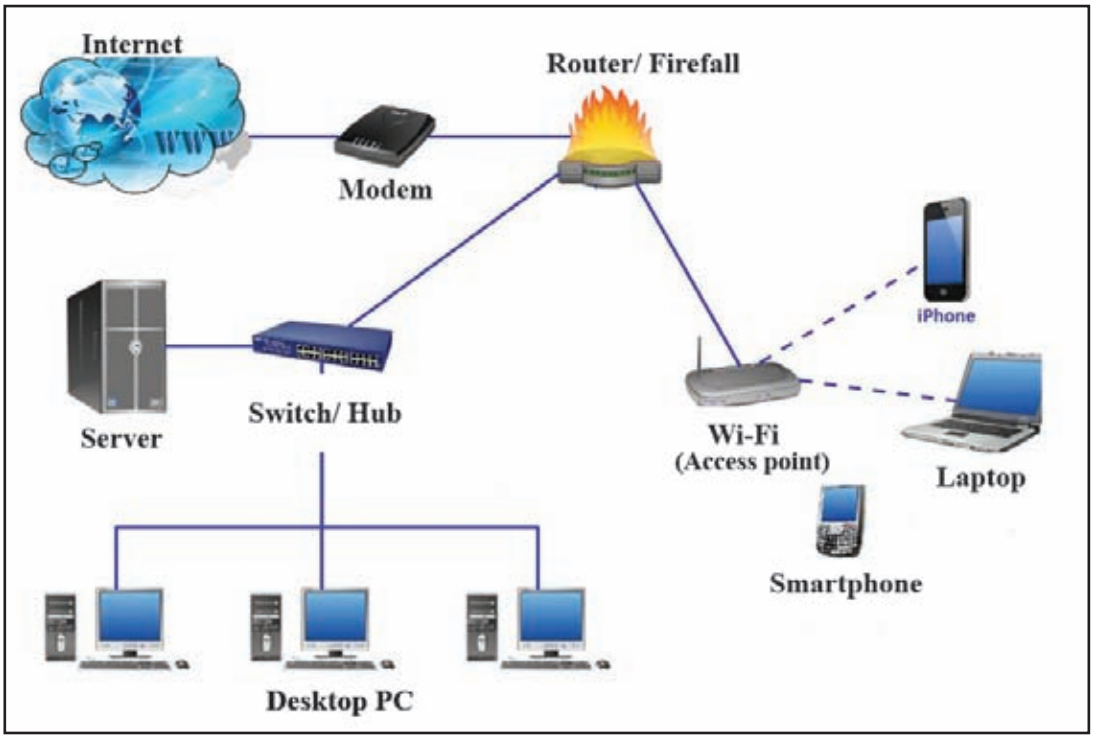


Figure 2.71

(i) Network Interface Card (NIC)

NIC has an RJ45 port and is built into the mother board in modern computers. In the port NIC was a separate code to be plugged to the mother board.

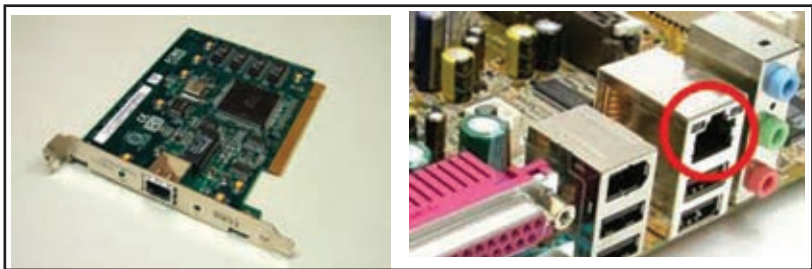


Figure 2.72 - Network interface card

Figure 2.73 - RJ 45 connector

(ii) Switch/Hub

Switch/Hub acts as the mediator to build a connection between two or more computers. (Figure 2.74) A guided/wired transmission media is used. One end is connected to port in the computer and the other end is connected to the port in the Switch / Hub.

Figure 2.74 - Switch / Hub

Differences between the switch and hub

- The main difference is the data transmission speed. Hub sends the transmitted data to all computers but switch sends data to the relevant computer only. Here hub may create an unnecessary network data congestion.

- In data transmission, hub uses half duplex mode and the switch uses full duplex mode.

(iii) Wireless Fidelity - Wi-Fi

Wi-Fi technology has become the most popular media in computer networking. For this purpose, Wi-Fi access points are used. This allows the users to build a computer network easily and internet connections for mobile phones and laptop computers using radio waves.

Figure 2.75 - Wi – Fi

(iv) Router

Router is the device used to build a connection between two or more computer networks. It is also called a Gateway. This finds out the most suitable ports for data transmission in network communication.

Figure 2.76 - Router

(v) Modem

In getting the internet with telephone wires, the modem is used to connect the computers of a computer network or a personal computer at home to the internet. The modem acts as a data translator. Digital signals sent from the computer is translated to analog signals so that they can be transmitted via telephone line and the analog signals coming from the telephone line send to the computer from the internet is translated to digital signals. This is called **MO**dulation and **DEM**odulation. Hence, '**MODEM**' is a combination of these two words. There are different types of MODEMs. Those are internal, external and wireless modems. Todays routers have a modem inbuilt in the device.

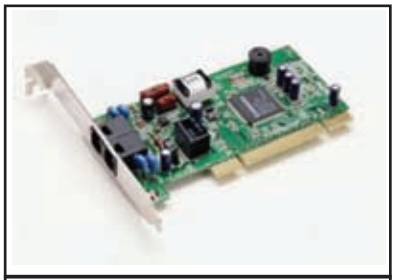
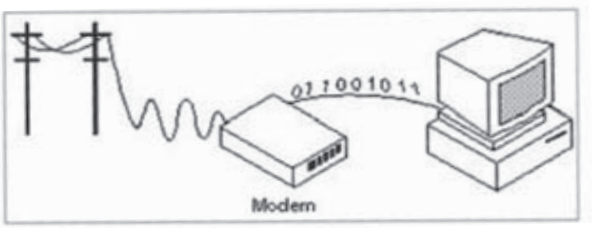


Figure 2.77 – Internal Modem

Figure 2.78 – External Modem

Figure 2.79 – Wireless Modem



Modulation - Demodulation

(vi) Firewall

Firewall is a network security. Instructions to control the data and instruction transmission between internet and computer network are built into the system. A firewall operates as a secured barrier between internet and network in exchanging data among computers. Firewalls can be purchased in both forms as software and hardware.

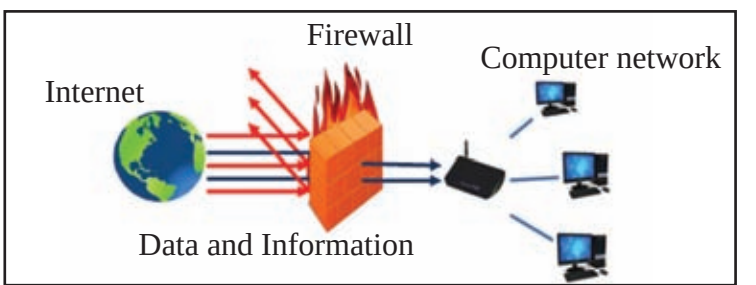


Figure 2.80 - Firewall

Activity

Observe the firewall in a computer operating system with the help of your teacher.

2.5.5 Client/Server network

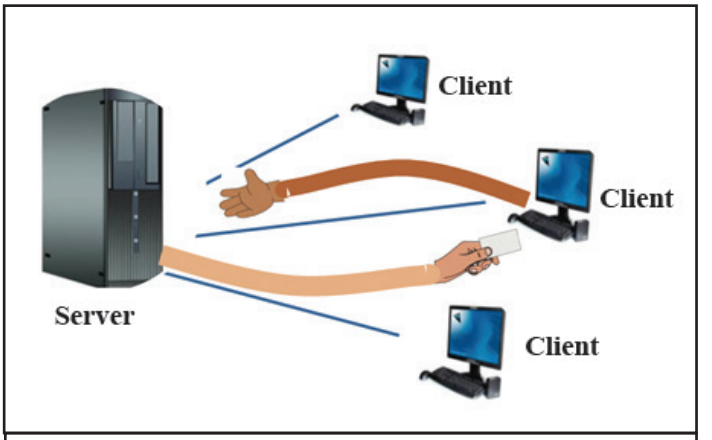


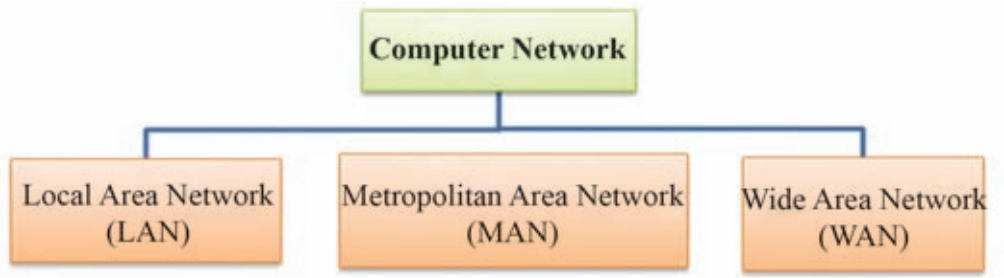
Figure 2.81 – Client / Server Network

A server computer responds to the client computer connected to the server. A network operating system is installed to the server. The one who requests data or information via internet or from an area network is called a client and the one who provides data and information is called the server.

2.5.6 Types of Computer Network

- **Computer Networks**

Computer networks can be classified according to geographical distribution of computers in the network.



(i) Local Area Network (LAN)

A LAN connects computers inside a room or several rooms in a building. (Figure 2.83) A computer network built in a school, university, a small scale business or an office can be given as examples.

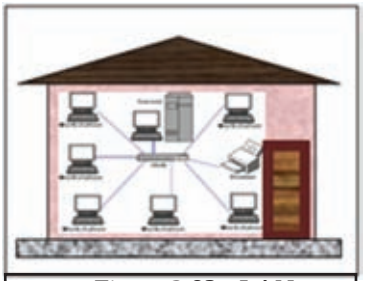


Figure 2.83 - LAN

(ii) Metropolitan Area Network - (MAN)

MAN is a combination of several Local Area Networks which covers less than 16 miles Examples include banking networks, institutes and universities with branches. (Figure 2.84)

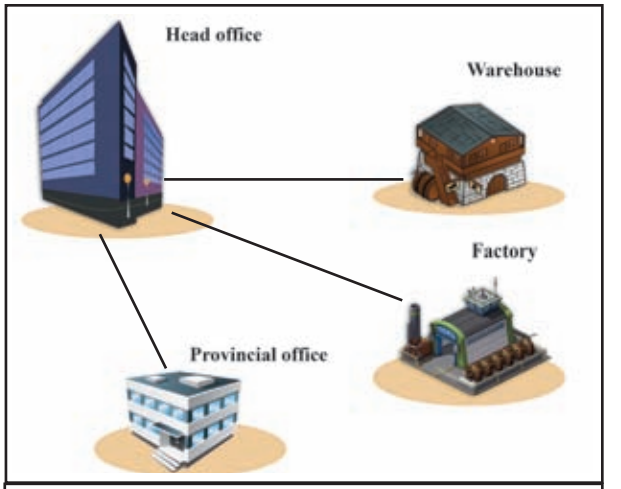


Figure 2.84 - MAN

(iii) Wide Area Network - WAN

These networks cover a wide area. This can be within or outside a country. The best example for WAN is the Internet. (Figure 2.85)

Figure 2.85 - WAN

Activity

Provide two examples for LAN, MAN and WAN.

2.5.7 Network Topology

Network topology is the pattern of connection in designing computer network. There are different types of network topologies. Those are,

i) Star Topology

This is a commonly used design and built by centralizing a switch/hub and computers. (Figure 2.86)

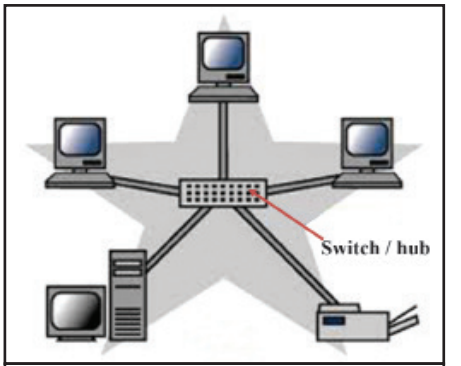


Figure 2.86 - Star Topology

ii) Bus Topology

Here, all the connections are established through a main cable. (figure 2.87) This cable is called the backbone because any issue with the network affects all the computers in the network. This design is easy in networking and fewer cables are required. However, a limited number of computers can be connected.

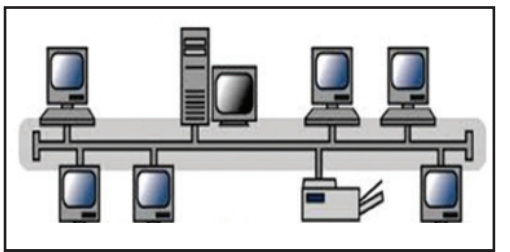


Figure 2.87- Bus Topology

ii) Ring Topology

Here, computers are positioned in a ring/bangle and connected through cables. Data or information move in a circular manner. The breakdown of one computer or cable can lead to the breakdown of the entire network.

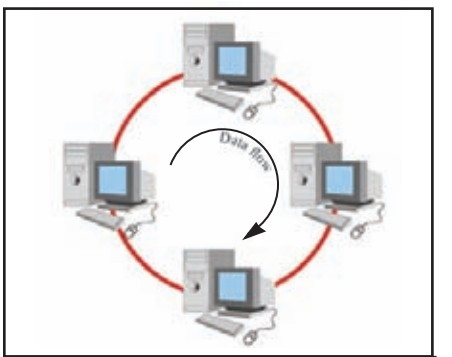


Figure 2.88 – Ring Topology

iv) Tree Topology

Tree topology has characteristics of both bus and star topologies. In this design several star topologies are connected to a bus backbone cable. (Figure 2.89) One of the advantages of this is the ability to control each network individually.

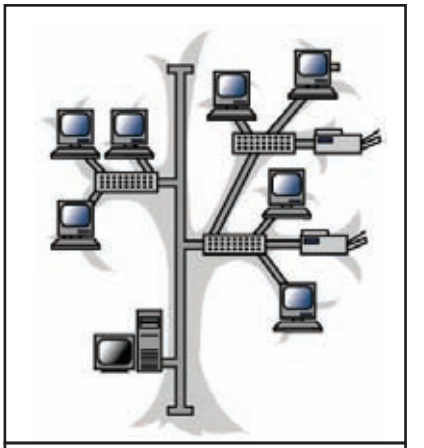


Figure 2.89 - Tree Topology

v) Mesh Topology

All the computers in the network are connected with each other. (Figure 2.90) Since this is a complex connection pattern, it is costly and difficult to control. However, a breakdown of one computer does not affect the connections in the network. Mesh networking can be found on internet.

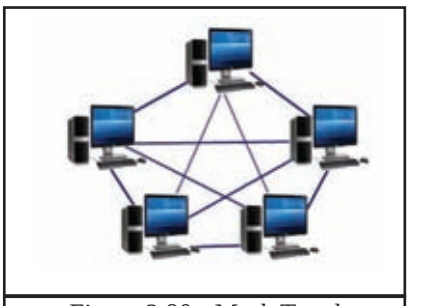
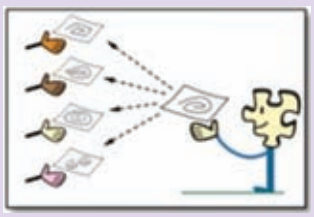


Figure 2.90 - Mesh Topology

2.5.8 Benefits of Networkings

Data and information can be shared between computers. 	The main advantage of networking is sharing data and information between computers. Data and information in a server, can be accessed by clients connected to the server.

Less storage space 	This saves space as well because the same data is not stored in several computers unnecessarily.
Ability to share resources 	The devices like printer, scanner and modem can be connected to network and shared by multiple users.
Ability to control central software 	Software can be installed on a server computer and shared by many users through client computers.
Ability to connect at any where and at any time 	By connecting to internet, a user can access his / her documents and data at any where and any time (24×365).
Security 	Only the authorized clients can access the server computer. Data and information in a network can be made secure.
Electronic mail 	E-mail is a convenient method of sharing information between computers.

2.5.9 Disadvantages of Networking

Possible security issues 	One major disadvantage of networking is the difficulty in securing data. Server can be accessed through any computer connected to the network. Hence it is difficult to secure it from the hackers (people who try to gain access to data without permission).
Breakdown of network 	In some topologies, breakdown of a computer or a cable can affect the function of the other computers of the network.
Virus 	If one of the computes in the network gets a virus attack, this can spread to other computers as well.
Computer break downs 	Due to defects or breakdown of the server, the other the clients can be affected.
Training requirements 	The need for a person who is specialized in network administration.

Summary

- A computer is an electronic device which accepts or collects data, processes them according to the instructions given and produces desired output.
- Characteristics of a computer are speed, accuracy, efficiency, versatility and storing and retrieving ability.
- Classification of computers

  According to size - Super Computers, Mainframe computers, Mini computers, Personal Computers / Micro Computers / Mini Computers

  According to technology - Analogue Computers, Digital Computers, Hybrid Computers

- Basic components of a computer
  - Input devices
  - Output devices
  - Central Processing Unit : Arithmetic and Logical Unit (ALU), Control Unit, Memory Registers
  - Primary Memory / Main Memory
  - Secondary storage

- External devices are connected to a computer through ports.
- Basic components of data transmission are sender/source, media, receiver/ destination.
- Modes of data transmission
  - Simplex–mode
  - Half–duplex mode
  - Full muplex mode
  - Data transmission medium
    - There are two types – guided and unguided / wireless
- Connectivity devices such as switches, routers, modems are necessary to build a network.
- Types of computer networks – LAN, MAN, WAN
- Computer network topology includes
  - Star topology
  - Bus topology,
  - Ring topology
  - Tree topology
  - Mesh topology
- There are advantages as well as disadvantages of computer networking.

3 Data Representation Methods in the Computer system

In this unit you will learn,

- computer data representation,
- Decimal, Binary, Octal and Hexadecimal number systems,
- most and least significant positional value of a number,
- converting decimal numbers to binary, octal numbers to hexadecimal numbers
- conversion among binary, octal, hexadecimal and decimal numbers,
- data storage capacity,
- coding systems in computers.

3.1 Computer Data Representation

Chanaka : Can you prepare this application using the computer Anjana?

Anjana : Sure, I'll do it. You read this. Let us type it. "Application…"

Chanaka : When "A" on the keyboard is pressed, how does the computer identify it Anjana?

Sameera : Let us ask our teacher.

Janitha : Teacher, how is letter "A" represented in the computer?

Teacher : look at this picture children. (Figure 3.1)

Step 1
Press “A” on the keyboard.

Step 2
The electronic symbol for letter “A” goes to the System Unit through the keyboard.

Step 3
Electronic signal of letter “A” goes to the video memory via RAM

Step 4

“A” is displayed on the screen after processing.

Figure 3.1 – Letter “A” representation on the computer.

Teacher : According to the figure above (Figure 3.1), it is clear for you how letter "A" is displayed on the screen.

Sameera/
Janitha : Thank you very much, Sir

3.1.1 Number System

When typing letters or words using the computer, these words or letters are represented by the computer as numbers it can understand. While this group of numbers that the computer can understand is called a 'Number System' the limited number of numerals in the number system called digits. The value of these numbers (numerals) depends on the position they occupy within the number.

While the concept of number system was present in the 'Abacus ' considered as the first calculating machine of the world, it has progressed up to the computer of today.

The number system used for the representation of data in the computer is as follows;

Table 3.1 - Numbers and Alphabetic characters used in the Number System

Number System	Base Value	Number and Alphabetic character used
1. Binary	2	0, 1
2. Octal	8	0, 1, 2, 3, 4, 5, 6, 7
3. Decimal	10	0, 1, 2, 3, 4, 5, 6, 7, 8, 9
4. Hexa - decimal	16	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F

3.1.2 Use of Binary Numbers in Computer Data Representation

Computer represents data in two signal states. There are two Voltage levels for these two symbols. One is named as the high voltage level and the other is named as low voltage level. "0" and "1" digits respectively represent these low and high voltage levels in a circuit. Thus, "1" and "0" status are equal to the “On” and “Off” states of an electronic circuit. Any data in the world can be represented on the computer using these two digits.

Figure 3.2 – A switch of an electronic circuit

According to the Figure 3.3 given below, when data stored in Secondary Storage is sent to the Main Memory and when it is sent to the Central Processing Unit from there, that data are converted to a binary code.

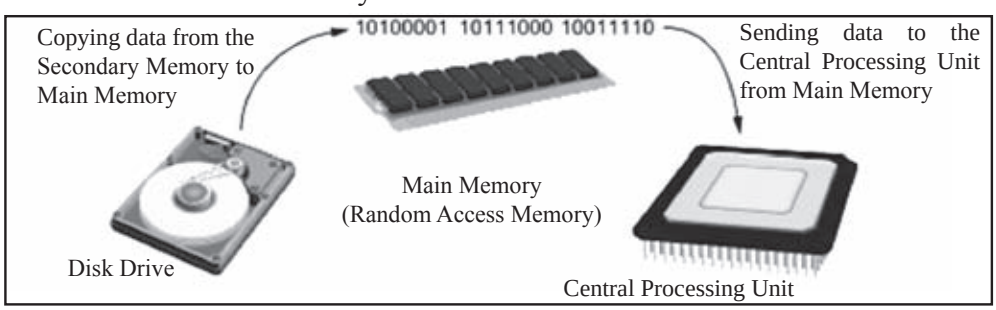


Figure 3.3 – How data is sent to the Central Processing Unit from the Secondary Storage

Let us consider the instance where Binary numbers are used for computer colours. Any colour can be made with the combination of different degrees of red, green and blue.

These can be represented as RGB (Red, Green, Blue) and the value of any colour ranges from 0 to 255.

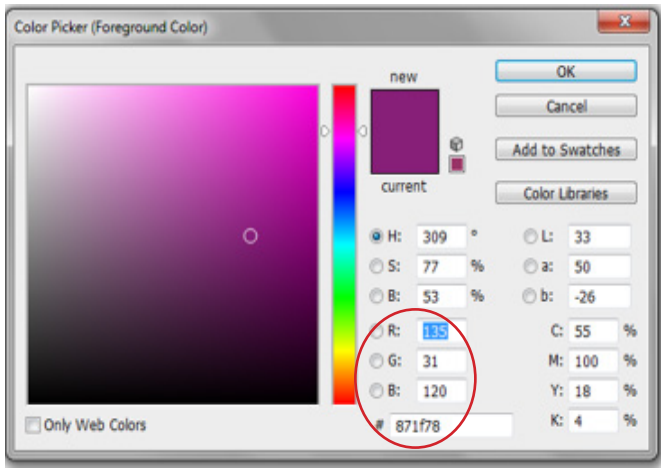


Figure 3.4 – Colour representation in computer

For instance, if you need to use dark purple for the background of a document, that colour can be represented in the computer as "135, 31, 120" (Figure 3.4). With these numbers, the colour combination for the above colour is represented in decimal numbers. Binary numbers for 135, 31 and 120 are 10000111_2, 11111_2, and 1111000_2.

3.2 Decimal, Binary, Octal and Hexa-Decimal Number Systems

3.2.1 Decimal Number System

Each number system is made of a Unit, Number and Base / Radix.

Unit

Unit is a single object. For instance, a mango, a Rupee, and a day can be considered a unit.

Number

A number is a symbol which represents a unit or quantity.

Base / Radix

A number of symbols used in a number system is called the base/radix. The base of any number system is indicated in decimal numbers.

From our childhood, we have learnt to perform calculations using decimal Number System which consists of digits from 0 to 9.

Normally, the base value of decimal numbers are not mentioned, but for the other numbers the base value has to be mentioned. The digits that are used in the decimal number system are as follows;

Table 3.2 – Digits of Decimal Number System

Number System	Decimal Number System or base 10 number system
Base / Radix	10
Digits used	0, 1, 2, 3, 4, 5, 6, 7, 8, 9

Let us study how a number included in the decimal number system is formed.

Example

Let us consider how the number 25 is formed.
25 is formed with the addition of 20 and 5.

$$25 = 20 + 5$$
$$= (2 \times 10) + (5 \times 1)$$
$$= (2 \times 10^1) + (5 \times 10^0)$$

These positional values such as 10^0, 10^1, 10^2 are called Weighting Factors of decimal number system. This number can be shown on a counting frame (abacus). (Figure 3.5)

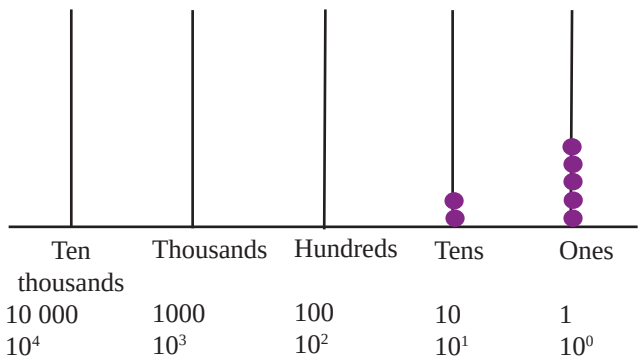


Figure 3.5 – Decimal number representation of 25

This can be shown as given below, as well.

2 5

$5 \times 10^0 = 5$

$2 \times 10^1 = 20$

25

Example

Next, let us consider how a decimal number is formed.

3 0 2. 7 5 - decimal number

10^2 10^1 10^0 10^{-1} 10^{-2} - weighting factor

$= (3 \times 10^2) + (0 \times 10^1) + (2 \times 10^0) + (7 \times 10^{-1}) + (5 \times 10^{-2})$

$= 300 + 0 + 2 + \frac{7}{10} + \frac{5}{100}$

$= 300 + 0 + 2 + 0.7 + 0.05$

$= 302.75$

302.75

$5 \times 10^{-2} = 0.05$

$7 \times 10^{-1} = 0.7$

$2 \times 10^0 = 2$

$0 \times 10^1 = 0$

$3 \times 10^2 = 300$

302 .75

3.2.2 Binary Number System

Though we use the decimal number system when we input numbers as data or instructions, the computer represents these data as 0 and 1. The number system which consists of 0 and 1 is the binary number system.

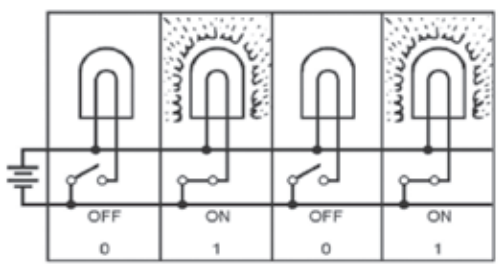


Figure 3.6 – Electronic circuit

The digits for the binary number system is given below. (Table 3.3)

Table 3.3 – Digits used in the Binary Number System

Number System	Binary Number System
Base	2
Digits used	0,1

For instance, let us consider 11101101_2.

1	1	1	0	1	1	0	1_2	- decimal number
↓	↓	↓	↓	↓	↓	↓	↓	
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	- weighting factor

The values such as 2^0, 2^1, 2^2, 2^3… are called the weighting factors of binary number system.

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	1	1	0	1	1	0	1

This number can be indicated in a binary base counting frame as given below. (Figure 3. 7)

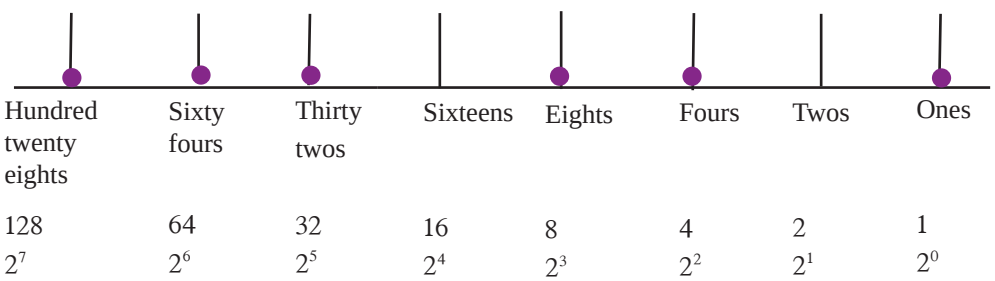


Figure 3.7 – Binary number representation.

The Binary number system is very important in computing and it contributes in the representation of a bit; the basic measuring unit of the computer. The smallest value and the highest value which can be seen in this number system is 0 or 1 respectively. This smallest value is called Bit [B][inary][Dig][it]

3.2.3 Octal Number System

The number system which uses eight digits: 0, 1, 2, 3, 4, 5, 6, 7 is called the octal number system.

Digits of the octal number system are given below. (Table 3.4)

Table 3.4 – Digits of Octal Number System

Number System	Octal Number System
Base	8
Digits used	0, 1, 2, 3, 4, 5, 6, 7

For instance, let us consider 236_8.

2 3 6 - octal number

↓ ↓ ↓

8^2 8^1 8^0 - weighting factor

The values such as 8^0, 8^1, 8^2, 8^3 … are called the weighting factors of the octal number system. This number can be represented as given below in a base eight counting frame. (Figure 3.7)

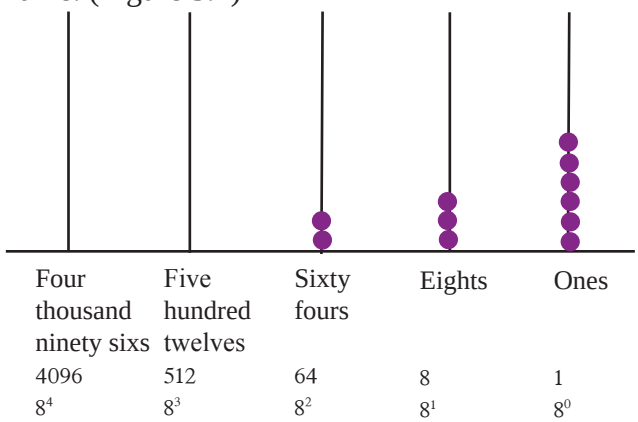


Figure 3.8 – Octal number representation

3.2.4 Hexa-Decimal Number System

The computer uses binary numbers and it is difficult for human beings to read them. Hence, the hexadecimal number system is used as it is easier for humans to use. Normally, calculations are performed using the ten fingers of the hands. Just imagine you have sixteen fingers on your hands. Then you can use sixteen numbers to count. In the hexadecimal number system, ten digits are used from 0 to 9 and for the other 6 digits, A, B, C, D, E and F symbols are used. Here, A, B, C, D, E and F are used to represent 10, 11, 12, 13, 14 and 15. (Table 3.5)

Table 3.5 – Comparison of Decimal and Hex-Decimal numbers

Decimal Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Hexa-Decimal Digit	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

The Digits of the hexadecimal number system are given in the table below. (Table 3.6)

Table 3.6 - Digits of Hexadecimal Number System

Number System	**Hexadecimal Number System**
Base	16
Digits Used	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F

When F the largest number of hexadecimal number system, is expressed in binary form, it can be indicated with 4 Bits. Thus, instead of using a binary number with 4 Bits, a single number in hexadecimal number system can be used. For example, Hexadecimal numbers are used to represent memory addresses of the computer.

You can see code "# 871F78" related to the dark purple colour shown in Figure 3.4. Here the value of the colour is started with "#" symbol. The colour value is indicated in the computer in hexa decimal numbers. Thus, the code for dark purple in the above example is "# 871F78". R,G,B values of this can be indicated from 0 to 255 in decimal numbers. If "#' or "&H" (ampersand) symbol is used in front of the value of any value, it is a hexa decimal number. Given below in Table 3.7 are the hexa decimal values and RGB values of dark purple colour.

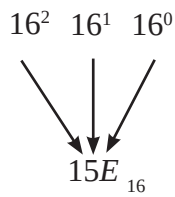
Table 3.7 – Hexadecimal Value of Dark Purple Colour

Name of Colour	**Colour**	**Hexadecimal Value**	**R**	**G**	**B**
Dark Purple		# 871F78 &H 871F78	135	31	120

For instance, let us consider $15E_{16}$

1 5 E_{16} -H exa-decimal number

16^2 16^1 16^0 - Weighting factor



Here, 16^0, 16^1, 16^2, 16^3….. values are called Hexadecimal Weighting Factors. This number can be represented on a sixteen base counting frame as below. (Figure 3.9)

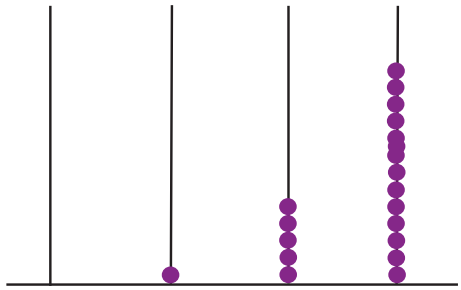


Figure 3.9 – Sixteen base number representation

Relationship among Decimal, Binary, Octal and Hexadecimal

Figure 3.8 - Relationship among Decimal, Binary, Octal and Hexadecimal

	Decimal	Binary	Octal	Hexadecimal	
	0	0	0	0	
2^0	1	1	1	1	$8^0, 16^0$
2^1	2	10	2	2	
	3	11	3	3	
	4	100	4	4	
	5	101	5	5	
	6	110	6	6	
	7	111	7	7	
2^3	8	1000	10	8	8^1
	9	1001	11	9	
	10	1010	12	A	
	11	1011	13	B	
	12	1100	14	C	
	13	1101	15	D	
	14	1110	16	E	
	15	1111	17	F	
2^4	16	10000	20	10	16^1
	17	10001	21	11	
	18	10010	22	12	
	19	10011	23	13	
	20	10100	24	14	
	21	10101	25	15	
	22	10110	26	16	
	23	10111	27	17	
	24	11000	30	18	

3.3 Most and Least Significant Positional Value of a Number

There are two separate methods to find the most and least significant values of decimal numbers and whole numbers. When a whole number is read from left to right, the number in the right most end is the least significant positional value and the number in the left most end which is not 0 is the most significant positional value. (Figure 3.10)

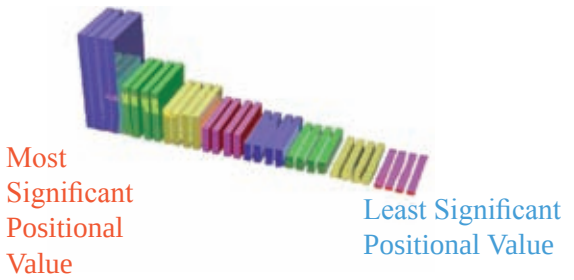


Figure 3.10 - Most and Least Significant Positional Values

In decimal numbers, the value in the right extreme after the decimal point which is not 0 becomes the least significant positional value and the number in the left extreme of the decimal point which is not 0 becomes the most significant positional value.

3.3.1 Most Significant Digit (MSD) and Least Significant Digit (LSD)

Given below in Table 3.9 are the most and least significant digits of a round figure or a decimal number.

Table 3.9 – The Most and Least Significant Positional Value of a number

Number	MSD	LSD
329	3	9
1237.0	1	7
58.32	5	2
0.0975	9	5
0.4	4	4

You can use the same method used for the decimal number system to find the most and least significant positional digits of binary, octal and hexadecimal numbers.

Activity

Find the most significant digit and the least significant digit of the following numbers.
(i) 56870_{10} (ii) 154.01_{10} (iii) 23.080_{8} (iv) *AD* 239_{16}
(v) 0.00110_{2}

3.3.2 Most Significant Bit (MSB) and Least Significant Bit (LSB)

Only the Binary Number System is used to find the most significant bit (MSB) and the least significant bit (LSB). There are two ways to find this using decimal numbers and whole numbers.

In a whole number, read from left to right, the value in the right extreme is the least significant bit and the value in the left extreme which is not 0 is the most significant bit. In binary decimal numbers, the value in the right extreme of the decimal point which is not 0 is the least significant bit and the value in the left extreme of the decimal point which is not 0 is the most significant bit.

Table 3.10 - The most significant bit and the least significant bit

Binary Number	MSB	LSB
1001	$1 = (2^3)$	$1 = (2^0)$
011.101	$1 = (2^1)$	$1 = (2^{-3})$

Activity

Find the most significant bit and the least significant bit of the following numbers.
(i) 1000_{2} (ii) 011101_{2} (iii) 0.11001_{2} (iv) 1.0010_{2}
(v) 0.00110_{2}

3.4 Converting Decimal Numbers to Binary, Octal and Hexa-Decimal Numbers

3.4.1 Conversion of Decimal numbers to numbers of other bases

All the data we input to the computer is taken by it as digits of binary number system; 0 and 1. Hence, the knowledge to convert a base ten number to another base is important. Here in this chapter, conversion of a decimal number to a binary number, octal number and a hexadecimal number is discussed.

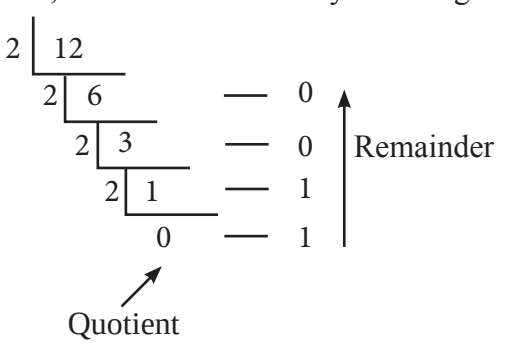
3.4.2 Conversion of Decimal Numbers to Binary Numbers

When a decimal number is converted to a binary number, the decimal number can be divided by two until the remainder is 0 and the remainder of the division can be written on the right side. After that, write all the remainders from the bottom to top to build the number.

Example

Converting number 12_{10} to a binary number.

➢ First, divide this number by 2 writing the remainders.

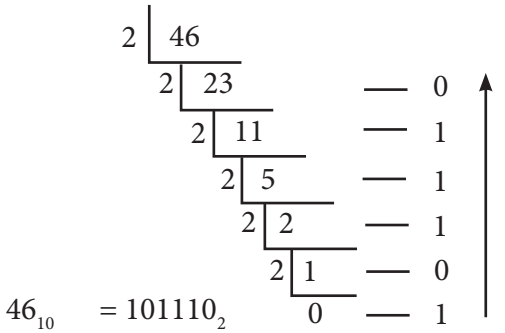


➢ Secondly, write down all the remainders from bottom to top.

$12_{10} = 1100_2$

Example

Converting 46_{10} to a binary number.



$46_{10} = 101110_2$

Activity

Convert the following decimal numbers to binary numbers.

(i) 155_{10} (ii) 472_{10} (iii)1163_{10}

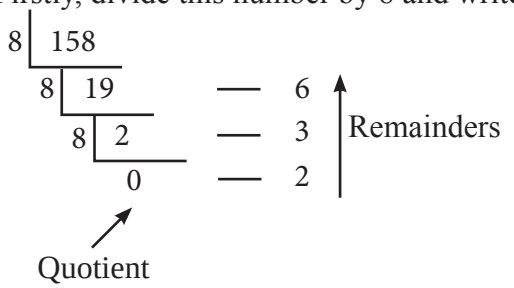
3.4.3 Converting Decimal Numbers to Octal Numbers

Here, divide the given number by 8 until the remainder is 0 and write the remainders from bottom to top.

Example

Converting 158_{10} to an octal number.

- Firstly, divide this number by 8 and write down the remainder.



- Secondly, write down all the remainders from bottom to top.

$158_{10} = 236_8$

Activity

Convert the following decimal numbers to octal numbers.

(i) 155_{10} (ii) 472_{10} (iii) 1163_{10}

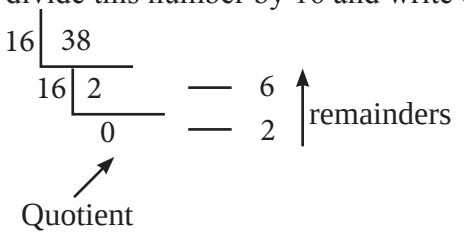
3.4.4 Converting Decimal Numbers to Hexadecimal Numbers

Here, divide the number by 16 until the remainder is 0 and write down the remainders from bottom to top.

Example

Converting number 38_{10} to a hexadecimal number.

➢ Firstly, divide this number by 16 and write down the remainders.

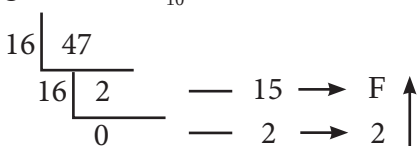


➢ Secondly, write down all the remainders from bottom to top.

$38_{10} = 26_{16}$

Example

Converting number 47_{10} to a hexadecimal number.



$47_{10} = 2F_{16}$

Activity

Convert the following decimal numbers to hexadecimal numbers.

(i) 256_{10} (ii) 478_{10} (iii) 1963_{10}

3.5 Conversion among Binary, Octal, Hexadecimal and Decimal Numbers

We have converted decimal numbers (base ten) to binary, octal and hexadecimal numbers earlier. Now let us consider how to convert binary numbers to decimal numbers, octal numbers to decimal numbers and hexadecimal numbers to decimal numbers. (Figure 3.11)

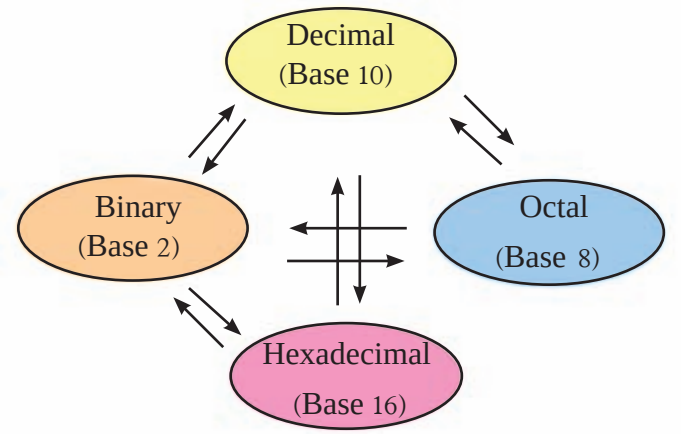


Figure 3.11 – Conversion between number systems

3.5.1 Converting Binary Numbers to Decimal Numbers

Example

Converting number 1101_2 to a decimal number.

$$\begin{array}{cccc} 1 & 1 & 0 & 1 \\ \downarrow & \downarrow & \downarrow & \downarrow \\ 2^3 & 2^2 & 2^1 & 2^0 \end{array}$$

$$\begin{aligned} 1101_2 &= (1\times2^3) + (1\times2^2) + (0\times2^1) + (0\times2^0) \\ &= (1\times8) + (1\times4) + (0\times2) + (1\times1) \\ &= 8 + 4 + 0 + 1 \end{aligned}$$

$$1101_2 = 13_{10}$$

1101_2

$1\times2^0 = 1$

$0\times2^1 = 0$

$1\times2^2 = 4$

$1\times2^3 = 8$

13

$1101_2 = 13_{10}$

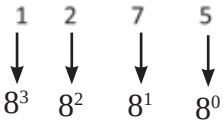
Activity

Convert the following binary numbers to decimal numbers.
(i)101_2 (ii) 111010110_2 (iii)1010010111_2

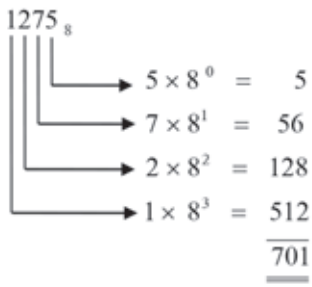
3.5.2 Converting Octal Numbers to Decimal Numbers

Example

Converting number 1275_8 to a decimal number.



$$1275_8 = (1\times8^3) + (2\times8^2) + (7\times8^1) + (5\times8^0)$$
$$= (1\times512) + (2\times 64) + (7\times8) + (5\times1)$$
$$= 512 + 128 + 56 + 5$$
$$1275_8 = 701_{10}$$



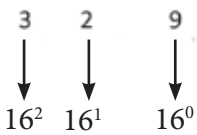
Activity

Convert the following octal numbers to decimal numbers.
(i) 230_8 (ii) 745_8 (iii) 2065_8

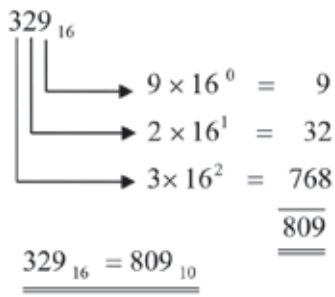
3.5.3 Converting Hexadecimal Numbers to Decimal Numbers

Example

Converting number 329_{16} to a decimal number.

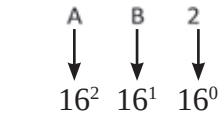


$$329_{16} = (3\times16^2) + (2\times16^1) + (9\times16^0)$$
$$= (3\times256) + (2\times16) + (9\times1)$$
$$= 768 + 32 + 9$$
$$329_{16} = 809_{10}$$

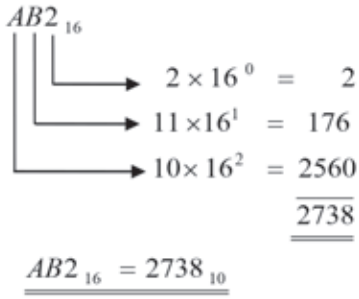


Example

Converting number $AB2_{16}$ to a decimal number.



$$AB2_{16} = (A \times 16^2) + (B \times 16^1) + (2 \times 16^0)$$
$$= (10 \times 256) + (11 \times 16) + (2 \times 1)$$
$$= 2560 + 176 + 2$$
$$AB2_{16} = 2738_{10}$$



Activity

Convert the following hexadecimal numbers to decimal numbers

(i) $1A_{16}$ (ii) $7EF_{16}$ (iii) $A49_{16}$

3.5.4 Converting Binary Numbers to Octal Numbers

From the digits used in the octal number system; 0, 1, 2, 3, 4, 5, 6, and 7, the largest digit is 7. We can indicate digit 7 as 111_2 in binary form. Thus 7; the largest digit in the octal number system, can be indicated in a binary form with 3 digits. Likewise, all the digits in the octal number system can be indicated in the three digit binary form. Given below in Table 3.11 are the binary forms of the digits used in eight base (octal) number system.

Table 3.11 – Indicating octal digits in decimal and binary numbers.

Decimal Number	Octal Number	Binary Number
0	0	000
1	1	001
2	2	010
3	3	011
4	4	100
5	5	101
6	6	110
7	7	111

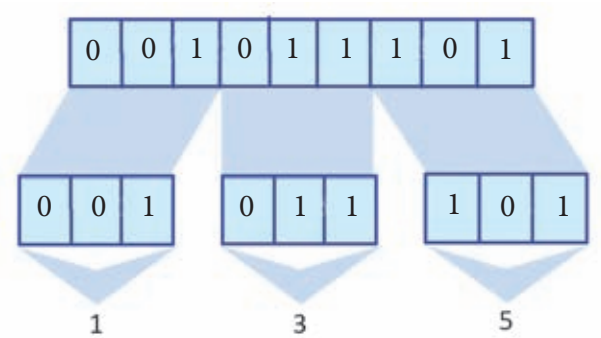
As per the above table, three bits are used when indicating an octal number in binary form. ($8 = 2^3$)

Let us consider how a binary number is converted to an octal number.

Example

Converting 1011101_2 to an octal number.

- First, divide the number into three bits from the right corner to the left corner. If the last cluster in the left corner does not consist of 3 bits, add 0s to complete.
- Write each octal number separately for each cluster.
- Then write these clusters in octal digits.
- Write these digits in order from the left corner to the right corner.



$1011101_2 = 135_8$

Activity

Convert the following binary numbers to octal numbers.

(i) 10011001_2 (ii) 111100111_2 (iii) 10101010110_2

3.5.5 Converting Binary Numbers to Hexadecimal Numbers

From the symbols used in the hexadecimal number system, the value represented by "F" possesses the largest numerical value. This can be indicated as a four-bit binary number; 1111_2. Thus, all the digits in the hexadecimal number system can be indicated as four-bit binary numbers. Given below in Table 3.12 are the binary numbers for the digits used in the hexadecimal number system.

Table 3.12 – Indicating hexadecimal digits in decimal and binary numbers.

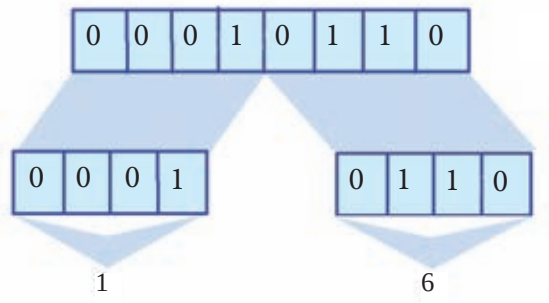
Decimal Number	Hexadecimal Number	Binary Number
0	0	0000
1	1	0001
2	2	0010
3	3	0011
4	4	0100
5	5	0101
6	6	0110
7	7	0111
8	8	1000
9	9	1001
10	A	1010
11	B	1011
12	C	1100
13	D	1101
14	E	1110
15	F	1111

As shown in the table above (Table 3.12), four bits are used to indicate a hexadecimal number in binary form. ($16 = 2^4$)

Example

Converting number 10110_2 to a hexadecimal number.

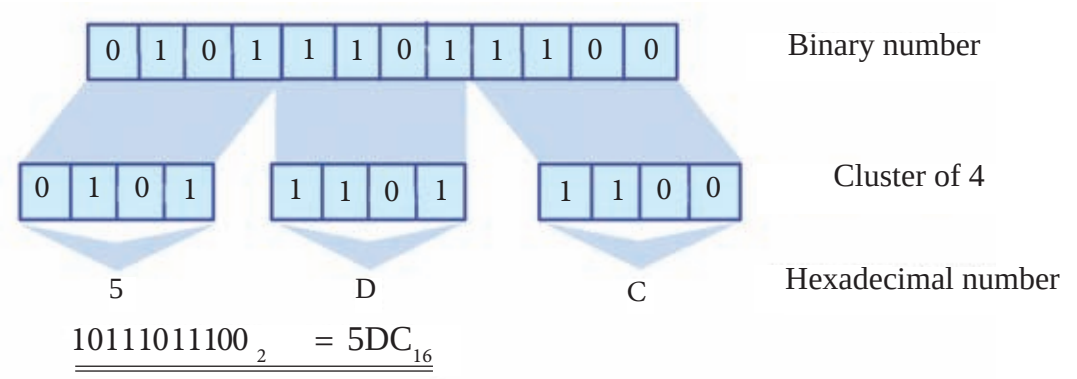
- First, divide the number into four-bit clusters from the right corner to the left corner.
- Write hexadecimal numbers separately for each cluster.
- Write these numbers in order from the left corner to the right corner and write down the base.



$10110_2 = 16_{16}$

Example

Converting number 10111011100_2 to a hexadecimal number.



$10111011100_2 = 5DC_{16}$

Activity

Convert the following binary numbers to hexadecimal numbers.

(i) 11011010_2 (ii) 11111001101_2 (iii) 10011100011_2

3.5.6 Converting Octal numbers to Binary Numbers

We have learned above that an octal number can be indicated in three digits when it is converted to a binary number.

Thus, each digit in octal numbers should be written in three digits when it is converted to base two.

Example

Converting number 457_8 to a binary number.

- Firstly, write each digit in octal number in three bits.
- Secondly, write down all the bits together to get the binary number for the octal number.

4	5	7
100	101	111

$457_8 = 100101111_2$

Activity

Convert the following octal numbers to binary numbers.

(i) 10_8 (ii) 245_8 (iii) 706_8

3.5.7 Converting Octal numbers to Hexadecimal Numbers

Example

Converting number 1057_8 to a hexadecimal number.

- First, write each digit in octal number in three bits.
- Divide the binary number you get into four-bit clusters from the right corner to the left corner.
- Write the related hexadecimal number for each cluster.

1	0	5	7
001	000	101	111

00 1 0	0 0 1 0	1111
2	2	15
2	2	F

$1057_8 = 22F_{16}$

Activity

Convert the following octal numbers to hexadecimal numbers

(i) 320_8 (ii) 475_8 (iii) 1673_8

3.5.8 Converting Hexadecimal Numbers to Binary Numbers

You have learnt earlier that any symbol in a hexadecimal number can be written in a four-bit binary number. Thus, when a hexadecimal number is converted to a binary number, each digit in that number should be indicated in a four-bit binary number.

Example

Converting number 74_{16} to a binary number.

7	4
0111	0100

$74_{16} = 1110100_2$

Converting number $2AE_{16}$ to a binary number.

2	*A*	*E*
0010	1 010	1110

$2AE_{16} = 1010101110_2$

Activity

Convert the following hexadecimal numbers to binary numbers.

(i) 78_{16} (ii) $B2C_{16}$ (iii) $4DEF_{16}$

3.5.9 Converting Hexadecimal Numbers to Octal Numbers

First, the hexadecimal number should be converted to a binary number and then it should be converted to an octal number.

Example

Converting number $23A_{16}$ to an octal number.

2	3	*A*
0010	0011	1010

001	0 0 0	1 1 1	010
1	0	7	2

$23A_{16} = 1072_8$

Activity

Convert the following hexadecimal numbers to octal numbers.

(i) 320_{16} (ii) $A7B_{16}$ (iii) $10ED_{16}$

Activity

1. Consider number "23_y". Here, 'y' is the base of the number system. From the number systems you have learned, as to which number system "23_y" belongs.
2. Convert the decimal number 83_{10} to a binary number. Show steps.
3. Convert the binary number 10110111_2 to an octal number. Show steps.
4. Convert the hexadecimal number $23D_{16}$ to a binary number.

5. Fill in the blanks in the table given below.

Table 3.13 – Several colours and their RGB values and the hexadecimal values

Name of the Colour	Colour	Hexadecimal Value	R	G	B
Dark purple		# 871F78	135	31	120
Light pink			255	182	193
Sky blue			50	153	204
Green			0	255	0
Yellow			255	238	0

3.6 Data Storage Capacity

A certain space is needed to store data in the computer. Data storage capacity is measured by units such as bits, bytes, kilobytes, Megabytes, Gigabytes, Terabytes and Petabytes. Let us understand how to arrange these different data storage capacities in order from the small unit to the big unit and to define the relationships between these as well.

3.6.1 Units to Measure Data Storage

Bit

This is the smallest unit used in the computer to store data. This word is coined from the words B inary Dig it A bit is the two binary digits; 0 and 1.

Byte

1 byte is 8 bits.

Nibble

A nibble is half of a byte or 4 bits. This unit is not commonly used like bits and bytes.

kilobyte

This consists of 1024 bytes. ($1024 = 2^{10}$) Kilobyte is written as KB or kbyte.

Megabyte

This consists of 1024 kilobytes (1024 = 210) or 1048576 bytes. Megabyte is written as MB or mbyte.

Gigabyte

One Gigabyte is made of 1024 Megabytes. (1024 MB) Gigabyte is written as GB or gbyte. It is wrong to write 'Gb' as it indicates gigabit.

Terabyte

One Terabyte is made of 1024 Gigabytes (1024 GB). This is written as TB.

Petabyte

One Petabyte is made of 1024 Terabytes (1024 TB).

In production of hard discs there are instances 1024 is considered as 1000.

Observation

Following are the relationships between units which measure data storage capacity.

8 bits	=	1 byte
4 bits	=	1 nibble
1024 bytes	=	1 kilobyte (KB)
1024 kilobytes	=	1 Megabyte (MB)
1024 Megabytes	=	1 Gigabyte (GB)
1024 Gigabytes	=	1 Terabyte (TB)
1024 Terabytes	=	1 Petabyte (PB)

Consider the examples given below to get an idea about the units above.

Table 3.14 – Approximate data storage capacity as text pages.

Name	Abbreviation	Approximate Bytes	Exact Bytes	Approximate Text pages
Byte	B	One	1	One text
Kilobyte	KB (or K)	Thousand	1024	½ page
Megabyte	MB	One million	1,048,576	500 pages
Gigabyte	GB	One billion	1,073,741,824	500,000 pages
Terabyte	TB	One trillion	1,099,511,627,776	500,000,000 pages

3.6.2 Capacities of Data Storage Devices

Different storage devices possess different storage capacities. The tasks fulfilled by these devices are also different. Let us study these different storage devices. (Figure 3.12)

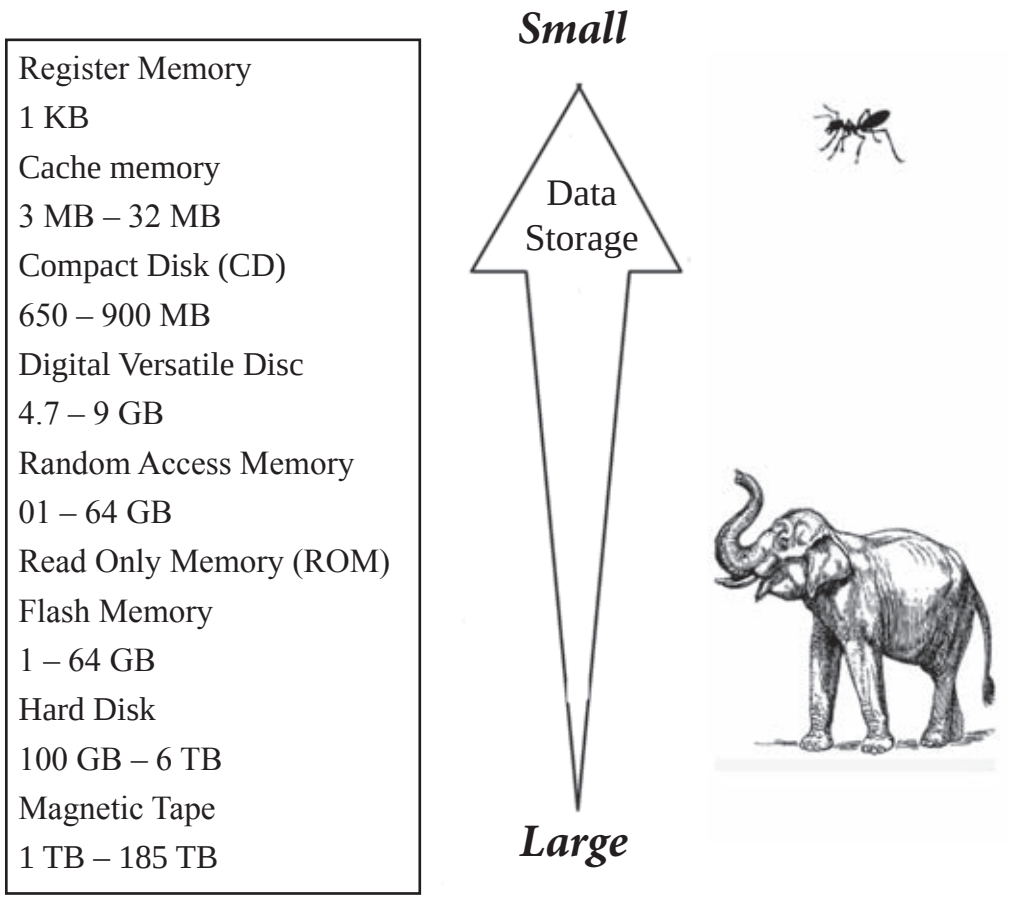


Figure 3.12 – Capacities of storage devices

When reading and writing data, the time spent to access the devices (access speed) is different. Consider the figure given below. (Figure 3.13)

3.6.3 Data Access Speed

Register Memory
Cache Memory
Random Access Memory
Read Only Memory
Flash Memory
Hard Disk
Digital Versatile Disc – DVD
Compact Disc (CD)
Magnetic Tape

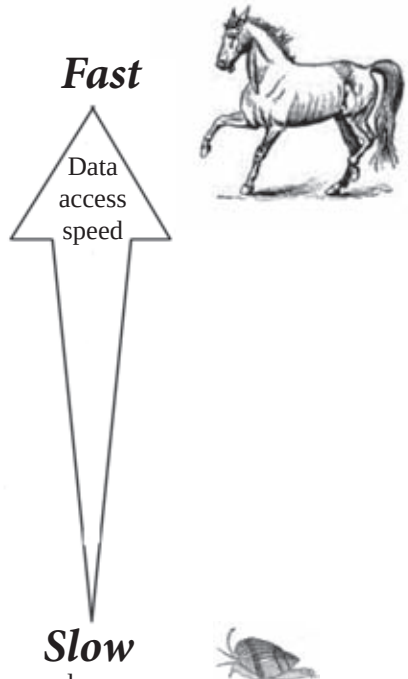


Figure 3.13 – Data access speed

3.6.4 Cost per unit Storage

For different storage devices, cost per a bit to store data is different. For instance, the cost is more for Register Memory and Cache Memory. The comparison is shown in the figure given below. (Figure 3.14)

Register Memory
Cache Memory
Random Access Memory
Read Only Memory
Magnetic Tape
Flash Memory
Hard Disk
Digital Versatile Disc – DVD

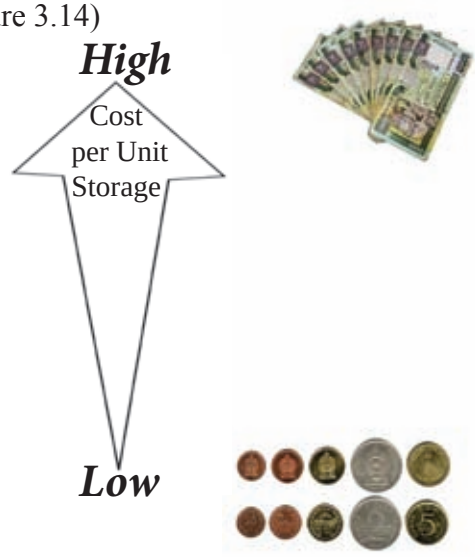


Figure 3.14 – Cost per unit storage

3.7 Coding Systems

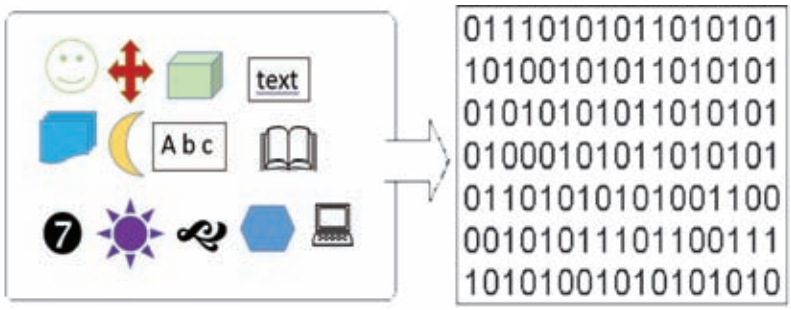


Figure 3.15 – Data you enter to the computer and computer data representation

According to the above figure (Figure 3.15), when you enter a data to the computer, it converts the data to different patterns made of 0 and 1. Thus, binary codes are used when storing numeric, alphabetic, special character, images and sounds in internal storage devices of computers.

In the beginning of the lesson, when you type 'A' on the keyboard, the code you get for 'A' is the bits pattern 1000001 (the binary code of letter 'A'). The number of bits used is 7. Thus, a combination made of a bit pattern is used to represent each data and the bits used for each code is different. Following are different coding systems used.

1. BCD Binary Coded Decimal
2. ASCII American Standards Code for Information Interchange
3. EBCDIC Extended Binary Coded Decimal Interchange Code
4. Unicode

3.7.1 BCD - Binary Coded Decimal

This coding system was used in the early stages of computing. In this system one digit is represented by 4 bits. This is used only to represent decimal numbers. Sixteen symbols ($2^4 = 16$) can be represented in this system. The table 3.15 shows the BCD codes for the 10 digits from 0 to 9.

Table 3.15 – Decimal Numbers and BCD Values

Decimal Value	BCD Value
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001

Example

Indicating number 37_{10} in BCD codes.

3 7_{10}

0011 0111

37_{10} = 00110111

Activity

Write the BCD values for the decimal values given below.

(i) 302 (ii) 2136 (iii) 17295

3.7.2 ASCII – American Standard Code for Information Interchange

Initially ASCII coding system used 7-bit binary digit. 128 characters can be represented using this coding system. ASCII is used to represent text. (Appendix - Table 3.17)

ASCII system is designed and approved by ANSI (American National Standard Institute).

Example

- **Text**

When the word 'School' is entered into the computer through the keyboard, write down how it is understood by the computer. (Use Appendix Table 3.7)

- First, write the decimal numbers for the symbols.

  S - 83 c - 99 h - 104 o - 111 l - 108

- Write binary numbers for each value.

  S - 1010011 c – 1100011 h - 1101000 o - 1101111
  l - 1101100

- Write the associated code

  S c h o o l

  101001111000111101000110111111011111101100

Activity

Write down the ASCII code of "ICT" in binary numbers.

3.7.3 EBCDIC – Extended Binary Coded Decimal Interchange Code

We can write only 128 characters using ASCII system, but the EBCDIC code system allows the use of 256 characters. Here, one symbol can be written with a binary number which consists of 8 bits. Hence, 256 characters can be represented using this system. This system was used in IBM main frame computers. The table below shows that there are different EBCDIC codes for the 26 different capital letters and 26 different EBCDIC codes for the 26 simple letters in this system.

Table 3.16 – EBCDIC values for English capital and simple letters

Uppercase			Lowercase		
	EBCDIC			**EBCDIC**	
Character	In Binary	In Hexa Decimal	Character	In Binary	In Hexa Decimal
A	1100 0001	C1	a	1000 0001	81
B	1100 0010	C2	b	1000 0010	82
C	1100 0100	C3	c	1000 0011	83
D	1100 0101	C4	d	1000 0100	84

3.7.4 Unicode System

Though 128 characters can be used in the ASCII system and 256 characters can be used in the EBCDIC system for data representation. For example, these systems cannot be used for Sinhala, Japanese, Chinese and Tamil languages as there are more than 256 characters. Hence Unicode system was designed according to a standard to represent 65536 different symbols of 16 bits (2^{16} = 65536).

As per the figure given below (Figure 3.16), shows the Unicode system can be used to represent Sinhala and Tamil letters, and special symbols and picture symbols.

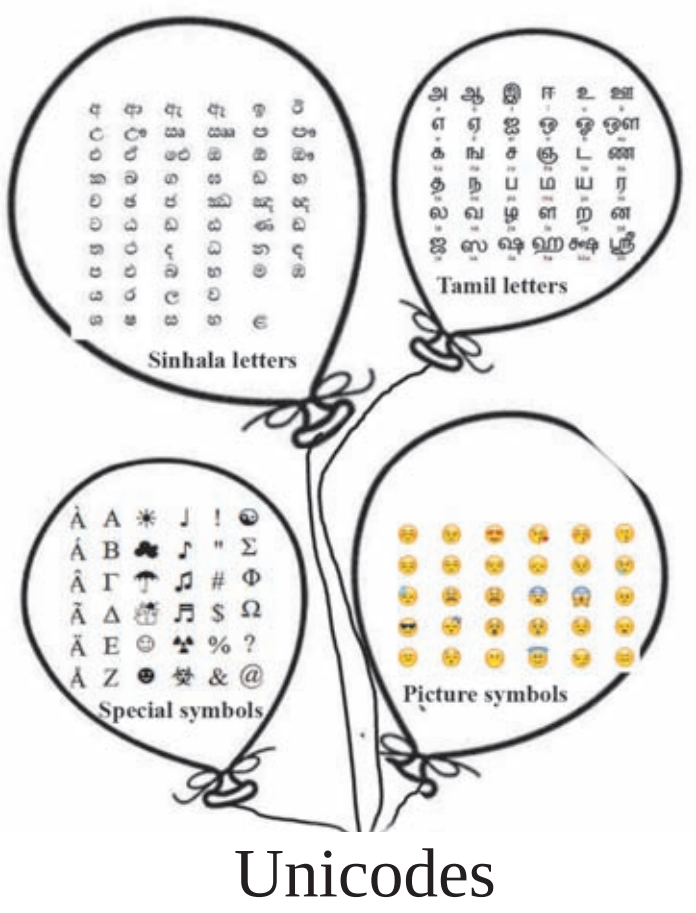


Figure 3.16 – Occasions Unicode are used

Unicode system uses unique number for each number, text or symbol in any or Operating System.

Example

- **Picture and Graphic Data**

Given below (Figure 3.17) is a close up or a highly enlarged image of photograph. A photograph consists of pixels (dots) made of different colours in big grid. Computer graphic data such as pictures, frames of a movie or frames of an animation consist of various colours. The picture given below consists of a number of different colours.

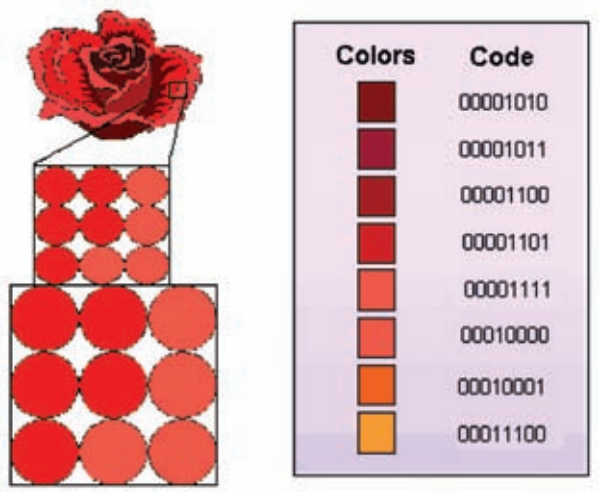


Figure 3.17 – Colours in a picture and their binary values.

- **Sound**

As shown in the figure below (Figure 3.17) is the sound emitted from a speaker is normally represented as analog waves. However, all data in computer are digital data and those are made of bytes. Hence, sound which comes as a analog data is converted to a digital data. Thus, a sound is also represented in a bits pattern made of 0s and 1s in a computer.

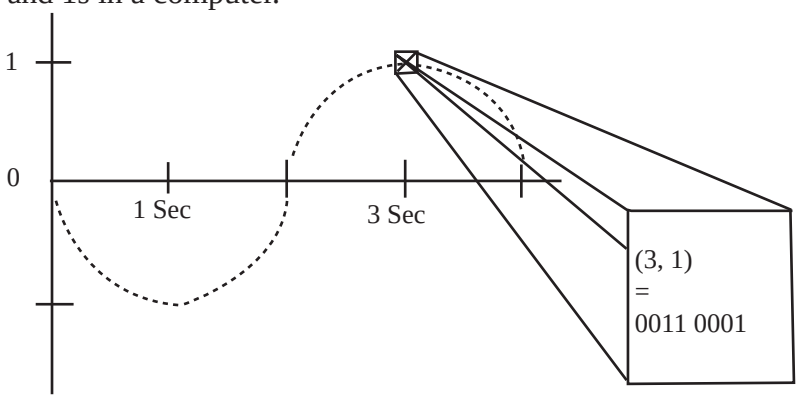


Figure 3.18 – Conversion of analog data of a sound to digital data

By this coding system, codes are classified to represent characters of all the international languages. The institution which initiated is the International Standard Institution and Unicode Consortium. Unicode is largely used in designing websites and newspapers. (Appendix - Table 3.18)

Activity

1. If 'A' character is represented as 1000001 in ASCII system, what is the ASCII code for letter 'F'?
2. What is the largest number presented in BCD (Binary Coded Decimal)?
3. What is the minimum number of bits required to present a hexadecimal number?
4. If 1000010_2 represents "B" in ASCII code, what is the ASCII code for letter "L"?
5. What are the coding systems used in computers? Explain the need to use such coding systems.

Summary

Number systems used for data representation

Number Systems		
Number Systems	**Base**	**Digits**
Binary	2	0, 1
Octal	8	0, 1, 2, 3, 4, 5, 6, 7
Decimal	10	0, 1, 2, 3, 4, 5, 6, 7, 8, 9
Hexadecimal	16	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F

❖ Code systems used in computers

Code System	Number of Bits Used
BCD - Binary Coded Decimal	4
ASCII - American Standard Code for Information Interchange Code	7
EBCDIC- Extended Binary Coded Decimal Interchange Code	8
Unicode	16

Appendix

ASCII and EBCDIC codes for characters and related decimal, octal and hexadecimal numbers

Table 3.17 - ASCII and EBCDIC codes for characters and related decimal, octal and hexadecimal numbers

Decimal	Hex	Octal	EBCDIC Character	ASCII Character		Decimal	Hex	Octal	EBCDIC Character	ASCII Character
00	00	000	NUL	NUL		128	80	200		
001	01	001	SOH	SOH		129	81	201	a	
002	02	002	STX	STX		130	82	202	b	
003	03	003	ETX	ETX		131	83	203	c	
004	04	004	PF	EOT		132	84	204	d	
005	05	005	HT	ENQ		133	85	205	e	
006	06	006	LC	ACK		134	86	206	f	
007	07	007	DEL	BEL		135	87	207	g	
008	08	010		BS		136	88	210	h	
009	09	011		HT		137	89	211	i	
010	0A	012	SMM	LF		138	8A	212		
011	0B	013	VT	VT		139	8B	213		
012	0C	014	FF	FF		140	8C	214		
013	0D	015	CR	CR		141	8D	215		
014	0E	016	SO	SO		142	8E	216		
015	0F	017	SI	SI		143	8F	217		
016	10	020	DLE	DLE		144	90	220		
017	11	021	DC1	DCI		145	91	221	j	

018	12	022	DC2	DC2		146	92	222	k	
019	13	023	TM	DC3		147	93	223	l	
020	14	024	RES	DC4		148	94	224	m	
021	15	025	NL	NAK		149	95	225	n	
022	16	026	BS	SYN		150	96	226	o	
023	17	027	IL	ETB		151	97	227	p	
024	18	030	CAN	CAN		152	98	230	q	
025	19	031	EM	EM		153	99	231	r	
026	1A	032	CC	SUB		154	9A	232		
027	1B	033	CU1	ESC		155	9B	233		
028	1C	034	IFS	FS		156	9C	234		
029	1D	035	IGS	GS		157	9D	235		
030	1E	036	IRS	RS		158	9E	236		
031	1F	037	IUS	US		159	9F	237		
032	20	040	DS	Space		160	A0	240		
033	21	041	SOS	!		161	A1	241		
034	22	042	FS	"		162	A2	242	s	
035	23	043		#		163	A3	243	t	
036	24	044	BYP	$		164	A4	244	u	
037	25	045	LF	%		165	A5	245	v	
038	26	046	ETB	&		166	A6	246	w	
039	27	047	ESC	'		167	A7	247	x	
040	28	050		(		168	A8	250	y	
041	29	051		)		169	A9	251	z	
042	2A	052	SM	*		170	AA	252		
043	2B	053	CU2	+		171	AB	253		
044	2C	054		,		172	AC	254		
045	2D	055	ENQ	-		173	AD	255	[	
046	2E	056	ACK	.		174	AE	256		
047	2F	057	BEL	/		175	AF	257		
048	30	060		0		176	B0	260		
049	31	061		1		177	B1	261		
050	32	062	SYN	2		178	B2	262		
051	33	063		3		179	B3	263		
052	34	064	PN	4		180	B4	264		
053	35	065	RS	5		181	B5	265		
054	36	066	UC	6		182	B6	266		
055	37	067	EOT	7		183	B7	267		

056	38	070		8		184	B8	270		
057	39	071		9		185	B9	271		
058	3A	072		:		186	BA	272		
059	3B	073	CU3	;		187	BB	273		
060	3C	074	DC4	<		188	BC	274		
061	3D	075	NAK	=		189	BD	275	]	
062	3E	076		>		190	BE	276		
063	3F	077	SUB	?		191	BF	277		
064	40	100	Space	@		192	CO	300	{	
065	41	101		A		193	C1	301	A	
066	42	102		B		194	C2	302	B	
067	43	103		C		195	C3	303	C	
068	44	104		D		196	C4	304	D	
069	45	105		E		197	C5	305	E	
070	46	106		F		198	C6	306	F	
071	47	107		G		199	C7	307	G	
072	48	110		H		200	C8	310	H	
073	49	111		I		201	C9	311	I	
074	4A	112	CENT	J		202	CA	312		
075	4B	113	.	K		203	CB	313		
076	4C	114	<	L		204	CC	314		
077	4D	115	(	M		205	CD	315		
078	4E	116	+	N		206	CE	316		
079	4F	117	|	O		207	CF	317		
080	50	120	&	P		208	D0	320	}	
081	51	121		Q		209	D1	321	J	
082	52	122		R		210	D2	322	K	
083	53	123		S		211	D3	323	L	
084	54	124		T		212	D4	324	M	
085	55	125		U		213	D5	325	N	
086	56	126		V		214	D6	326	O	
087	57	127		W		215	D7	327	P	
088	58	130		X		216	D8	330	Q	
089	59	131		Y		217	D9	331	R	
090	5A	132	!	Z		218	DA	332		
091	5B	133	$	[		219	DB	333		
092	5C	134	*	\		220	DC	334		

093	5D	135	)	]		221	DD	335		
094	5E	136	;	^		222	DE	336		
095	5F	137		_		223	DF	337		
096	60	140	-	`		224	E0	340		
097	61	141	/	a		225	E1	341		
098	62	142		b		226	E2	342	S	
099	63	143		c		227	E3	343	T	
100	64	144		d		228	E4	344	U	
101	65	145		e		229	E5	345	V	
102	66	146		f		230	E6	346	W	
103	67	147		g		231	E7	347	X	
104	68	150		h		232	E8	350	Y	
105	69	151		i		233	E9	351	Z	
106	6A	152		j		234	EA	352		
107	6B	153	,	k		235	EB	353		
108	6C	154	%	l		236	EC	354		
109	6D	155	_	m		237	ED	355		
110	6E	156	>	n		238	EE	356		
111	6F	157	?	o		239	EF	357		
112	70	160		p		240	F0	360	0	
113	71	161		q		241	F1	361	1	
114	72	162		r		242	F2	362	2	
115	73	163		s		243	F3	363	3	
116	74	164		t		244	F4	364	4	
117	75	165		u		245	F5	365	5	
118	76	166		v		246	F6	366	6	
119	77	167		w		247	F7	367	7	
120	78	170		x		248	F8	370	8	
121	79	171		y		249	F9	371	9	
122	7A	172	:	z		250	FA	372		
123	7B	173	#	{		251	FB	373		
124	7C	174	@	|		252	FC	374		
125	7D	175	`	}		253	FD	375		
126	7E	176	=	~		254	FE	376		
127	7F	177	"	DEL		255	FF	377		

Table 3.18 – ASCII and EBCDIC values related to letters

Unicode for Sinhala and Tamil letters

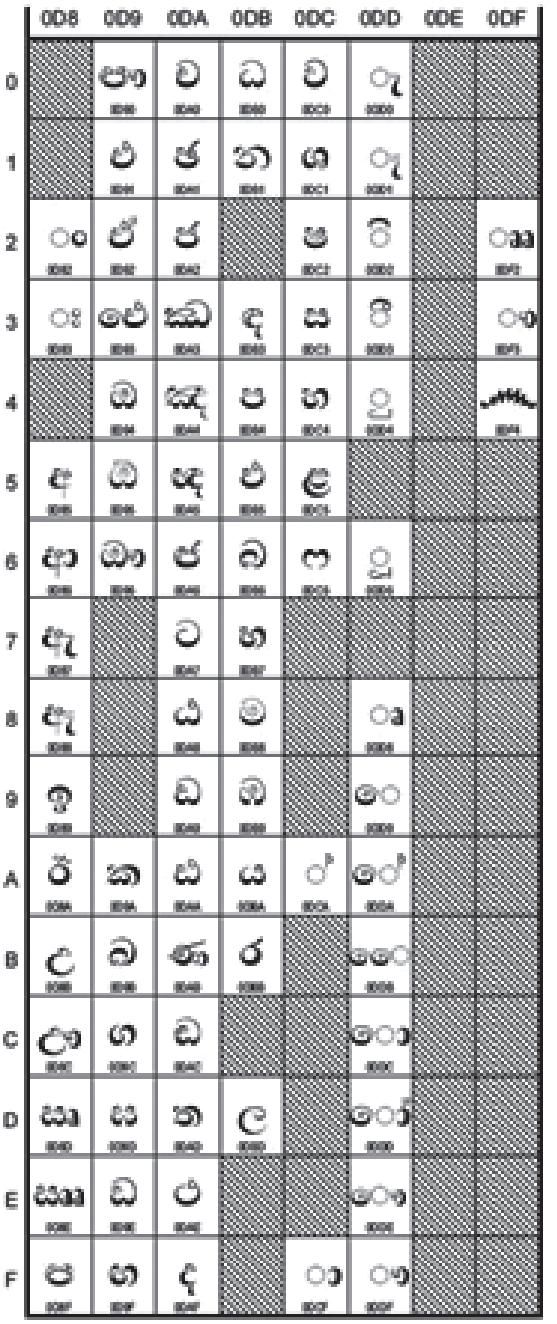


Table 3.18 – Sinhala Unicode

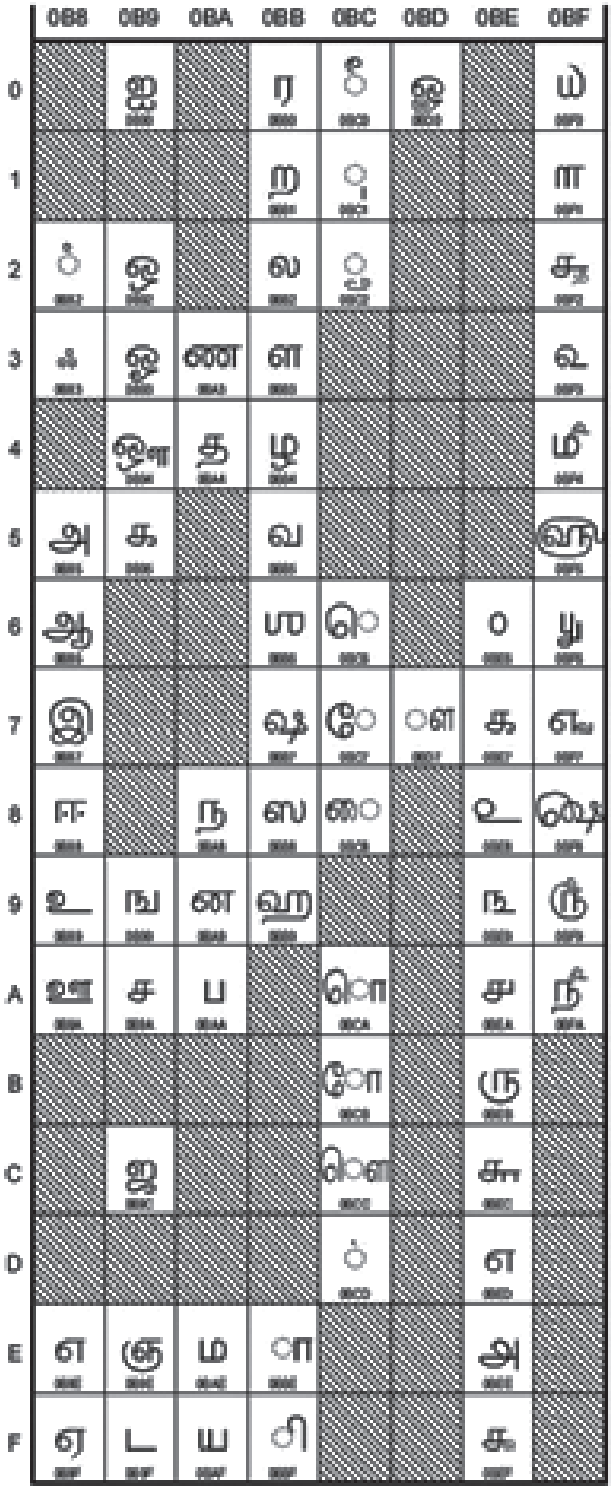


Table 3.19 – Tamil Unicode

4 Logic Gates with Boolean Functions

In this chapter you will learn about,

- signals used in electronic science
- basic logic gates and combinational logic gates
- representing Boolean expressions using truth tables
- creating combinational logic gates based on basic logic gates
- drawing digital circuits for Boolean expressions
- Constructing truth tables after writing Boolean expressions for digital circuits
- Integrated Circuits
- practical usage of logic gates

4.1 Introduction

Communication happens in various ways among living beings in day to day life. Drumming was used in the past, as a method of communication. Further, a railway guard in a station blows a horn waving a green flag to signal that a train is going to leave. A green light should be there for the train to start and if it is a red light, the signal is to stop.

Usually, two keys are used to open a safe and both keys are needed to open it. Before you start a journey in a car, all its doors should be closed properly. If at least one door is not closed properly, a light will be on or there will be a sound for the driver to signal it. When all the doors are closed, this signal will be stopped. Further, you should wear seat belts if you are seated in the front seats of a car. Otherwise there will be a signal to indicate this. Thus, as we use signals in our day to day life to make decisions, the computer also uses signals.

4.2 Logic Gates

Circuits which enable building of certain logical conditions using binary values and which enable making certain decisions, are called Logic Circuits. The Computer is made of a large number of complex digital circuits. These electronic circuits are designed as required connecting a large number of basic logical circuits called logic gates.

Central Processing Unit is made up of a collection of a large number of logic gates.

The following Figure 4.1 shows a circuit made up of basic. logic gates; AND, OR, and NOT.

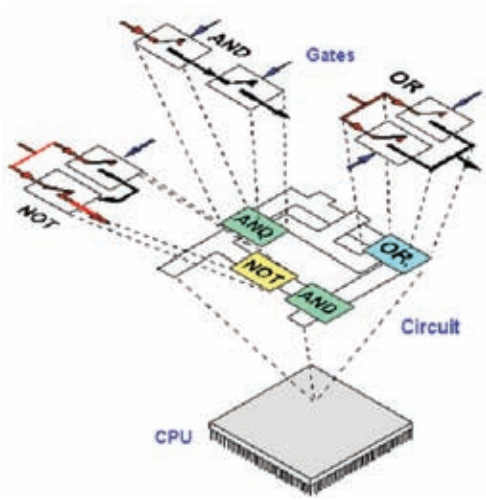


Figure 4.1 – Circuit with Basic Logic Gates

The function carried out by a logic gate is giving an output considering an input or several inputs.

There are numerous of technical methods to produce logic gates and its internal circuit consists of devices such as transistors, diodes and resistors.

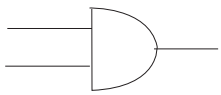
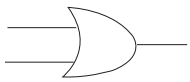
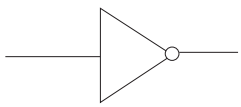
According to the way that the circuits are used, logic gates can be classified, into two types.

1. Basic Logic Gates

2. Combinational Logic Gates

4.3 Basic Logic Gates

There are three types of basic logic gates. Those are,

1. AND gate 
2. OR gate 
3. NOT gate 

4.3.1 AND Gate

Let us consider the example given below to understand AND logic.

- If the door of your computer lab is locked with a key and padlock, both door key and padlock key are needed to open that door. If both keys are there, you can open the door. If either door key or padlock key is used, you cannot open the door. Further, if keys are not there, you cannot open the door.

- Let us consider the simple series electronic circuit given below to understand AND operation.

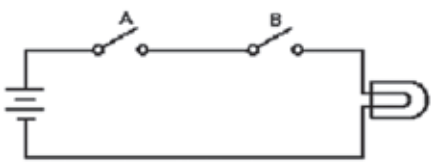


Figure 4.2–E lectronic circuit wheni nput Aa nd B value is 0.

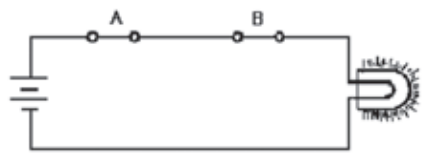


Figure 4.3 – Electronic circuit when input A and B value is 1.

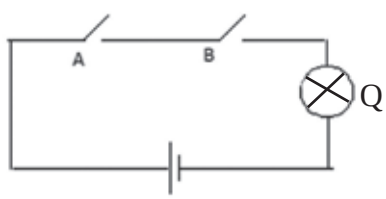


Figure 4.4 - Electronic circuit for AND logic gate.

Here, the two switches A and B, bulb Q and two batteries are connected in series. Let us consider the two switches as input and the bulb as output.

When both switches A and B are closed only, the bulb will be switched on. The bulb will not be switched on when either switch A or B is closed. When both switches are open, the bulb will not be switched on.

If Logic 1 indicates both switches are closed and the bulb is switched on (Figure 4.2) and if Logic 0 indicates when one switch is open and the bulb is switched off (Figure 4.3), the relationships between AND logic gate inputs and outputs are given below. (Table 4.1)

Table 4.1 – Nature of the bulb in the circuit for AND

A	B	Q
Open	Open	Switched off
Open	Closed	Switched off
Closed	Open	Switched off
Closed	Closed	Switched on

Table 4.2 – Truth Table for AND Logic Gate

A	B	Q
0	0	0
0	1	0
1	0	0
1	1	1

Here, Q=1 when both A and B input are in “1” state only. When either inputs are in “0” state Q = 0. This table is called the truth table for AND logic gate.

Observation

If at least one input is in "0" state, the output of AND gate is "0".

Four states (2^2 = 4) are shown in the table as this gate consists of two inputs.

Logic of AND gate is “A” AND“B”. According to Boolean expressions, it is represented as A.B

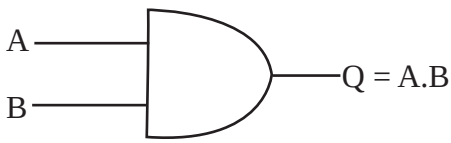


Figure 4.5 - The Boolean algebra expression and symbol for AND logic gate.

This AND logic gate consists of a minimum of two inputs and there are AND logic gates with more than two inputs.

Activity

1. Given below is an AND logic gate with three inputs; A, B and C. (Figure 4.6)

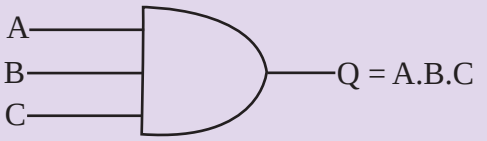


Figure 4.6 - AND logic gate with three inputs.

The above AND logic gate is equivalent to the circuit given below. (Figure 4.7)

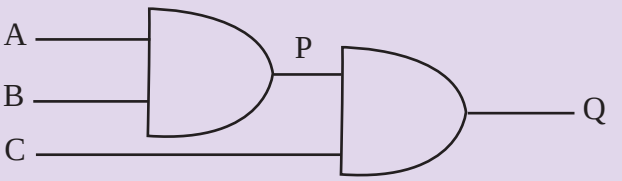


Figure 4.7 – Electronic circuit for AND logic gate with three inputs

I. Write down P which is the output of the AND logic gate for A and B inputs.

II. Write down Q which is the output of AND logic gate for P and C inputs.

The value of Q is equivalent to the output of AND logic gate with three inputs A, B and C.
Hence, the Boolean expression for this circuit is,

$Q = A.B.C$

There are 8 states in the Truth Table related to the above circuit. As there are 3 inputs, there are 8 states in the Truth Table. ($2^3 = 8$)

2. Fill in the table given below. Fill in column A.B column using the truth table for AND logic gate with 2 inputs. (Table 4.3) Fill in A.B.C subsequently.

Table 4.3 - Truth Table for AND logic gate with 3 inputs.

A	B	C	A.B	Q=A.B.C
0	0	0	0	.....
0	0	1	.....	0
0	1	0	0	.....
0	1	1	.....	.....
1	0	0	0	0
1	0	1	.....	.....
1	1	0	.....	0
1	1	1	.....	.....

4.3.2 OR Gate

Let us consider the following example to understand OR logic.

- A bus passenger who is in a two door bus can get down from the front or back door.
- If there are several routes to reach your home, you can use any of these routes,

Let us consider the simple electronic circuit given below. (Figure 4.8 and 4.9)

Here A and B two switches and Q bulb are connected to two batteries in parallel. Let us consider the two switches A and B as input and the bulb as output.

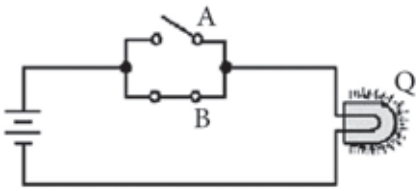


Figure 4.8 - Electronic circuit when one logical state of the two inputs is 1

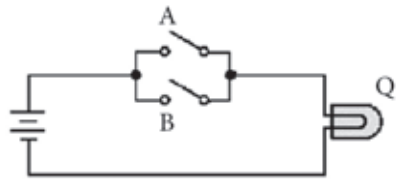


Figure 4.9 – Electronic circuit when the logical state of the two inputs is 0.

The bulb of this circuit will be 'on' when either A or B switch or both A and B switches are closed. This can be tabulated as follows. (Table 4.4)

Table 4.4 - Nature of the bulb of the electronic circuit for OR gate

A	B	Q
Open	Open	Switched off
Open	Closed	Switched on
Closed	Open	Switched on
Closed	Closed	Switched on

When either of the switches A or B is "on", it is represented as state "1" (Figure 4.7). The state when both switches are open or the bulb is switched off (Figure 4.8) is indicated as logic “0”. This table is called the Truth Table for OR logic gate. (Table 4.5)

Table 4.5 - Truth Table for OR logic gate.

A	B	Q
0	0	0
0	1	1
1	0	1
1	1	1

Observation

At least one input should be 1 for the output of OR gate to be 1.

When both input of the above OR gate is 0, output will always be 0. Further, when all inputs are 0 of an OR logic gate with more than 2 inputs, output will always be 0.

In the above table (Table 4.5), when A=1 or B=1 or both A and B are in state "1", Q=1. This table is called the Truth Table related to the OR logic gate.

In Boolean algebra, this operation is symbolically represented as “A + B”. Note that this is not the addition operation you use in Mathematics to add numbers. Further, it is not the plus mark to indicate a plus number. Hence, it represents “A OR B”.

Given below in Figure 4.9 is the Boolean algebra expression related to the OR gate and the circuit symbols.

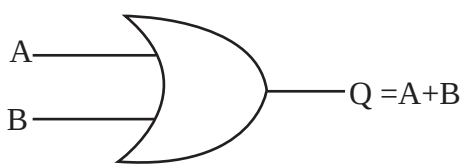


Figure 4.10 - The Boolean algebra expression and the symbol for OR logic gate.

Activity

Following is the logical circuit for AND to get the Q output from A, B and C inputs. (Figure 4.11)

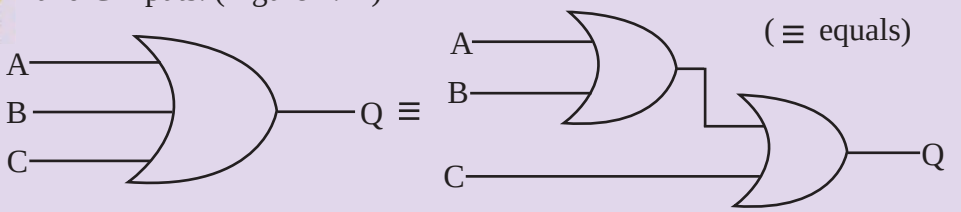


Figure 4.11 – OR logic gate with three inputs.

1. Write the Boolean expression for this.
2. Construct the Truth Table to obtain the above output.

4.3.3 NOT Gate

Let us learn about the complement symbol to understand the NOT gate. The task of the NOT gate is to provide the complement as the output. Thus, complement of "0" is "1" and the complement of "1" is "0".

The NOT gate is the electronic circuit that provides the complement as the output of the input. Let us consider the circuit given below. (Figure 4.12)

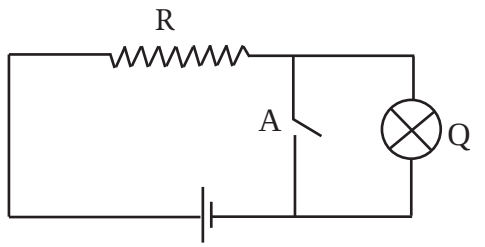


Figure 4.12 – Electronic circuit for NOT logic gate.

When the A switch is closed, the bulb is not switched on as no electricity runs through. However, when the A switch is open, the bulb will be switched on. When the input is A here, the complement of A is the output. In Figure 4.13 is the Boolean algebra expression related to the NOT operation and its circuit symbols.

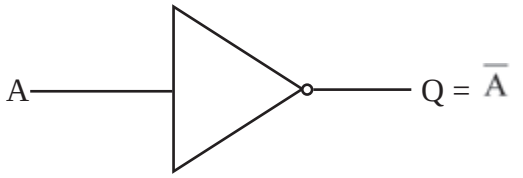


Figure 4.13 - Boolean algebra expression related to NOT logic gate and symbols.

Following is the truth table related to the NOT gate. (Table 4.6)

Table 4.6 - Truth Table related to the NOT logic gate.

A	Q
0	1
1	0

4.4 Combinational Logic Gates

The function of devices such as the computer, calculator, washing machine, microwave oven, mobile phone, modern televisions, digital clock, air condition etc is based on the function of logic gates. There are circuits which are designed with various logic gates to get the required output. Such combinational logic circuit can be designed using basic logic gates.

4.4.1 NOR Gate

The logic gate which indicates NOT OR (i.e. complement operation of the OR operation) is called the NOR gate. The logic of the NOR gate is the combination of OR and NOT to get the output from NOT after leading the output to NOT from OR gate. This can be shown as follows. (Figure 4.14)

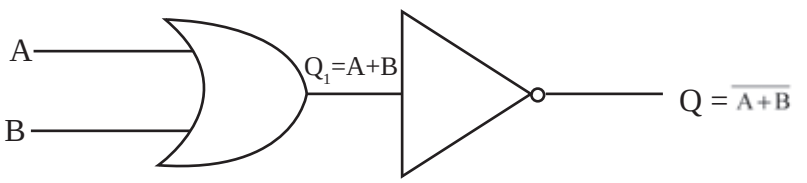


Figure 4.14 – Electronic circuit for the NOR logic gate.

The truth table for this can be built based on basic truth tables. (Table 4.7)

Table 4.7 - Truth Table for NOR logic gate based on basic Truth Tables.

A	B	$Q_1 = A+B$	$Q = \overline{A+B}$
0	0	0	1
0	1	1	0
1	0	1	0
1	1	1	0

Observation

When the both inputs of the NOR logic gate is 0, the output is always "1". Further, in an NOR logic gate with more than 2 inputs, when all those inputs are 0, output is always 1.

Thus, the NOR gate is equivalent to the OR and NOT gates connected in series. Following is the Boolean expression for the NOR gate and the circuit symbols.

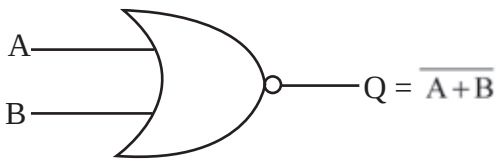


Figure 4.15 - Boolean expression for NOR gate and the circuit symbols

The logic circuit and the Truth Table related to this are given below. (Table 4.8)

Table 4.8 - Truth Table for the NOR logic gate

A	B	Q
0	0	1
0	1	0
1	0	0
1	1	0

Activity

The logic circuit with output Q and inputs A, B and C is given below. (Figure 4.16)

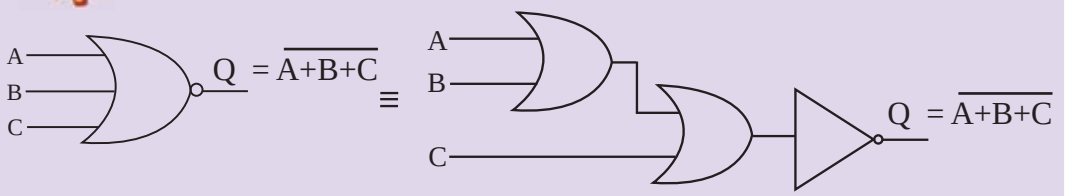


Figure 4.16 – NOR logic gate with three inputs

1. Write the Boolean expression for the above.
2. Construct the truth table.

4.4.2 NAND Gate

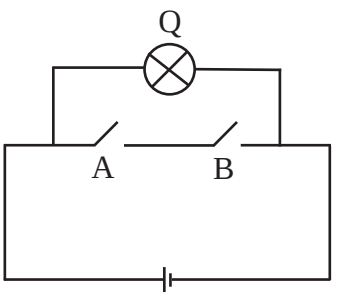


Figure 4.17 – Electronic circuit for the NAND logic gate

Here, the two switches A and B, and the bulb Q are connected to a battery. Let us consider the two switches as input and the bulb as output. When both A and B switches are closed only the bulb is not switched on. On all the other occasions, the bulb will be switched on.

The logic gate which indicates the complement operation of AND or NOT AND operation is called the NAND gate. This is equivalent to connecting output of AND gate to a NOT gate in series. This can be shown as follows. (Figure 4.18)

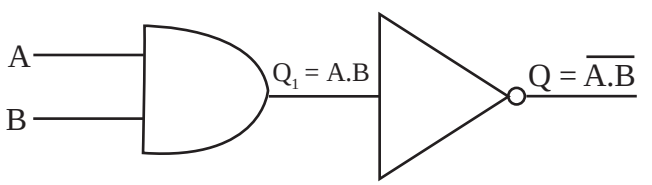


Figure 4.18 - Electronic circuit for NAND logic gate

The Truth Table for this logic based on the Truth Tables related to basic gates. (Table 4.9)

Table 4.9 - The Truth Table for the NAND logic gate based on basic Truth Tables.

A	B	Q = A.B	Q = $\overline{A.B}$
0	0	0	1
0	1	0	1
1	0	0	1
1	1	1	0

The Boolean symbol and expression to represent NAND can be shown as follows. (Figure 4.19)

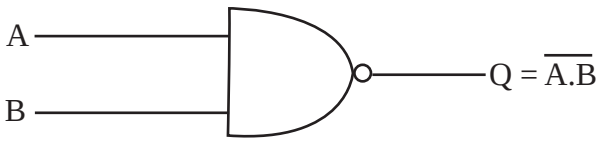


Figure 4.19 – Boolean expression and the symbol for NAND logic gate.

Truth Table for NAND logic gate is given below. (Table 4.10)

Table 4.10 - Truth Table for the NAND logic gate

A	B	Q = $\overline{A.B}$
0	0	1
0	1	1
1	0	1
1	1	0

Observation

When the both (or all) inputs of NAND logic gate are 1, the output is always 0.

Activity

The following is the NAND logic circuit with three inputs A, B and C with output Q. (Figure 4.20)

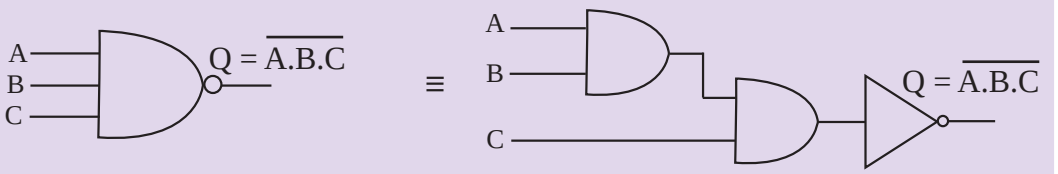


Figure 4.20 – NAND logic gate with three inputs

1. Write the Boolean expression for this.
2. Construct the Truth Table to get the above output.

4.5 Designing Logical Circuits Related to Boolean Expressions

Let us design a circuit with logic gates to get Boolean expression $Q=A.(\overline{A}+B)+\overline{B}$.

There are two inputs in this circuit. These are A and B. The logical circuit for the above Boolean expression is given below. (Figure 4.21)

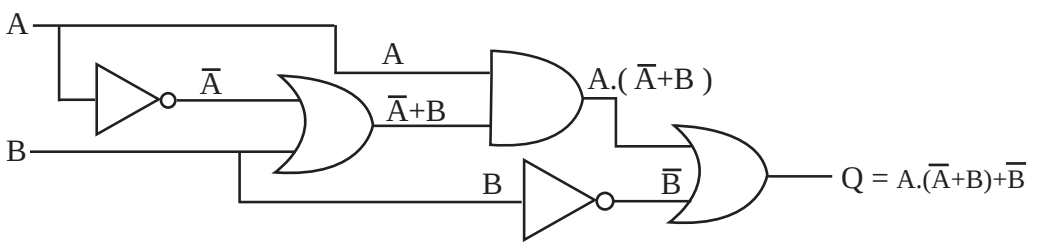


Figure 4.21 – The circuit for the Boolean expression $Q=A.(\overline{A}+B)+\overline{B}$

Activity

1. Draw circuits for the Boolean expressions given below and construct the related truth tables.

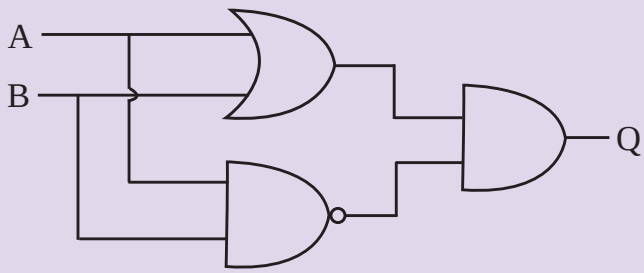
(a) A+A.B

(b) A.(A+B)

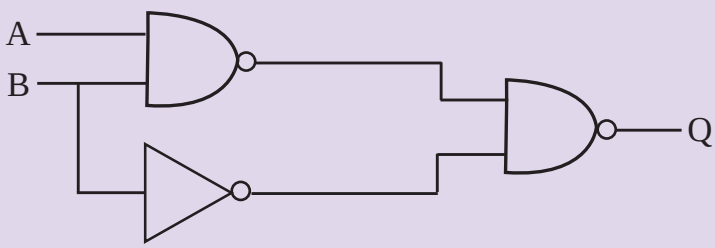
(c) (A+B).(A.$\overline{C}$)

2. Write Boolean expressions for the circuits given below and construct Truth Tables.

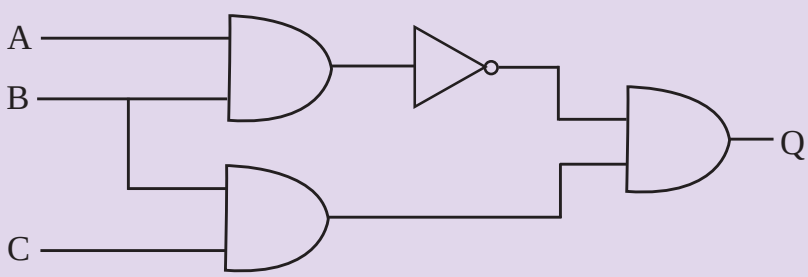
(a).



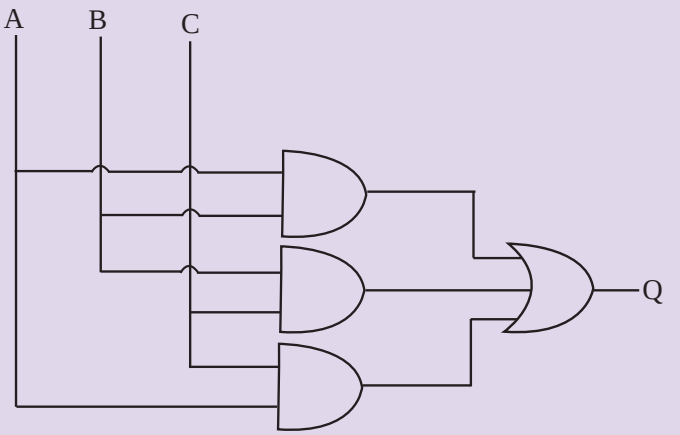
(b).



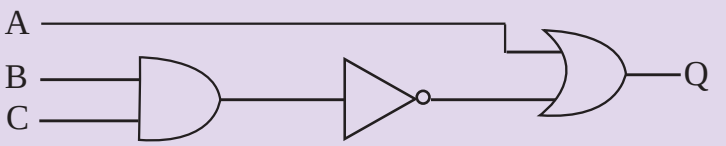
(c).



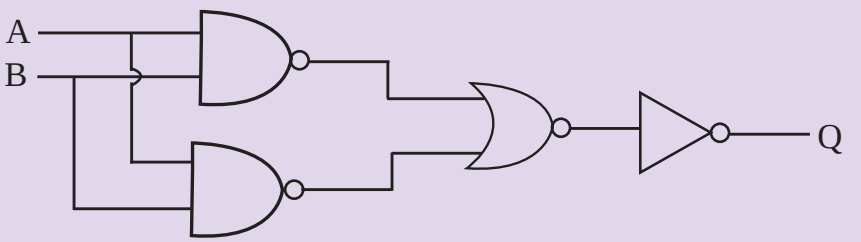
(d).



(e).



(f).



Activity

Use Multimedia Logic (MM Logic) software to draw all the logic circuits you have learnt in this chapter. Observe the function of the circuit. (http://www.softronix.com/logic.html)

4.6 Integrated Circuits

Integrated Circuits (ICs) are used to construct electronic circuits. A complex electronic circuit consists of various circuits. For instance, a modern television circuit and a mobile phone consist of many circuits. An integrated circuit is a type of circuit designed for a certain function with devices such as transistors, resistors, capacitors and diodes. Now there are methods to produce circuits in small sizes so that one circuit can be packed in one. Circuits produced in this way are called integrated circuits.

As per Figure 4.23, a micro processor is made of a large number of integrated circuits which use logic gates.

In these integrated circuits, there are logic gates. For instance, Figure 4.22 is a logic circuit which uses an AND gate. Thus, there are integrated circuits designed with the logic gates.

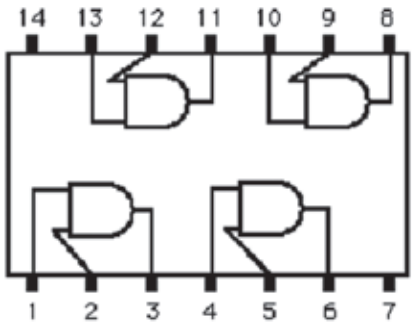


Figure 4.22 – Logic integrated circuit with AND Logic gate

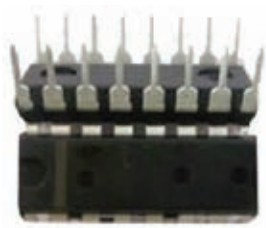


Figure 4.23 – External appearance of an Integrated Circuit.

In this integrated circuit (Figure 4.22), 1, 2, 4, 5, 9, 10, 12 and 13 pins are inputs. 3, 6, 8 and 11 pins are outputs. Figure 4.24 is the external appearance of an integrated circuit which consists of 14 pins.

Activity

1. Consider the Integrated Circuit given below. (Figure 4.24)

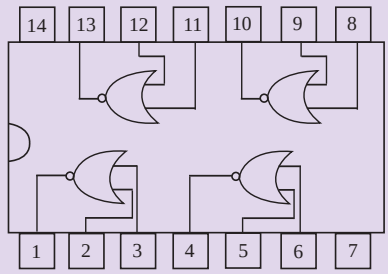


Figure 4.24 – NOR Logic Integrated Circuit

Consider the pins 1, 2 and 3 in the above circuit. If 2 = 0 and 3 = 0, what is the value of pin 1?

2. In the Integrated Circuit given below (Figure 4.34), if pins 1 = 1 and 2 = 1, what is the value of 3?

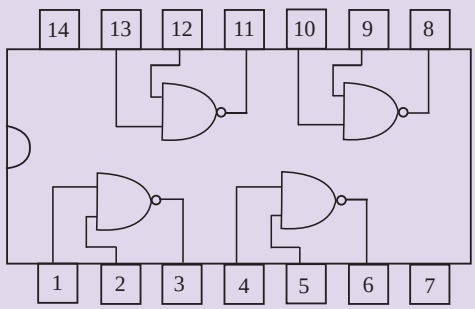


Figure 4.25 – NAND Logic Integrated Circuit

4.7 Practical Usage of Logic Gates

Example 1

Home Alarm System

The circuit given below is an alarm system which informs the house owner of a theft at home. This is designed using OR gates. This circuit protects two windows, the front and back door of the house. When any window or door is opened, an alarm system will be on. The logic gates which is connected to windows and doors are connected to sensors. Input is "1" when windows or doors are open; input is 0 when windows or door are closed. As shown in Figure 4.27, when all the inputs are 0, there will be no alarm.

This means all the window are closed at this moment. However, there will be an alarm when one input value is 1 or several input values are 1 or all input values are 1. This means when a thief opens one window or door or several of these, there will be an alarm. For instance, Figure 4.28 shows the alarm which warns the house owner when the first window is opened by somebody. The moments the alarm is on like this are shown in Table 4.11.

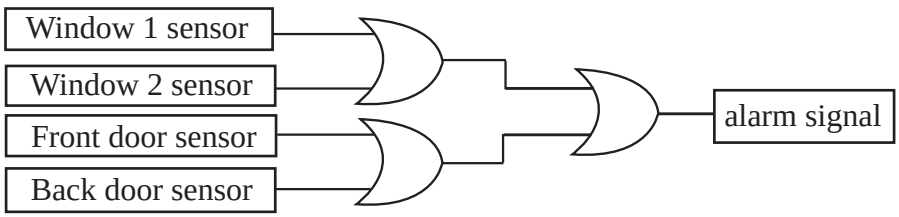


Figure 4. 26 - Home alarm system

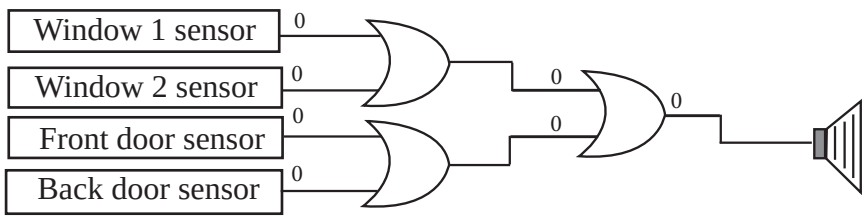


Figure 4.27 - No alarm when doors and windows are closed

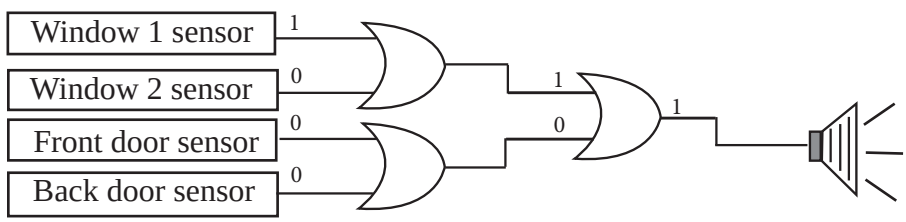


Figure 4.28 – Alarm on when at least one door or window is open

Window 1	Window 2	Front Door	Back Door	Occasion
0	0	0	0	0
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	1
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

Status
open = 0
closed = 1
warning state = 1
no warning state = 0

Example 2

Circuits designed to control street lights.

Following Figure 4.29 is a circuit designed using logic gates to control street lights. This is designed using a dark / light sensor, timer and a manual switch.

There are several occasions when the lights are on. These are,

- When only the manuals switch is closed
- When the input of the timer is 1 and when the environment is dark
- When only the manuals Switch is closed

When the manual switch is closed, its input is 1. Hence, the light is on.

When the input of the timer is 1 and when the environment is dark

If the time is in the range of two pre-arranged ranges the input is 1 and otherwise 0. This means, the input is 1 when time is from 6 pm and 6 am, and the input is 0 when from 6 am to 6 pm. Further, the light sensor will be 1 when there is light above pre arranged value and it will be 0 when it is dark. Here, the street light will be on when the timer's input is 1 and light sensor's value is 0. When the environment is gloomy with a rain cloud, the street light will not be on though the light sensor's value is 0 if the time is not between 6 am and 6 pm.

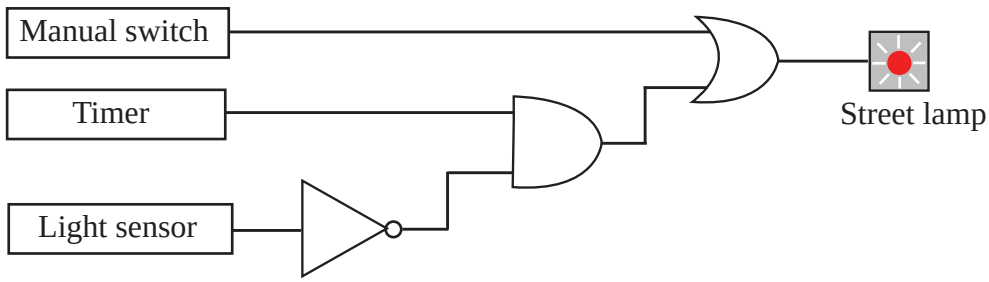


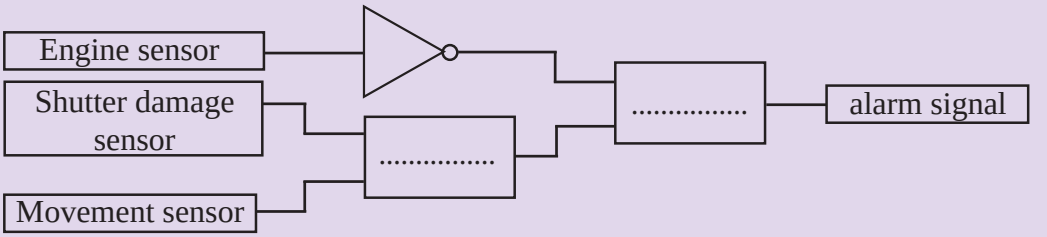
Figure 4.29 - The circuit to control street lights.

Activity

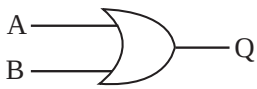
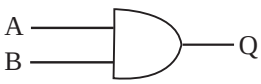
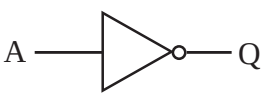
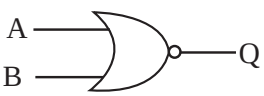
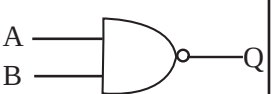
A motor car manufacturing company has manufactured a motor car protecting circuit to warn if there is a movement in the car when the engine is not on or when there is damage to a shutter. This has three sensors to detect whether the engine is on and another sensor to detect whether there is a damage to a shutter. Another sensor is there to detect whether the car is moving.

This circuit is designed with three basic circuits. One of these is a NOT gate and the other two gates should be included in the empty boxes. What are the logic gates suitable for these?

Draw the circuit.



Summary

Logic Gate	Symbol	Boolean Expression	Truth Table
OR		Q = A+B	A B Q 0 0 0 0 1 1 1 0 1 1 1 1
AND		Q = A.B	A B Q 0 0 0 0 1 0 1 0 0 1 1 1
NOT		Q = $\overline{A}$	A Q 0 1 1 0
NOR		Q = $\overline{A+B}$	A B Q 0 0 1 0 1 0 1 0 0 1 1 0
NAND		Q = $\overline{A.B}$	A B Q 0 0 1 0 1 1 1 0 1 1 1 0

5 Operating Systems

By completing this lesson you will learn,

- the necessity of an operating system
- the function of an operating system
- user interfaces of operating systems
- services of an operating system
- types of operating systems
- advantages of operating systems
- utility Programmes of operating system
- drives, folder and files.

5.1 Introduction to Operating Systems

A Computer consists of hardware, firmware and software.

Any physical component of a computer system with a definite shape is called a hardware. Examples of hardware include: mouse, keyboard, display unit, hard disk, speaker, printer etc.

The booting instructions stored in the ROM (Read Only Memory) are called firmware. The initial text information displayed on the screen are displayed by firmware.

How the initial operations of a computer are performed

- When the user powers up the computer the CPU (Central Processing Unit) activates the BIOS (Basic Input Output System).
- The first program activated is POST (Power On Self-Test). Using the CMOS (Complementary Metal Oxide Semiconductor) memory this checks all the hardware and confirms that all are functioning properly.
- After that it reads the MBR (Master Boot Record) in boot drive in accordance with the firmware 'bootstrap loader' which is provided by the computer manufacturer.
- Then the computer loads in the Operating System in boot drive to the RAM (Random Access Memory)

- Once this is performed the Operating System takes over the control of the computer and displays a user interface to the user.

This whole process is called booting which means that an Operating System is loaded into the RAM (main memory).

Software is a set of instructions given to the computer to perform some activity using a computer. There are many types of software. They can be broadly classified as follows:

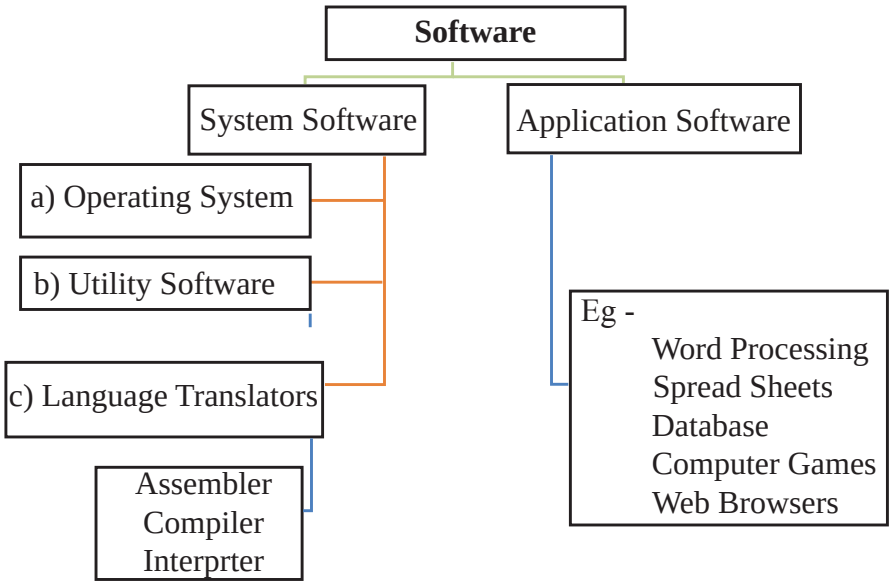


Figure 5.1 - Types of Software

5.1.1 System Software

1) System Software - System software are generally divided into three types. They are:

   a. **Operating System** – The Operating System provides for the user to utilize the functions of a computer by managing the hardware and software in it. The image 5.2 below depicts how the system software and application software interact with the hardware.

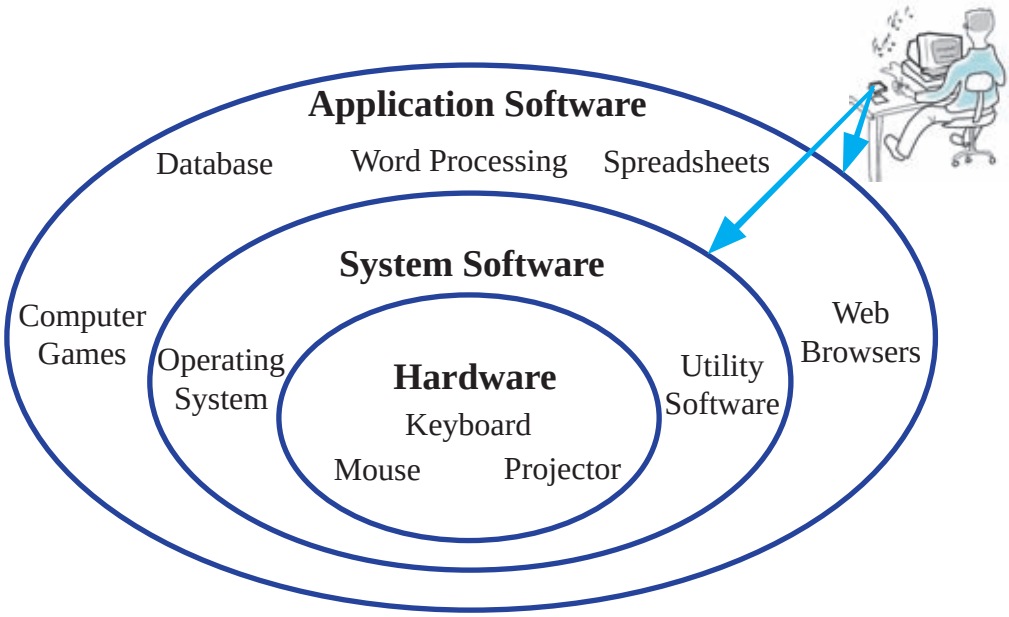


Figure 5.2 – Hardware, System Software, Application Software

b. **Utility Software** – These are used to manage and analyze the software in the computer. The utility software differ from the application software in their complexity and operational activities. Utility software helps in managing the resources of the computer. However, the application software function in different to the utility software. There are many utility software which dedicated to perform certain functions. Some of them are mentioned below:

    i. Anti -Virus Software – to protect the computer from virus infections
    ii. Disk Formatting – to prepare the storage device in order to save the files and folders

c. **Language Translators** - A computer program (software) is made up by using a set of instruction codes. These instructions are written in high level languages which are very close to the human languages. These high level languages are translated into machine language (i.e 0's and 1's) which are understood by the computer by language translators. assembler, compiler and interpreter are examples for language translators.

5.1.2 Application Software

The application software which runs on the Operating System is used to carry out computer based activities of the user such as creating documents, mathematical functions, data entry and, computer games.

Ex: Word processing, spread sheets, database, computer games,
Web browsers

5.1.3 Importance of Operating System

The software which facilitate the interaction between human user and hardware is the Operating System. The Operating System provides instructions for installation and management of various application software. Not only that the Operating System manages all the input, output and computer memory too, which means that Operating System is the sole software which manages the whole computer system.

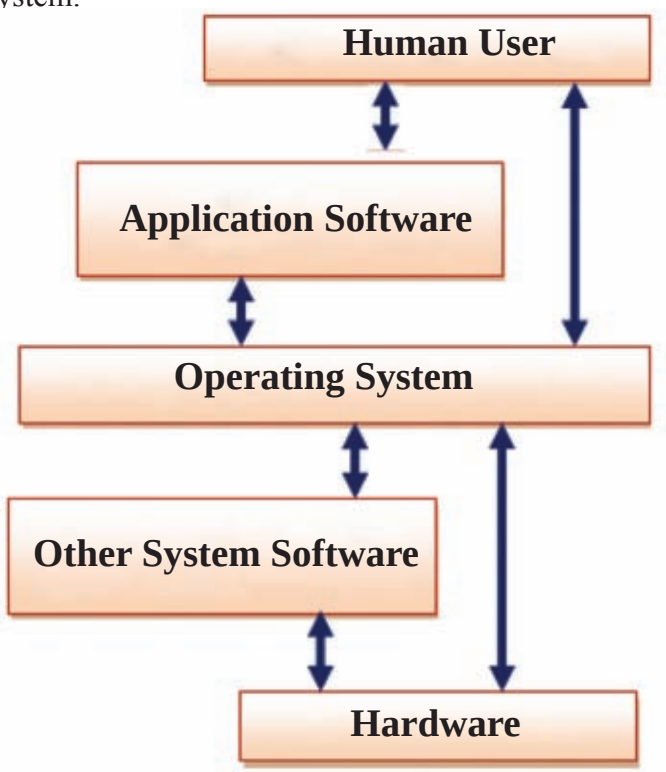


Figure 5.3 - Interaction between the user and the computer

5.1.4 Introduction to several Operating Systems

1. Microsoft Windows Operating System

This Operating System which was introduced by Microsoft is proprietary software which means users have to pay for software license. Nevertheless this Operating System very popular around the world and is available in many different editions such as:

Windows Xp, Windows vista, Windows 7, Windows 8

In addition to the above versions there is a Windows Mobile version which is meant to be used in smart phones, tablets etc. There is a server edition called MS Windows Server as well.

2. Apple Mac Operating System

The Mac Operating System which was developed by Apple Incorporation is called Apple Macintosh. This Operating System is also a proprietary software which requires payment for license. However, this Operating System can only be installed on Apple computers which are manufactured by Apple Incorporation.

3. Ubuntu Operating System

Ubuntu has been developed based on Linux Operating System, This Operating System is available free of charge. Hence it is called a Free and Open Source Software. We can download Ubuntu free from the URL: http//www.ubuntu.com

4. Android Operating System

Android operating system is developed by Google. This is mainly used for the mobile devices. This is also a Free and Open Source Software.

5. Hanthana Linux

This operating system is developed based on Linux operating system and can be downloaded free of charge at www.hanthana.org

5.1.5 Types of Operating Systems

The main function of an Operating System is to provide an environment suitable for executing the commands issued by the user. Based on the functionality of the Operating System it can be classified as:

1. Single user operating system
2. Multi user operating system
3. Multi-tasking operating system
4. Real time operating system

1. Single user Operating System

The Operating System which provides service to one person at a time is called a Single User Operating System.

Example - MS Dos Operating System

2. Multi-User Operating System

The Operating System which allows multiple users to use a system is simultaneously called a multi-user operating system. This type of Operating System is commonly used in Mainframe or Server computer where several users are connected to a computer system simultaneously.

Example - Linux, Windows server

3. Multi-tasking Operating System

The operating system which allows to run multiple process at the same time is called a multi-tasking operating system. A single user can run multiple operations (tasks) at the same time on this type of operating system.

Example - Windows 7, Windows 8, Ubuntu, Mac Operating System

4. Real Time Operating System

These are the Operating Systems which gives the output in real time without any observable delays. Real Time Operating Systems are mostly utilized in ATM end points. Also these kind of Operating Systems are installed in scientific devices and small gadgets. These Operating Systems are specifically designed for particular devices.

Example - ATM machines, Calculators

5.1.6 Services of an Operating System

The Operating System is a software which manages the hardware and other software in a computer system. It provides services to other software. There are two main services performed by an operating system. They are:

1. Managing the hardware of a computer
2. Providing user interface

1) Managing the Hardware of a computer

Hardware of a computer are managed by using the following processes;

i. Process Management
ii. Memory Management
iii. Device Management
iv. File Management
v. Security Management
vi. Network Management

Figure 5.4 shows the inter connection between resource management within computer.

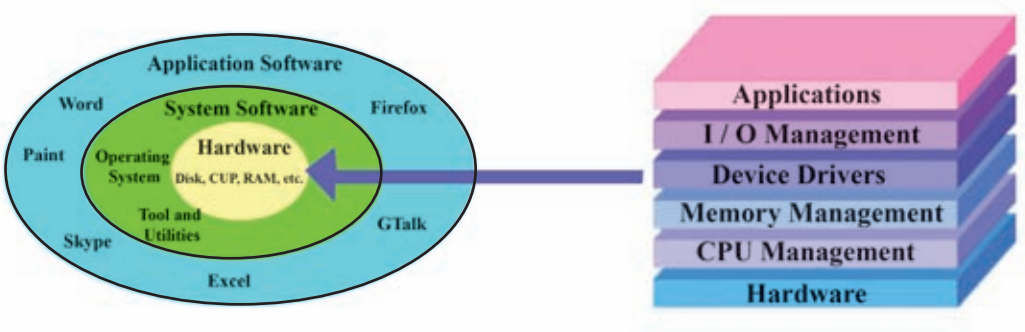


Figure 5.4 - Resource Management

Let us now consider the above mentioned management tasks;

i. Process Management

A user can perform tasks using a computer. Consider the example of printing a letter. Eventhough we see the printing of a letter as a single process, it is infact performed by dividing the whole process into small tasks within the computer. We call this small task as a process.

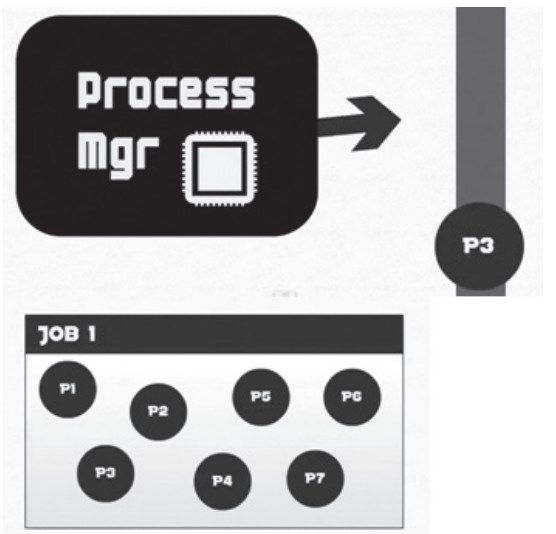


Figure 5.5 - Processes Management

We can call a running computer program or part of the program as a process. All the activities in a computer run as either a single process or a multiple processes.

Resource management activities such as allocation of CPU time, allocation of memory, and allocation of input output devices of each process are managed under the resource management of Operating System.

Odering of the processes (according to a sequence) is also performed under management. For example consider keying in some data using the keyboard while a document is being printed. The processor has to prioritize which action has to be performed first. For an observer it appears that both these actions are performed once. Infact, they run as two different processes. Also observe the situation where we make some changes to the document which is in print. Do these changes appear in that document which is being printed? The answer is "No" because these changes which was made after giving the print command do not appear in the printout. This proves that the processes within the computer are performed in certain order.

ii. Memory Management

Memory (We specifically talk about RAM – Random Access Memory) plays a major role during the functioning of the computer. The input data are stored in the RAM before being transferred to the CPU and the processed data i.e. information are also stored in the RAM before being sent to the Output devices. Hence systematic management of the memory is vital for the proper functioning of a computer. Memory management process makes sure that enough memory is allocated for each process and it also makes sure that the memory is freed once a particular process ends.

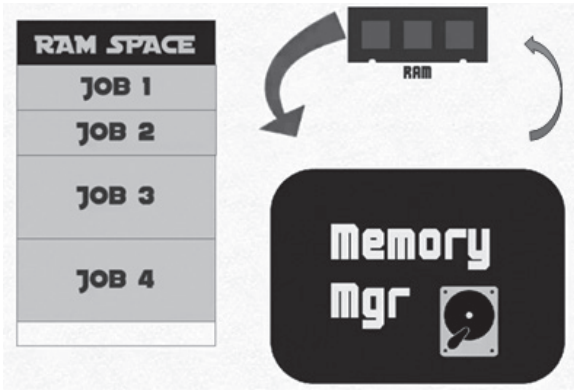


Figure 5.6 - Memory Management

The Operating System employs various techniques to memory management. We must keep in mind that the Operating System utilizes both the Primary Memory (RAM) and the Secondary Memory efficiently in order to manage the memory for various processes.

Again consider the example where we type some changes to a word document is being printed. Do changes we incorporate to the document are printed? No, it does not. Once the command for print is sent the data are sent to the RAM. Only those data which is in the RAM would be printed. Those changes we add after the 'print command' are not printed.

Activity

- Explain how to find the capacity of Random Access Memory (RAM)
- Write down the capasity you use.

iii. Device Management

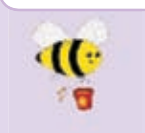
There are several peripheral devices connected to a computer system. The operating system is responsible for the management of those devices. Device controllers are used to control the peripheral devices whereas device drivers are used to control software components.

Figure 5.7 - Device Management

For example if you want your newly bought printer to work properly you need to install the relevant device driver on the Operating System. If you do not install the driver you may not be able to get the full features of the Printer (such as printing on both sides of the paper, etc).

Today there are devices which work once they are connected (plug and play). The relevant device drivers are installed automatically once the device is connected to the computer for the first time. Therefore nowadays the process of installation of the device driver has become easy.

Activity



When you connect a printer to a computer, the Operating System installs the relevant device driver automatically. When it does not install automatically we need to manually install it. Find out and write down the steps on how a device driver is installed in your Operating System.

iv. File Management

We can save data in files and we keep the files within the folders in order to manage methodically. The Operating System to manage the files and folders.

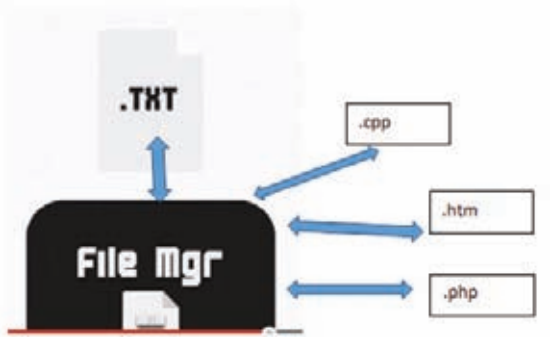


Figure 5.8 - File Management

Some of the services performed by the Operating System in file management are listed below:

- Making new files and saving them at suitable places
- Deleting the unnecessary files
- Arranging the folders in order and deleting the unnecessary folders
- Renaming the files and folders
- Changing the storage location of files and folders
- Creating backups of the files and folders as needed

Figure 5.9 - File Management

File and folder management includes handling file properties, file operations, file access and file systems.

Activity

1. There are many properties of a file/folder. Write down how you can find the properties of a file/folder and write down the properties.
2. Write down the names of the Operating System which uses the following file types;
    - FAT16
    - FAT32
    - NTFS
    - ext4
    - ReiserFS
3. Explain the following two methods used for accessing the files using the Figure 5.10:
    - Sequential Access
    - Random Access

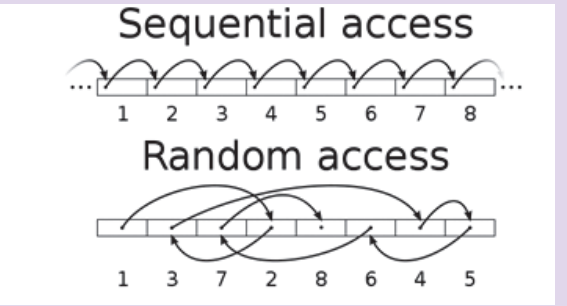


Figure 5.10 - Sequential Access and Random Access

v. Security Management

There are many security threats to a computer. For instance, Malicious Software (Malware) such as a virus could harm the smooth functioning of a computer. There could be other threats such as deletion or destruction of data/ information by unauthorized access to the system.

Protecting the computer from these kind of attacks also managed by the Operating System up to some extend. Various kinds of techniques are used by the Operating System to perform function.

Activity

1. List out and explain each of the methods used by Operating System to prevent and control unauthorized access.

2. As Operating System cannot control or mitigate all the threats brought in by external malicious software. An Operating System gets the support of external (third party) software for this purpose. List out all the threats which are difficult to be controlled by Operating System alone and write down the names of different software which can be used against each of those threats.

vi. Network Management

Operating Systems support different types of network connectivities. They support wired and wireless connectivity for hardware devices in the system such as computers, printers, scanners that exist in the network.

The Operating System also helps in accessing one computer from a remote computer. A computer network facilitates from simple text communication to a multimedia data communication. Today data communication is utilized at a greater scale in networks. This concept is well demonstrated by Cloud Computing.

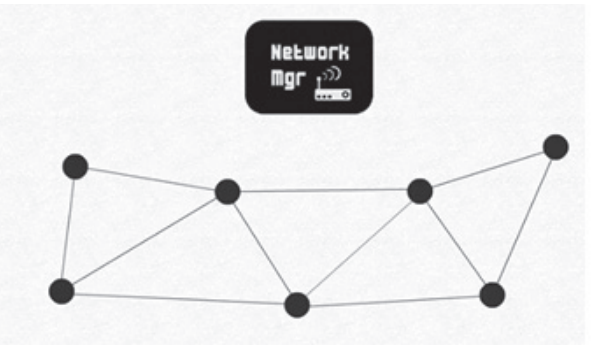


Figure 5.11 - Computer Network Management

2. Providing user friendly interface

We need an interface to interact with the computer. An Operating System provides a user interface to input commands and instructions in a user friendly manner. Using this interface, we can perform tasks without using complex instructions.

There are two types of user interfaces provided by the Operating Systems. They are:

1. Command Line Interface-CLI
2. Graphical User Interface-GUI

The following section discusses in detail about each of the above interfaces.

1. Command Line Interface (CLI)

This kind of interface was used by all the Operating System systems of the early days. This interface had a 'prompt' where the commands are keyed in using a keyboard. In using command line interface, the correct syntax has to be used.

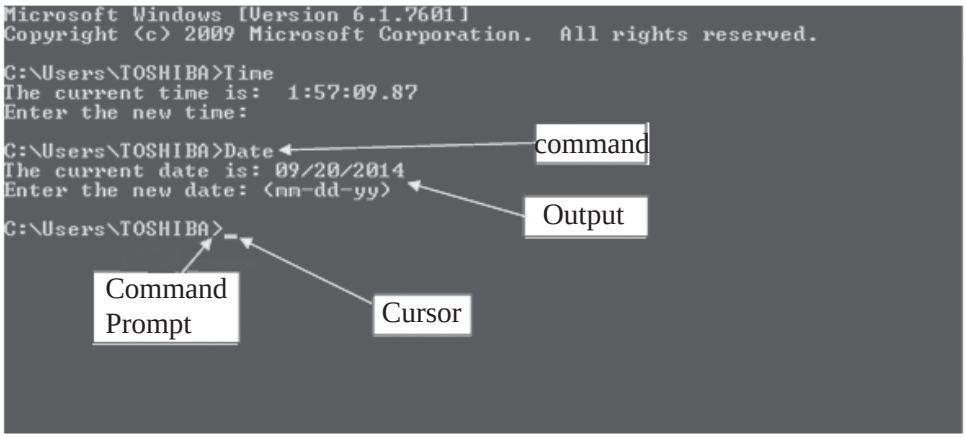


Figure 5.12 - Command Line Interface

Activity

1. Explain how you can obtain the CLI of the Operating System you use.
2. List out a few commands used in CLI and the function performed by these commands.

2. Graphical User Interface (GUI)

Almost all the present day Operating Systems use graphics on their interfaces. This GUI provides the ability to use the mouse or finger tips to navigate the commands. Therefore it has become much easier to interact with the computers today.

These Operating System with GUI uses four components in order to make a friendly environment. These components are abbreviated as WIMP. WIMP stand for;

1. **W**indows
2. **I**cons
3. **M**enus
4. **P**ointer

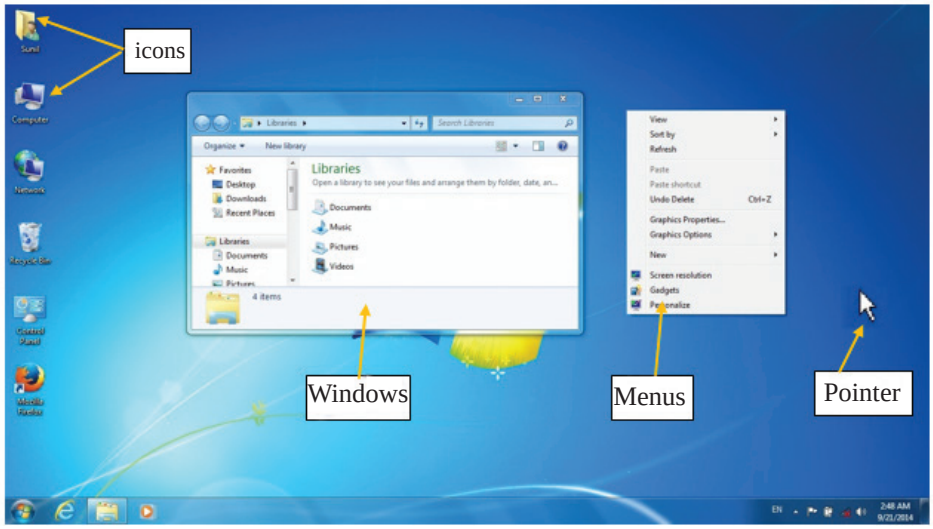


Figure 5.13 – Graphical User Interface

Activity

1. Write down all the components of two different windows in the Operating System that you use.
2. Name all the icons in your desktop
3. Explain how you use the options in two menus of two applications that you use.
4. There are different shapes (styles) for the mouse pointer. List few shapes of the mouse pointer. Explain how you can change the shape of the mouse pointer.
5. Write down the advantages and disadvantages of using the finger point against the mouse pointer of an Operating System.

The utility programs in an Operating System

Several processes are performed by the Operating System for the functioning of the computer. Many utility programs are available in the Operating System for the functioning of the machine as well as to protect from security threats. In the past we had to buy different utility programs and install whereas nowadays most of the required utilities come with the Operating System.

There can be many types of utility programs in an Operating System:

- Backup Software - To copy files and take back up of hard drives
- Disk scanner - To check the errors in hard drive
- Disk defragmentation - Organizing the hard disk by rearranging clusters of small spaces together and creating a larger free space. This increases the efficiency of the hard disk.
- File/data compression - Compression of larger files into smaller files
- Task Manager - to display information regarding the processes and programmes in a computer and the general status of the computer
- System diagnosis tools - to monitor errors in hardware and software of a computer or network of computers and diagnosis of system errors.
- Anti-Virus Software - Protecting the computer by identifying and eliminating malicious software
- Clipboard - temporary storage of data/files for cut/copy and paste operations
- Data synchronization software - to establish consistency among data from a source to a target data storage and vice versa
- Disk partitioning software - can divide an individual drive into multiple logical drives
- Screensavers - for blanking the screen or filling it with moving images or patterns when the computer is not in use.
- System profilers - to provide detailed information about the software installed and hardware attached to the computer.
- Network utilities - to analyze the computer's network connectivity, configure network settings, check data transfer or log events.

In the following section details of some of the utilities in an operating system are given:

- Disk Partitioning
- Disk Formatting
- Defragmentation

Disk Partitioning

What is a Partition?

By default there will be only one physical drive in a hard drive. But this drive is normally divided into many logical partitions. This process of dividing an individual drive into multiple logical drives is called disk partitioning.

Normally partitioning is performed at the time when a hard disk is configured for the first time. Partitioning could also be performed when a new hard disk is to be added or when an existing hard disk is replaced with a new hard disk.

We may need to change the existing partition. When an already partitioned hard disk is partitioned again, all the data in that hard disk would be deleted. Therefore, it is necessary to keep it a point to keep a backup copy of the existing data before partitioning again.

The following image depicts how a hard disk would look before and after partitioning.

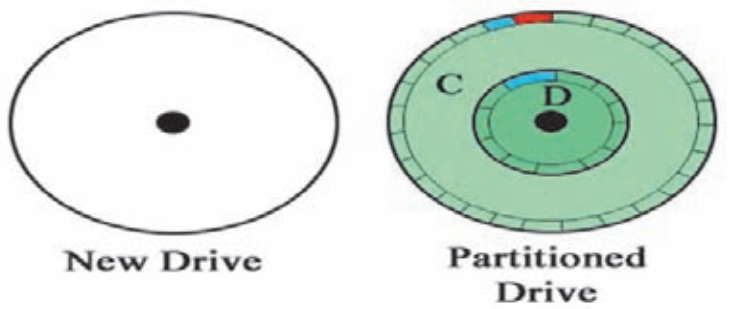


Figure 5.14 - Hard Disk – before and after partitioning

Why do we need partitioning?

There could be many reasons for undertaking partitioning. Below are some of the reasons for partitioning.

- When we need to save different items in different places. (Ex: Software in one drive and all other data in another drive).
- When we need to have more than one Operating System in the same machine. (Ex: When we need to install both Windows and Ubuntu Operating System)
- To meet the requirement of the Operating System (Ex: Sometimes it becomes mandatory that a separate partition is allocated for the Operating System)

We can see each of the divided partition as separate drives. In Windows environment, it is a customary to name the first drive as C: drive and go on. This means that the First partition becomes the first drive and would be named as C: drive and the second drive would be named as D: drive and so on.

Note: In windows environment, Multimedia drives (DVD, CD), flash drives etc. which are connected to the computer would be identified as 'Drives' and they would be named using an English letter after C (after partitioning the hard disk).

However, in Linux environment all the partitions, multimedia drives, flash drives etc. would be identified as individual folders (in Linux they are called Directories). Therefore it cannot be seen drives named C: D: etc in Linux environment.

Disk Formatting

A hard disk cannot be used once partitioning is completed. We need to format each of the drives individually.

Formatting is the process of preparing a data storage device such as a hard disk drive, solid-state drive, floppy disk or USB flash drive for storing data. This is done using a file format in the Operating System.

The USB Flash Drives come pre-formatted so that they can be put into use directly.

We can format hard disk drive, solid-state drive, floppy disk or USB flash drive whenever need arises. Every time we perform formatting the data in the drive would be deleted. Therefore it is necessary to keep back up copies of the data before formatting.

Once a hard disk is partitioned and formatted we can start saving data on it.

Usually a hard disk is partitioned and formatted before installing an Operating System for the first time. After the first time the need for partitioning or formatting could arise very rarely.

You can see in the image below how a hard disk would look like after partitioning and formatting.

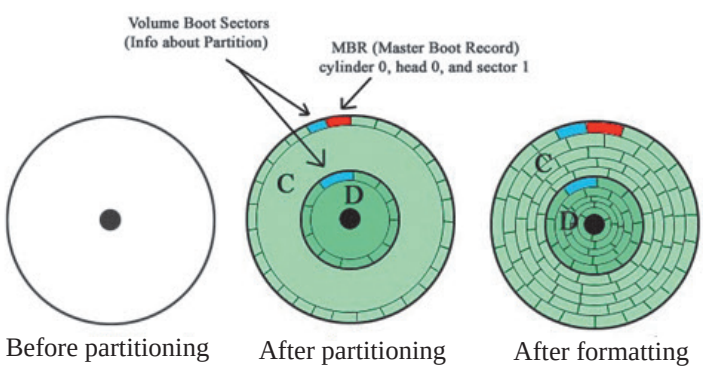


Figure 5.15 – Har Disk – before and after partitioning and formatting

Defragmentation

The following shows the defragment in Windows. Sometimes a file (which is larger in size) may not be stored as a single track in the hard disk. This process where a single file is broken into different pieces and stored in different parts of the disk is called fragmentation.

Figure 5.16 - How a file is stored in different places of a disk

The Operating System splits a file into several portions and saves them in different places in the disk especially when a saved file becomes larger due to multiple editing. Further, the empty spaces that are created in the disk due to the deletion of files is used to save new files which causes fragmentation.

It takes longer time to read a file when a file is defragmented and saved in different places in the disk. It affects the efficiency of the computer.

If you observe a slowness of the machine (there could be many reasons for the slowness of the computer, whereas fragmentation could be a one reason) the best action to take would be to start defragmentation.

Disk defragmentation is the process of rearranging the fragmented data on a volume (such as a hard disk or a storage device) so it will work more efficiently.

Figure 5.17 - Before Defragmentation After Defragmentation

However Linux based Operating Systems use a different method to store files. Linux Operating System makes sure that ample space is left between the saved files so that they can be saved at the same location as a single intact file even when the file expands due to editing. Therefore there is very little possibility for fragmentation to happen. It is also because Linux based Operating Systems have the ability even to relocate the file in a new place if the file exceeds its allocated memory space. Therefore there is no need for ‘defragmentation utility’ in Linux based Operating Systems.

5.2 Introduction to File Systems

Computer is a machine which allows for storage of large volumes of data while facilitating the quick retrieval of those saved data when we need. The data we save must be given a file name for the purpose of identification. There are many file names used in the storage media which are relevant to a partuclar Operating System and Application Software. But all these file names consist of two components, namely file name and file extension. However the file extension are hidden to the user by the Operating System by default.

5.2.1 Finding out the File Extension

Start ⟶ Control Panel ⟶ Folder Options ⟶ View ⟶ Hide Extensions for known File types (See Figure 5.11) ⟶ untick it ⟶ Then click OK.

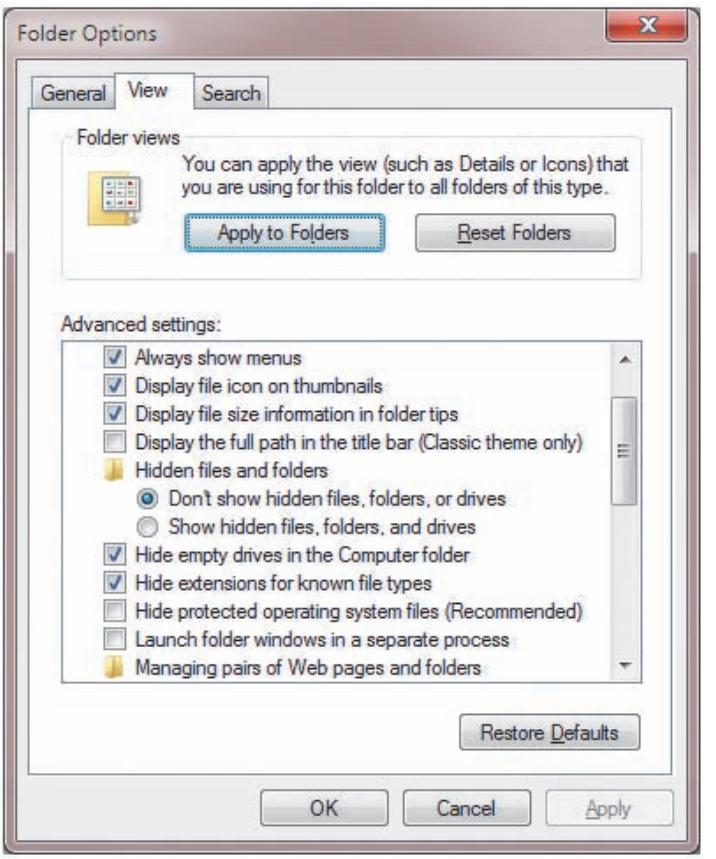


Figure 5.18 - Details of a file

Now double click on any folder. Then we can view file extensions of any file.

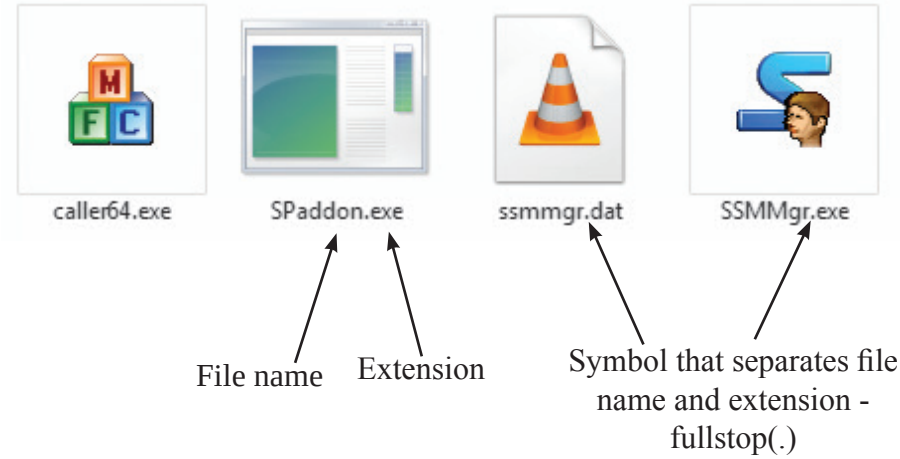


Figure 5.19 - Window to set up display of file extensions

Note: The Operating System identifies the file type using the file extensions.

There are many file extensions in use. Some of them are listed below:

File Extension	File Type
exe	Executable
docx	Word
xlsx	Excel
pptx	PowerPoint
accdb	Access

A file name and a location are given when saving a file in the computer. The Operating System maintains many other information relevant to the file.

Type of file

Size of the File

Saved Date and Time

To view these data, right click on a particular file and then click on 'properties' from the list that appears.

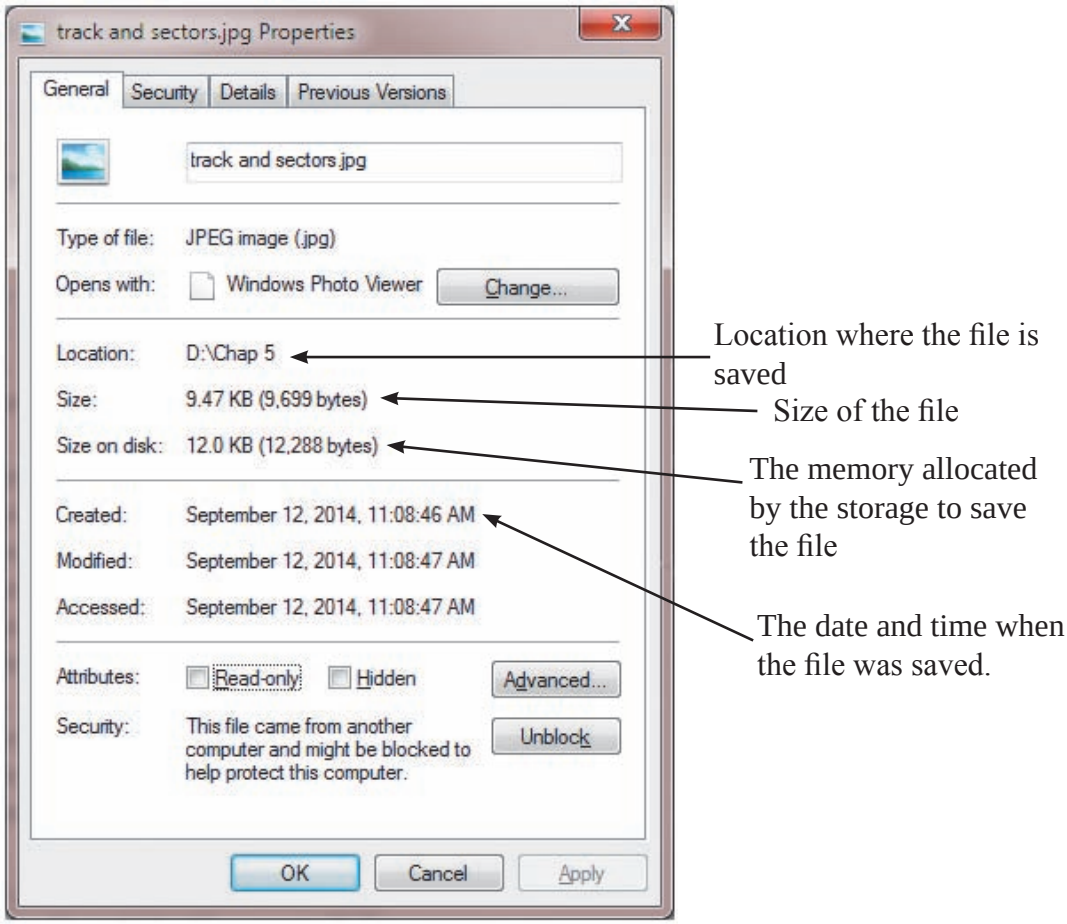


Figure 5.20 - Viewing details of a file

Selecting a location to save a file

A location is used in the storage space to save a file. It is called a drive. The previous section detailed that several drives can exist after partitioning.

Drives

By default a computer uses the hard drive to save. If the hard drive is not partitioned then it would be labelled as C: drive. If the hard drive is partitioned then the partitions could be named in order as [C:], [D:], [E:] etc.

If there are other storage media such as CD, DVD or Blue Ray Disk drives in a computer then these drives are given different letter names. For example if the hard disk is partitioned into four separate partitions then they would be labelled [C:], [D:], [E:]and [F:] drives whereas a CD, DVD or Blue Ray Disk drive would be named as [G:] drive.

In the same manner when a pen drive is connected to the computer the new drive would be labelled as [K:] drive.

If you want to see the number of drives in a computer, observe the following steps: Open the icon “Computer”. Now you can see, the externally connected drives such as Blue Ray Disk drives and pen drives are shown as devices with removable storage.

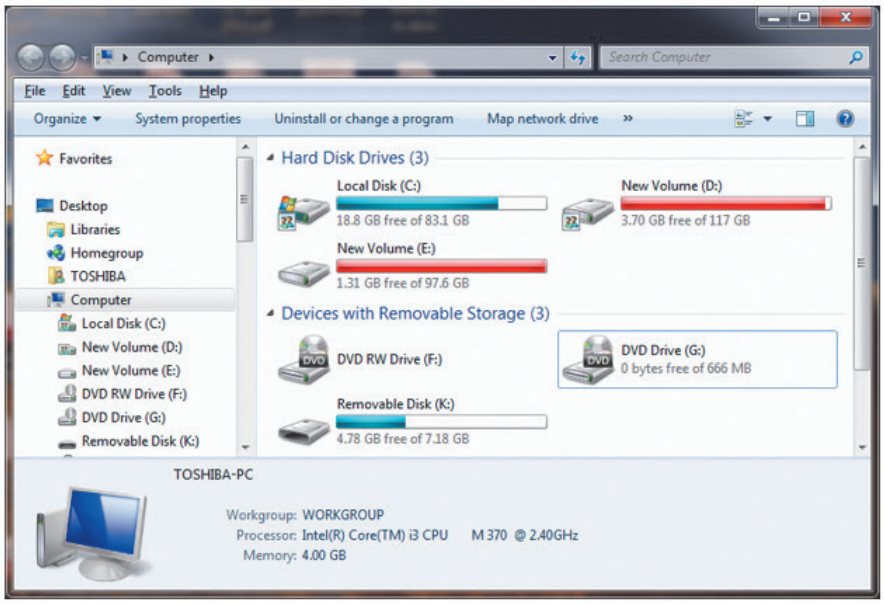


Figure 5.21 - Viewing the drives

Even though we use the drives to store the files, in general they are not directly stored to the drive. Usually we create a folder in a drive and then store the file it in. We should give a name to the folder in order to identify the folders too.

Creating a Folder

1. Select the drive where the folder to be created.
2. Now select 'Folder' under 'New' in 'File Menu' or 'New folder' under 'Tools'.
3. Provide a suitable folder name

Managing files and folders

We have to perform many activities using the files and folders in a drive.

1. Copy and paste of files/folders
2. Select the file/folder to be copied
3. Select copy (Edit → Copy or Ctrl +C)
4. Select the destination drive or folder
5. Select paste (Edit → Paste or Ctrl + V)

Cut and Paste of files/folders

1. Select the file/folder to be cut
2. Select to cut (Edit → cut or Ctrl +X)
3. Select the destination drive or folder
4. Select paste (Edit → Paste or Ctrl + V)

Renaming a file/folder

1. Select the file/folder to be renamed
2. Select to rename under File menu
3. Key the new name and Enter

Deleting a file/folder

1. Select the file/folder to be deleted
2. Select to delete under File menu or use Delete key on the Keyboard
3. Click 'Yes' in the dialog box that appears.

Then the deleted file/folder would be placed in Recycle Bin temporarily.

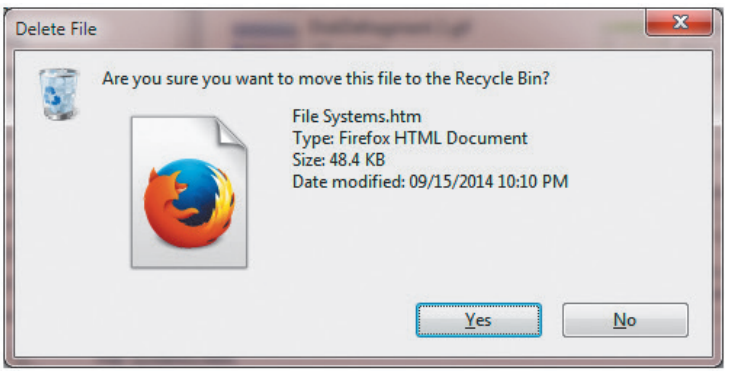


Figure 5.22 - Delete Dialog box

Restore a Deleted file/folder

1.Open Recycle bin

2.Select the file/folder to be restored

3.Click Restore under File menu

Summary

- Operating System is essential for Operating a Computer.
- All the Application Software in the computer runs on the Operating System.
- The User Interface functions as the facilitator between the computer and the user.
- The GUI is convenient to the user than the CLI.
- The types of Operating System are: Single User, Multi User, Multi-tasking and Real Time User.
- The Operating System which provides service to one person at a time is called a Single User Operating System.
- The Operating System which allows multiple users to use a system is called a Multi User Operating System.
- The Operating System which allows to run multiple process at the same time is called a Multi-Tasking Operating System.
- The Operating System helps in managing all the resources of a computer. The hard disk is partitioned and formatted before installing an Operating System.
- A file consists of a File Name and Extension
- Folders are used to save files
- In order to save the files the user creates folders inside the drive.

6 Word Processing

This chapter covers the following;

- word processing
- benefits of a word processing software
- creating a document
- formatting of document
- adding clip arts and charts to a document
- opening and closing files
- mail merge
- printing a document
- shortcut keys

6.1 Word Processing

Your school principal has informed you that this year's Art Festival is going to be celebrated. The assigned task of your team is preparing necessary documents for the arts festival.

Accordingly you have to;

- Design invitations
- Prepare letters to the parents
- Design certificates

These documents should be well prepared and printed. After drafting the above documents, you now want to find out the best method of document preparation.

"We will prepare hand written invitations", was one of the suggestions.

“Good idea, but it’s difficult to write in a similar size and a similar way. So we’ll use the type writer in the library”, was another suggestion.

“We should find attractive types of letters and add pictures. A border will give a good finish. A typewriter won’t provide such facilities, will it?” Everybody is confused. You need to find a solution for this problem.

We often use different types of documents in our day-to-day activities and preparing these documents in different styles is called word processing. In order to avoid the shortcomings of preparation of pen or pencil in based documents, typewrites were used in the early days. Even though such typed documents were better than the hand written documents, manual typewriters do not allow functions such as formatting, saving, printing in required sizes.

The computer is the best machine for such an activity. A word processing software can provide the following faclities;

- Creation and editing
- Insert objects such as images
- Saving and retrieving
- Print preview and printing
- Spell checking and grammar
- Find and replace
- Mail merge

6.1.1 Word Processing Software

Several popular word processing software are available. Some need to be purchased and some are Free and Open Source Software (FOSS).

Given below are some of the word processing softwares. You can find more information about those softwares from their websites.

Name of the software	Producer
AbiWord	Source Gear Corporation
FrameMaker	Adobe Systems Incorporated
iWork Pages	Apple
Kingsoft Office Writer	King soft
Libre Office Writer	Open Office Writer
Microsoft Office Word	Microsoft Corporation
Open Office Writer	Apache Software foundation (Open Source Software)
Word Perfect	Corel

The user can create documents using internet as well if the computer does not have a Word Processing software. For this the user can use cloud computing. There are many advantages of using cloud computing such as;

- The user does not have to install a word processing software on the computer
- The user does not have to allocate space to install software in the hard disk
- To save the document, internet itself provides facilities for space.
- The user can open or edit the document from any computer which has internet facility

Example - Google Docs, Windows 365

In addition, smart phones and tablet PC's are used for Word Processing today and word processing software is available for this purpose.

Eg: Documents To Go, Google Docs, Kingsoft Office, Polaris Office etc.

Now we will learn how to use a word processing software to prepare documents.

This chapter explains two word processing software which are commonly used today. Further, some topics and tools which are common to other software are also discussed.

6.1.2 Running a Word Processing Software

These lessons are presented based on Microsoft.

Microsoft Office Word 2010

Start → All Programs → Microsoft Office → Microsoft Office Word 2010
(This could be different depending on the operating System)

The graphical user interface of a Microsoft Word 2010 software is shown in figure 6.1

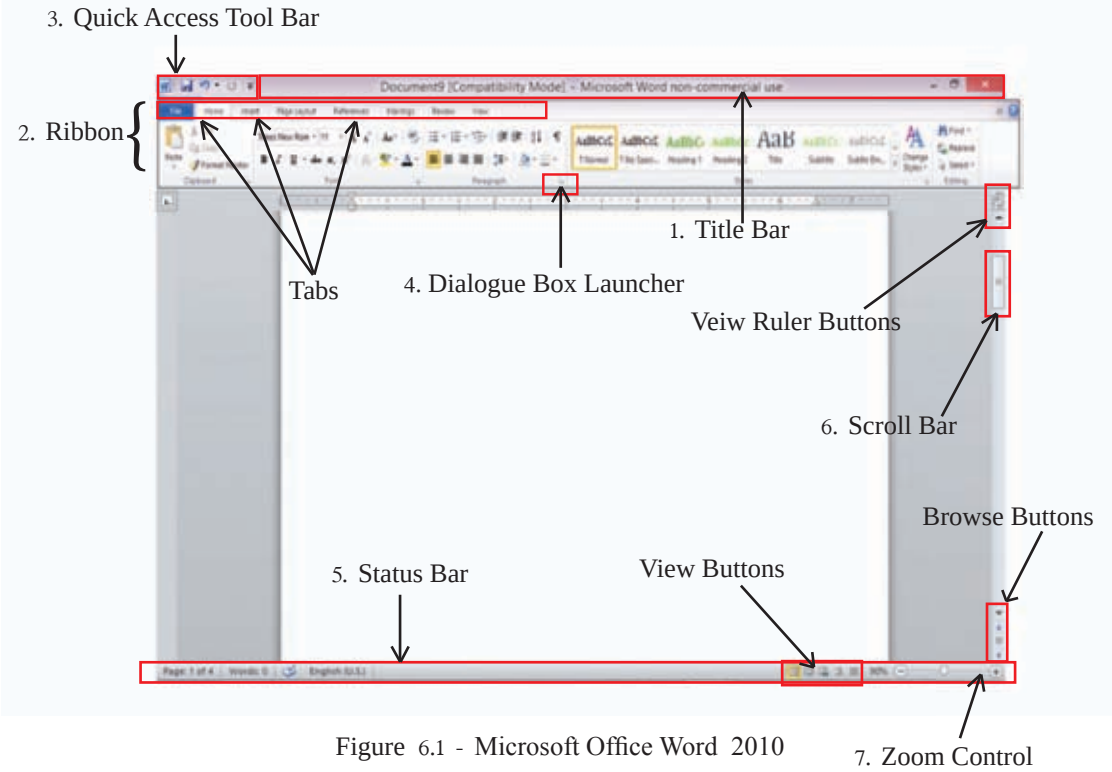


Figure 6.1 - Microsoft Office Word 2010

1. **Title Bar** - (Figure 6.2) The top most bar on a Microsoft Office 2010 window is the Title Bar. The name of the opened document will appear here. A new document is shown as Document X and 'X' is the document number. Window Minimize button, Minimize/Restore button and the Close buttons are located in the top right hand side.

Figure 6.2 – Title Bar

2. **Ribbon** – Ribbon is a special feature of Word 2010 windows. Features of this (File, Home, Insert etc) are called Tabs. The special feature of the ribbon is that the items are shown as Icons, so their functions are clear. Facilities are there for the users to adjust these tabs according to their wishes. Moreover, ribbon is divided into several classes. (Clipboard, Font, Paragraph, Styles, Editing, etc.)

Some features of the Home Ribbon (Figure 6.3):

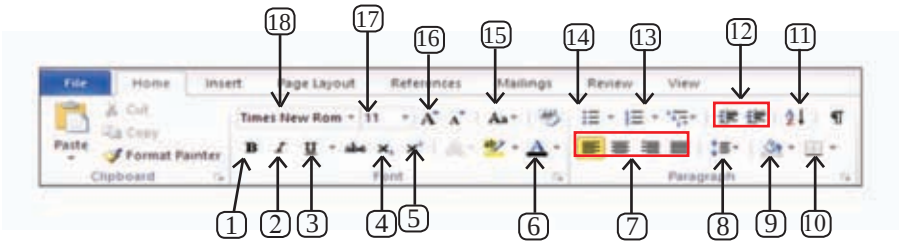


Figure 6.3 – Home Ribbon

1. Bold
2. Italic
3. Underline
4. Subscript
5. Superscript
6. Font color
7. Alignments
8. Line spacing
9. Shading
10. Border
11. Sort
12. Indentation
13. Numbering
14. Bullets
15. Change case
16. Grow font
17. Font Size
18. Font Name

3. **Quick Access Tool Bar** (Figure 6.4) - This is always placed above the Ribbon and can be placed below the Ribbon. Quick Access Tool Bar contains quick commands such as opening a new document, saving or opening a document, Zooming, Undo, Redo, etc and this can be adjusted according to the user's requirements.

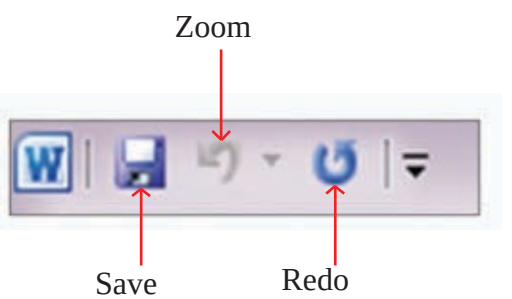
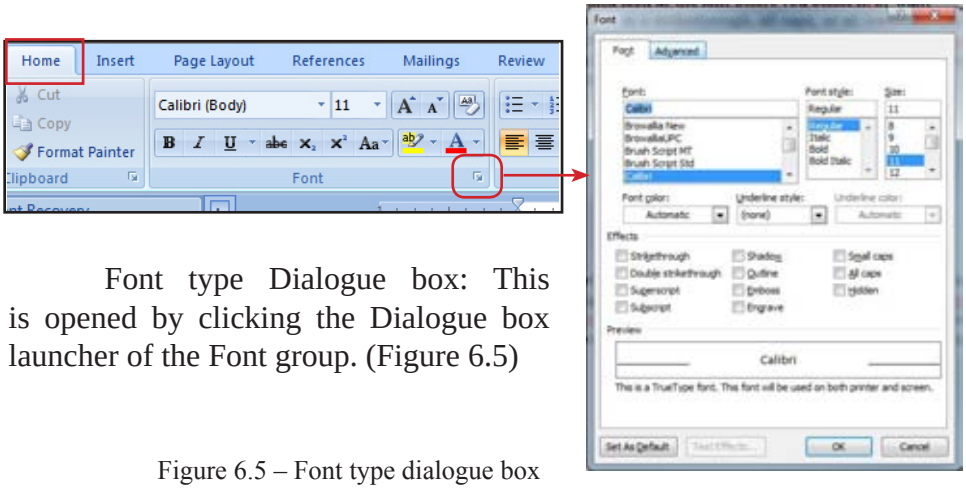


Figure 6.4 - Quick Access Tool Bar

4. **Dialogue Box launcher** Figure 6.5 - Dialogue Box launcher shows additional tools. Dialogue boxes can be opened by clicking the arrow at the right hand side of the group name. Apart from the tools which appear in the Ribbon, Dialogue boxes provide several other useful tools in document preparation.



Font type Dialogue box: This is opened by clicking the Dialogue box launcher of the Font group. (Figure 6.5)

Figure 6.5 – Font type dialogue box

5. **Status Bar** (Figure 6.6) - This is at left bottom of Microsoft Word window. This shows the number of pages and words of the document, language used, view buttons, etc. Further, status bar can be used to add slight changes to the document.

Figure 6.6 – Status Bar

6. **Scroll Bar** - used to go up and down of the document.

7. **Zoom** (Figure 6.7) - Zoom can adjust the size of the pictures on the screen. This does not affect the original document and zooming is performed as per the wish of the user. Zooming is used to check the quality of the document while editing.

Figure 6.7 – Zooming

To learn the tools which are not explained here, position the mouse pointer on tool to see the Tool Tip.

LibreOffice Writer 4.1

Start → All Programs → LibreOffice Writer (This could be different depending on the operating system.)

Figure 6.8 shows the graphical user interface of LibreOffice Writer software.

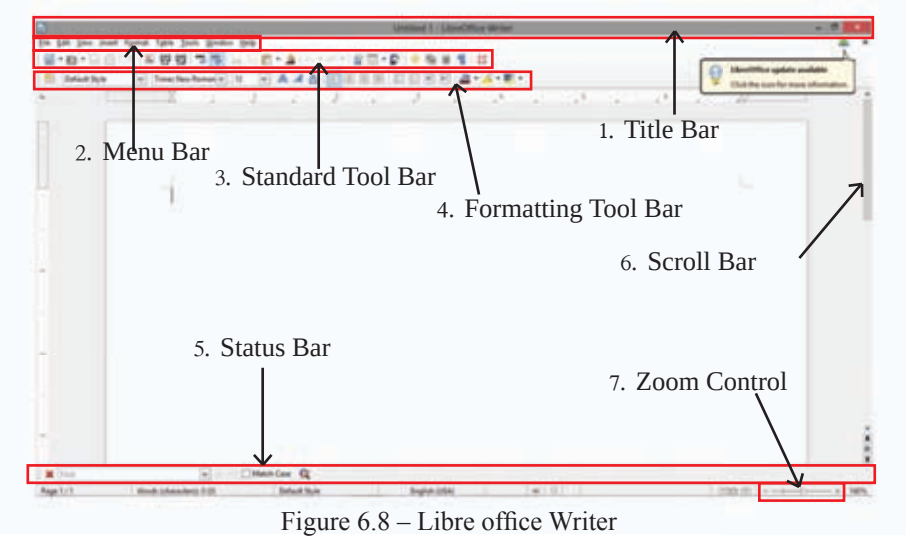


Figure 6.8 – Libre office Writer

1. **Title Bar** (Figure 6.9) - This is top most bar of Libre Office Writer window. This shows the name of the opened document. A new document is shown as Untitled X and 'X' is the document number.

Figure 6.9 – Title Bar

2. **Menu Bar -** This is positioned below the Title Bar. The features available here are respectively File, Edit, View, Insert, Format, Tables, Tools, Window, and Help. When one function is selected, the relevant submenu for that will be opened and the available features of the submenu can be selected as per your wish.

Figure 6.10 – Menu Bar

- If 'File' menu is selected, the submenu will show options such as opening a new document, opening or saving a document, closing a document, etc.
- By opening '…' of the submenu, dialogue boxes can be selected. Figure 6.11
- By using right hand side arrows of the submenu, another submenu can be opened. Figure 6.11

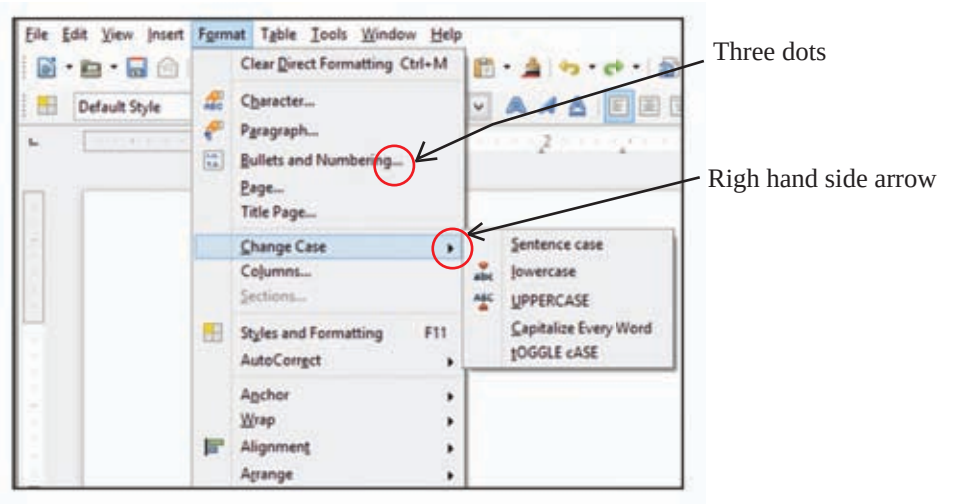


Figure 6.11 - Submenu

Tool bars - The bars positioned below Menu Bar of LibreOffice Writer window are tool bars. The Standard Tool Bar and Formatting Tool Bar will appear when the Writer window is opened and the opening or closing of the other tool bars can be done as per user requirements. For this, open 'View' menu, and then 'Toolbars' of submenu. The user can close the toolbars appear on the submenu.

3. **Standard Tool Bar** (Figure 6.12) – This contains commands in the form of Icons.

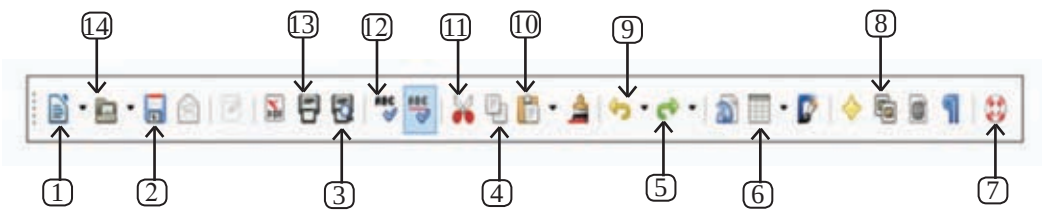


Figure 6.12 – Standard Tool Bar

1. New
2. Save
3. Page Preview
4. Copy
5. Redo
6. -Table
7. Help
8. Gallery
9. Undo
10. Paste
11. Cut
12. Spelling and grammar
13. Print
14. Open

4. **Formatting Tool Bar** (Figure 6.13) - This contains a several letter formatting methods which can be used in documents. The commands appear in the form of Icons.

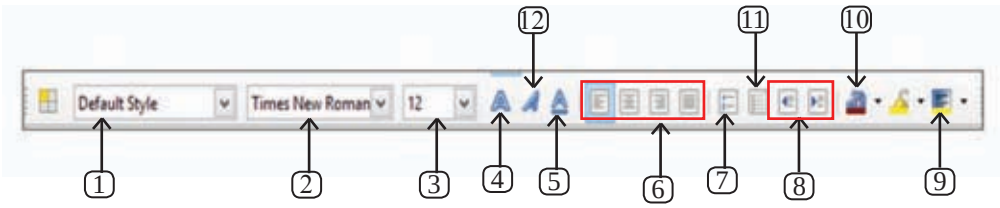


Figure 6.13 – Formatting Tool Bar

1. Apply style
2. Font
3. Font size
4. Bold
5. Underline
6. Alignment
7. Numbering
8. Indentation
9. Background color
10. Font color
11. Bullets
12. Italics

5. **Status Bar** - This is positioned at the left bottom of the Writer window and displayed the number of pages, words, the language used, zooming, etc.

6. **Scroll Button and Scroll Bar** - used to go up and down of the document.

7. **Zoom -** This allows to change the scale of the pictures that is displayed on the screen. Zoom does not affect the physical document and the scales can be adjusted by the user. Zooming is also used in editing to check the finishing quality of the document.

To learn the tools which are not explained here, position the mouse pointer on the tool see the Tool Tip.

6.2 Let us discuss some important things in preparing a new document.

Step 1

Opening a new page

Even though there is a new page when Word software is open, the user has to get a new page for another document.

For Microsoft Word ...

File → New → (Ctrl + N) → Blank Document

For LibreOffice Writer ...

File→New (Ctrl+N)→Text Document

Step 2

Saving the Document

It is essential to save the document in a proper place with a proper name. This enables the user to find the saved document easily.

Select File → Save (Ctrl + S)

- select a saving location using 'Save in'

  type a proper name for the document in 'File name'
- click 'save' button

Step 3

Saving the file by another name

Once the user save the document by giving a name, it is called 'File'. The user can save the file by another name in another place. Then the user will get two files by the existing name and the new name. Since files are saved with a file extension, it is easyt ofi ndt hos e a gain

(file extension)

MS Word 2007/ 2010 - .docx
MS Word 97-2003 - .doc
LibreOffice Writer - .odt

For this…

Select File → Save as

- Select a Saving Location from 'Save in'
- Type a proper name for the document in 'File name'
- Click Save button

Step 4

Closing the document

It is wise to close the document till it is used again. Unwanted, opened files will be a disturbance for the computer.

For this...

Select 'File → Close'

Step 5

Opening the document

The user may need to open a file saved in the computer or in a different medium.

For this...

- Select 'File → Open' (Ctrl+O)
- Select the saved file in the 'Look in' location in the open dialog box.
- Select the document from the window
- Click 'Open' button.

Step 6

Saving a document using a password

Saving a file with password provides security. Hence other cannot open the document. For this;

If it is Microsoft Word;

- Select 'File → Save'
- Select a suitable saving location from 'Save in'
- Type a suitable name for the document
- Select 'tools'
- Select 'General Options'
- Type a password in the 'password to open' box in order to open the word file.
- Click 'Ok'
- Type the same password in the 'Re-enter Password to open' box
- Click 'save' button.

If it is LibreOffice Writer;

- Select 'File → Save'
- Select a suitable saving location from 'Save in'
- Type a suitable name for the document
- Click on the box 'Save with a Password'
- Click 'save' button
- Type the password to open the file in 'Set Password' dialog box
- Type the same password in the second box and click 'Ok' button.

Activity

Open the word processing software. Perform the following;

1. Type the paragraph in activity figure 1. Save the document as "Assign1" in your folder. Close the document.
2. Open "Assign1" file. Save it in your folder as 'Assign2' in. Now close the document.

Word Processor
A word processor, or word processing progrm, does exactly what the name implies. It processes words. It also processes processes paragraphs, and entire papers. Some examples of word processing programs include Microsoft Word, Word perfect (Windows only), Apple Works (Mac only), and Open Office.org.

figure 1: Activity

6.3 Preparing a Document

6.3.1 Page Setup

The first step in document preparation is to use page setup.

For Microsoft Word…

Use 'Page Layout → Page Setup'

For Libre Office Clac…

Use 'Format → Page' and 'Page' Dialogue Box

There are common Page Setup tools available in Word Processing software. You can select paper size and format as per international standards. (A4, A5, B4, Letter) These sizes can be adjusted according to the user's requirements. User can adjust 'Orientation' and 'Margins'.

There are two types of Orientation Portrait  and Landscape 

6.3.2 Formatting

Formatting can be performed after or before typing a letter or document. This adds clarity and attractiveness to the document.

6.3.3 Methods of Selection

A document contains different features such as letters, words, shapes, images, tables, etc. User may make changes to these. User have to select the item before modification. Following are some of the methods.

A letter or letters	Drag the Mouse across the letter(s)
A word	Double click the mouse on that word
A few words	Select the first word you need to change, keep the mouse pointer there and drag till the last word
A sentence	Click on the first word of the sentence and drag till the last word
A row	Drag the mouse till you see a right arrow which is white. Click it once.
A paragraph	• Click the mouse thrice on the paragraph • Or click the first word of the paragraph and drag till the last word
A document	• Press Ctrl + A on the key board • Drag the mouse pointer till you see a right arrow which is white. Then click it thrice

6.3.4 Text Formatting

User is able to perform the following;

1. Change Font Size.
2. Change Font Style - Make letters Bold or Italic.
3. Underline letters.
4. Use different types of fonts in different languages.
5. Change font colour.

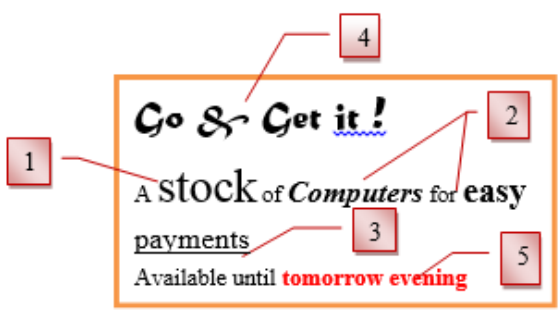


Figure 6.14 – Formatting

For Microsoft Word…

- Select your letters or paragraphs
- Click on the required tools of Home → Font. Or
- Open Font Dialogue Box

Further, mind that you can make use of several tools at the same time.

For LibreOffice Writer…

- Select your letters or paragraphs
- Use Formatting Tool Bar
- Click on the necessary formatting tools or
- Open 'Format → Character' Dialogue Box

Further, mind that you can make use of several tools at the same time.

Activity

Open the Word Processing software and perform the following.

1. Prepare your page as follows.

Size – A4	Orientation Landscape	Margins – 2' from left and right 1.5' from top and bottom

Use 'Page Setup' Dialogue Box.

Type paragraphs on Activity 2. Save that document in your folder as 'Assign2'. Close the document.

2. Open 'Assign 2' file. Format the document as in activity 3. Then save it in the folder as 'Assign3'. Close the document.

What is a computer?

A computer is an electronic device that manipulates information or data. It has the ability to store, retrieve and process data.

You can use a computer to type documents, send email and browse the Web. You can also use it to handle spreadsheets, accounting, database management, presentations, games and more.

Activity 2

Activity 3

What is a computer?

A computer is an electronic device that manipulates information or data. It has the ability to store, retrieve and process data.

You can use a computer to type documents, send email and browse the Web. You can also use it to handle **spreadsheets, accounting, database management,** presentations, games and more.

6.3.5 Paragraph Formatting

Alignment (Figure 6.16)

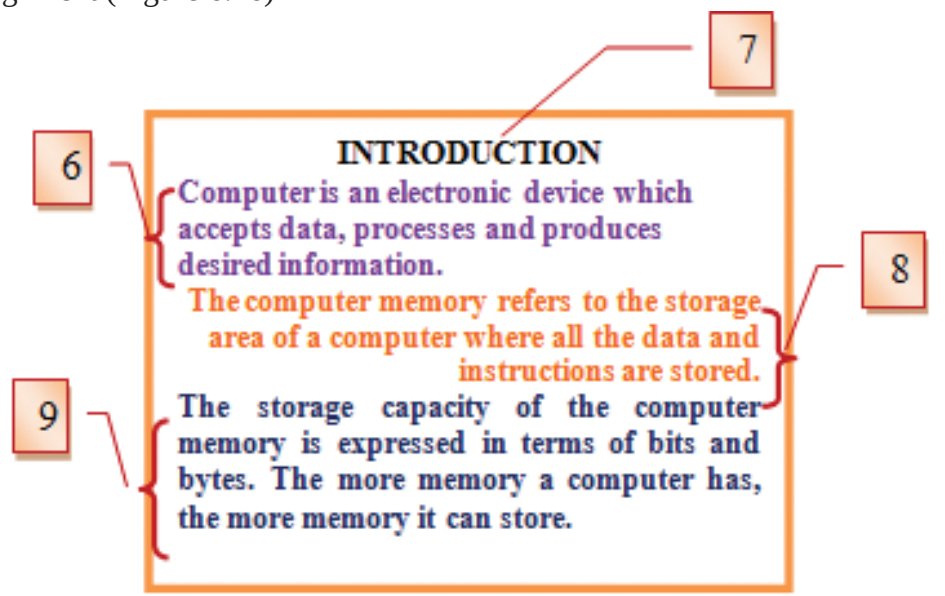


Figure 6.15

6. Left Align
7. Center Align
8. Right Align
9. Justify

- Indentation (Figure 6.16 and 6.17)

10. Left Indentation 
11. Right Indentation 
12. First Line Indentation
13. Hanging Indentation
14. Line spacing
15. Paragraph spacing 

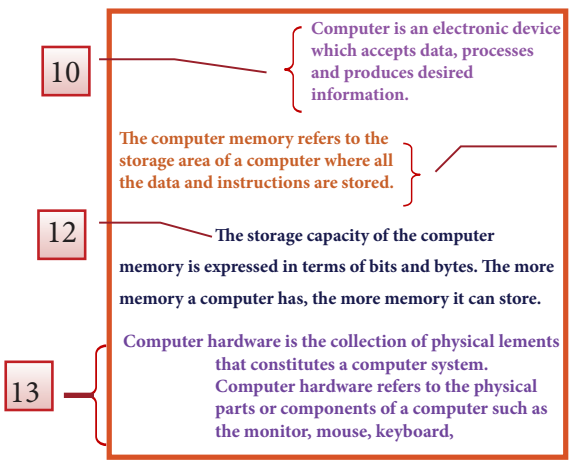


Figure 6.16 – Indentation

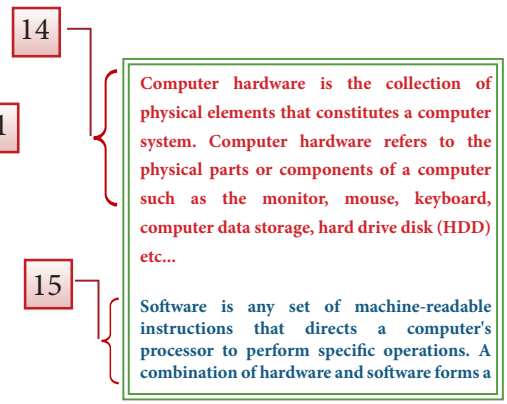


Figure 6.17 – Indentation

For Microsoft Word...

Select your words or paragraphs

- Click on the formatting tools you need on 'Home → Paragraph'
  Or
- Open 'Paragraph' Dialogue Box
- Select the tools you need there
- Click 'Ok'

For LibreOffice Writer...

Select your words or paragraphs

- Click on the formatting tools you need on Formatting Tool Bar
  Or
- Open 'Format → Paragraph' Dialogue Box
- Select the tools you need there
- Click 'Ok'

Activity

Open the Word Processing software and perform the following.

1. Open 'Assign3' file. Format its paragraphs as shown in activity 4. Then save it in your folder as 'Assign4'. Close the document.
2. Open 'Assign3' file again. Format it again as shown in activity 5. Then save it in your folder as 'Assign5' and close the document.

What is a computer?

A computer is an electronic device that manipulates ***information*** or ***data***. It has the ability to store, retrieve, and process data.

You can use a computer to type document, send email, and browse the web.

You can also use it to handle ***spreadsheets, accounting database, management,*** presentations, games, and more.

Activity 4

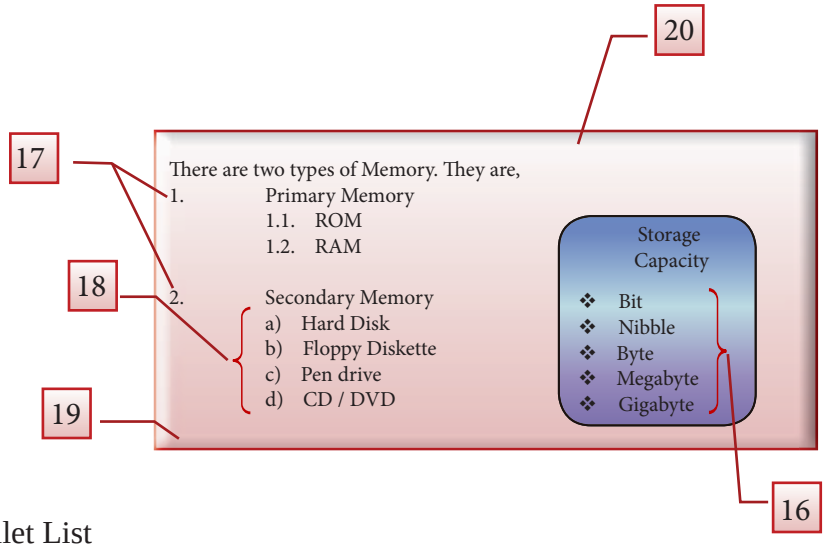
What is a computer?

A computer is an electronic device that manipulates ***information*** or ***data.*** It has the ability to store, retrieve, and process data.

You can use a computer to type documents send email and brows the Web.

Activity 5

6.3.6 Bullets and Numbering and other formatting methods



16. Bullet List
17. Number List
18. Multilevel List
19. Shading/ Background Color
20. Border

N.B. For the selected sentences, you can use 'Bullets and Numbering' from 'Paragraph' section.

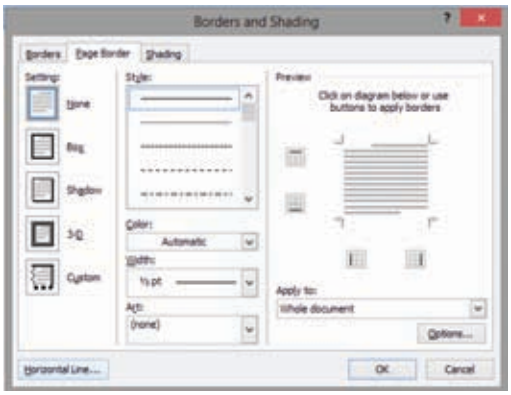
1. Press Tab on the key board

2. Press Shift + Tab at the end of the Multilevel list to combine it to the main list again

21. Shading / Adding background colours and borders

For Microsoft Word...

- Select the paragraph / document
- Select 'Page Borders' from 'Page Layout' → Page Background
- Use Borders/ Page Border/ Shading for this on Borders and Shading Dialogue Box.
- Click Ok



For LibreOffice Writer...

For colours to the paragraph:

- Format → Character → Background Select a necessary colour from the tabs

For Borders;

- Select 'Format →Paragraph → Border'

For colours to the document:

Select the necessary colour from 'Format → Page → Background'

For Borders:

- select the necessary border and colour from 'Format → Page → Border'

After selecting, click 'Ok'.

Activity

Open the Word Processing software and perform the following.

1. Open a new page. Make a list of bullets as shown in Activity figure 6. Save the document in your folder as 'Assign6'. Then close the document.

2. Open 'Assign6' file you have saved. Add a border to the page. Save the changed file as 'Assign7' on Save as Type – Word 97 – 2003. Close the document.

Different type of software

- Antivirus
  - AVG
  - Semantic
  - Kaspersky
- E-mail
  - Outlook
  - Yahoo mail
  - Gmail
- Games
  - Worlds of Warcraft
  - Car race
- Internet browser
  - Firefox
  - Explore
  - Google
- Operating system
  - Windows xp
  - Windows 7
  - Linux

Activity 6

6.4 Formatting the Document

Some tools provides clarity and attractiveness to the document are shown below;
(Figure 6.20)

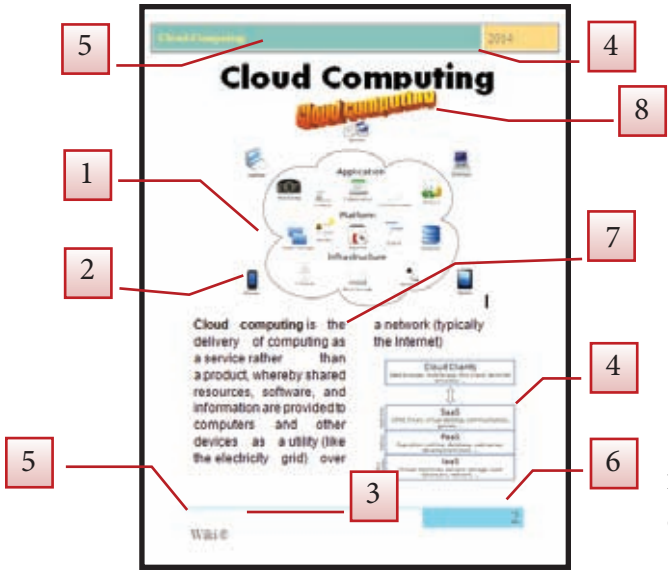


Figure 6.20

1. Shapes / Objects
2. Pictures/ Images/ ClipArt
3. Symbols
4. Tables
5. Header and Footer
6. Page Numbers
7. Columns
8. WordArt/ Fontwork

Apart from the tools mentioned above, you can add other appropriate tools as well.

6.4.1 Shapes and Images

Shapes and images are added to provides clarity and attractiveness to the document. For this, keep the cursor in the place you wish to add the shape or image.

For Microsoft Word...

Use 'Insert' tab and its Ribbon.

- If it is a shape

Select Insert → Shape

- Click a shape on it and drag it to the page clicking the Mouse
- If it is an image, select 'Picture/ ClipArt' on 'Insert' tab.
- Open any image you like

For LibreOffice Writer…

Use Insert tab on Menu Bar

- If it is a shape Select 'Insert Object → OLE Object' Or Select a shape from Drawing tool, click it and drag it to the page using Mouse.
- If it is an image, select 'Insert → Picture From File'
- Open any image you like

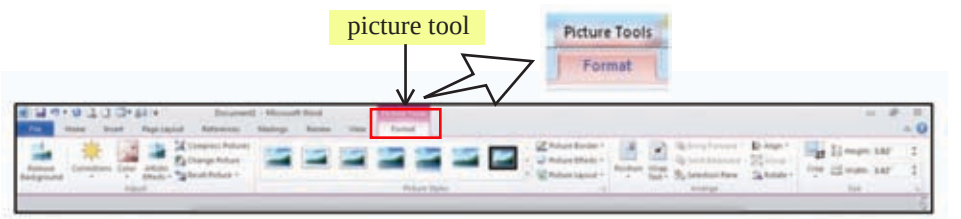
Figure 6.21 – Preparing the shape or image

6.4.2 Formatting the shape or image

User can format the shape or image inserted in the document. For instance, user can change its size, colour, add borders, change its position, etc. (figure 6.21)

First, select the shape or image by clicking on it. Then make use of the Tool Bar to perform the required changes.

The Tool Bar used in Microsoft Word to prepare the shape / image.



The Tool Bar used in LibreOffice Writer to prepare the shape / image.

6.4.3 Symbols

User may use different symbols in document preparation. However, there is a limited number of symbols on the keyboard. Additional symbols are available for use.

For Microsoft Word…

Open the Dialogue Box by clicking 'Insert → Symbols'. Then click 'Insert' to add the necessary symbols to the Document.

For LibreOffice Writer…

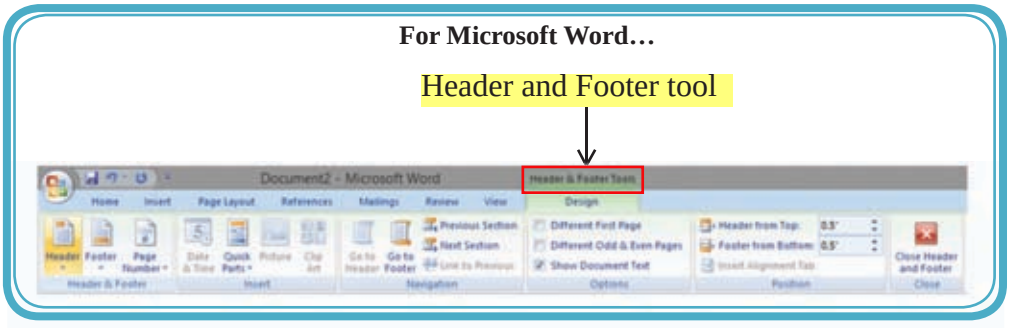
Open the Dialogue Box by clicking 'Insert → Special Character'. Then click 'Ok' on the symbols you need to include to the document.

6.4.4 Header Footer and Page Numbers

It is essential to add Header and Footer and the page numbers in a document For this purpose;

'Insert → Header and Footer' and 'Page Numbers'

For Microsoft Word…



6.4.5 Column

This feature is often used in newspapers and magazines. Columns can be made before or after typing.

For this, select the paragraph.

For Microsoft Word...

'Page Layout' → 'Columns' → select the number of columns you need.

For LibreOffice Writer...

'Formatting' → 'Columns' → select the number of columns you need.

Activity

1. Open the Word Processing software and perform the following.
2. Open a new page. Type the paragraphs given in Activity 7. Then format the paragraphs as given below. Save the document as Assign10 with the password 'WordPass' password. Close the document.

Electronic Waste Disposal

Electronic waste (e-waste): what is it and how do we get rid of it ?

This term applies to consumer and business electronic equipment that is near or at the end of its useful life There is no clear definition for electronic waste (e-waste) at this time, but if you can plug it in an electrical outlet or it contains circuit boards or chips, it is most likely e-waste. These products can contain heavy metals like cadmium, lead, copper, and chromium that can contaminate the environment Do NOT dispose of these items in the trash or your recycling bins.

Examples of electronic waste include, but not limited to :

- ★ **TVs, computer monitors, Printers, Scanners, Keyboards, mice, cables, circuit boards, lamps, clocks, flashlight, calculators, phones, answering machines, digital / video cameras, radios, VCRs, DVD players, MP3 and CD players.**
- ★ **Kitchen equipment (toasters, coffee makers, microwave evens)**
- ★ **Laboratory equipment (hot plates, microscopes, calorimeters)**
- ★ **Broken computer monitors, television tubes (CRTs)**

Student E - waste Recycling Options

Any laboratory equipment that has the possibility of being contaminated with chemical, biological, or radioactive substances must be cleared through EH&S and Departmental Facilities Office before disposal.

If you live on - campus you can dispose of your electronic waste easity and conveniently by creating a Fix It Ticket or contacting your college maintenance office.

If you live off - campus, learn more about the Sants Cruz County electronic waste disposal program:

Additional information on disposal / recycling of e-waste and other regulated items can be found in all college mailrooms, Graduate Student Housing Mailroom and the Village Laundry Community room. Multibins are blue cabinets built to collect batteries, small electronics, printer cartideges, and CDs. They are located in every college mailroom.

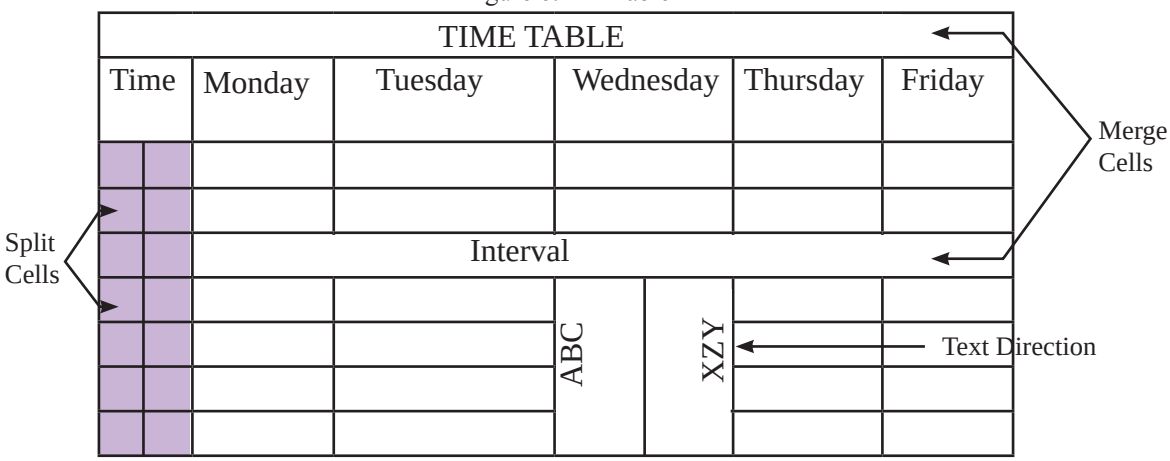
Activity 7

6.4.6 Tables

User may need to tabulate data in documents. For this purpose, you need to prepare a standard table. Word Processing software provides facilities to prepare tables. Some of them are;

- Insert or draw the required rows and columns.
- Delete unnecessary rows / columns.
- Merge cells.
- Split cells.
- Colour the table.
- Change text direction.
- Text Direction.

Figure 6.12 – Table



- To insert the Table

For Microsoft Word...

- Insert → Table
- Select the necessary rows and columns
- Insert the necessary rows and columns in 'Insert Table'
- Click 'Ok'

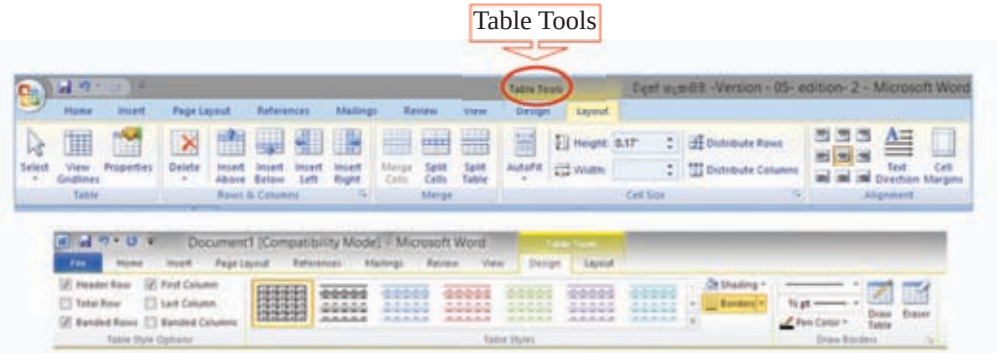
For LibreOffice Writer…

- Table →Insert→Table
- Insert the necessary rows and columns in 'Insert →Table'
- Click 'Insert'

- Select Table, rows, columns, cells before you create the table.
- To move from cell to cell, use arrow keys on the key board, Tab key or click mouse.

Format tables;

For Microsoft Word…



After creating a table, Table Tools Ribbon will be opened when you select that created table. You can select the adjustments you need to add for the table/ rows/ columns/ cells from 'Design' and 'Layout' ribbons.

E.g.: Merging

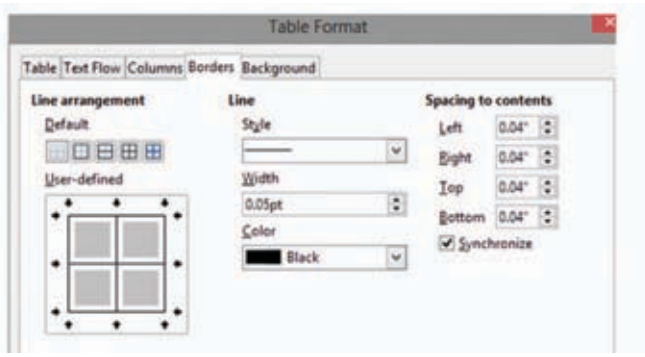
1. Select the rows/ columns/ cells you wish to merge.
2. Click 'Layout' ribbon on 'Table Tools'. Click on 'Merge Cells'.

For LibreOffice…

After creating a table, select the table. Click on the 'Table' tab on Menu Bar.

Make use of tools such as Delete, Select, Insert, Split, Merge on the Menu Bar.

Also make use of the Dialogue Box opened by selecting Table → Table Properties → Table Format.



Activity

1. Open a new page. Create a table as shown in activity 8.
2. Save that document in your folder as 'Assign11'.

Class Time Table - Grade 10

	Monday	Tuesday	Wednesday	Thursday	Friday
Period 1					
Period 2					
Period 3					
Period 4					
INTERVAL					
Period 5					
Period 6					
Period 7					
Period 8					

Activity 8

6.5 Proof reading

6.5.1 Correcting Spelling and Grammar

Spelling and Grammar errors will be indicated automatically, and also the possible words will be shown. Spelling errors are underlined in red colour and grammar errors are underlined in green colour.

Step 1 Drag the cursor to the opening of the document.

For Microsoft Word…….

- Use 'Review → Spelling and Grammar'

For LibreOffice Writer……..

- Use 'Tools → Spelling and Grammar'

Step 2 Click 'Change' after selecting the correct word for the red or green underlined wrong word. Click 'Ignore' for the words which are not there in English Dictionary. (names of people, villages, countries)

6.5.2 Thesaurus

Thesaurus can be used to find synonyms for the words in documents. For this purpose,

- Select the word you have typed.

For Microsoft Word...

Review → Thesaurus

For LibreOffice Writer...

- Tools → Language → Thesaurus

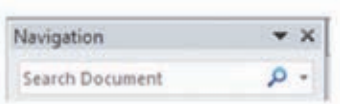
6.5.3 Find and Replace Words

Suppose that the user has to delete a word in the document. If the document contains many pages, finding the word would not be easy. You can use 'Find' facility for this.

- Get the cursor to the beginning of the document.

For Microsoft Word…

- Click 'Find' in Home → Editing



- As shown above, type the word you need to find in Search Document on Tool Bar.

For LibreOffice Writer...

Click Edit → Find

Type the word you need to find in 'Find' place in the Tool Bar as shown above. Then click 'Find Next'.

- To replace a word in the document with another word, replace facility is used. For this,

For Microsoft Word…

- Click 'Replace' in 'Home → Editing'

For LibreOffice writer…

- Click 'Replace' in Edit Menu

- In the Window you get, type the word you need to find in 'Find What' or 'Search for'. Then click Replace / Replace All. Figure 6.22

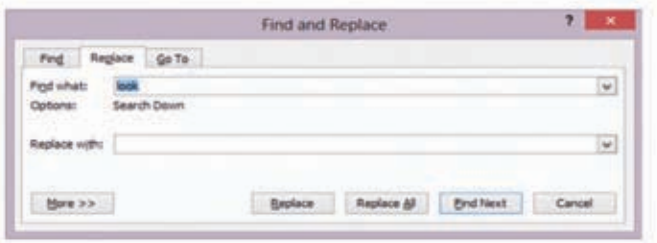


Figure 6.22 – Find and Replace

Activity

Open the Word Processing software and perform the following.

1. Type the paragraphs given in Activity 9. Save that document in the folder as 'Assign12'.

Cloud Computing

Cloud computing is the delivery of computing services over the Internet. Cloud services allow individuals and businesses to use software and hardware that are managed by third parties at remote locations. Examples of cloud services include online file storage, social networking sites, webmail, and online business applications.

The cloud computing model allows access to information and computer resources from anywhere that a network connection is available. Cloud computing provides a shared pool of resources, including data storage space, networks, computer processing power, and specialized corporate and user applications.

Activity figure 9

2. Change letters of the following words as.

   - Businesses – Businasses
   - Computing – camputing
   - Network – natwork
   - Promises – prommises
   - Resource – resourses

3. Then correct those words using Spelling and Grammar facility.

4. Find the following words using 'Find' facility.
   Webmail, information, storage

5. Replace the following words using Replace facility.

   - Business – trade
   - Expensive – luxurious
   - Connection – relation

6. After replacing words, save your document in your folder as 'Assign13'.

6.6 Print

6.6.1 Print Preview

Print Preview is useful to check the document before printing. User can check whether the document is prepared as needed such as indentation, borders, etc.

6.6.2 Print

This tool is used to print the document.

Get the 'Print' dialogue box by selecting 'File → Print'. The following are images of Microsoft Office Print (Figure 6.23) and LibreOffice Print (Figure 6.24)

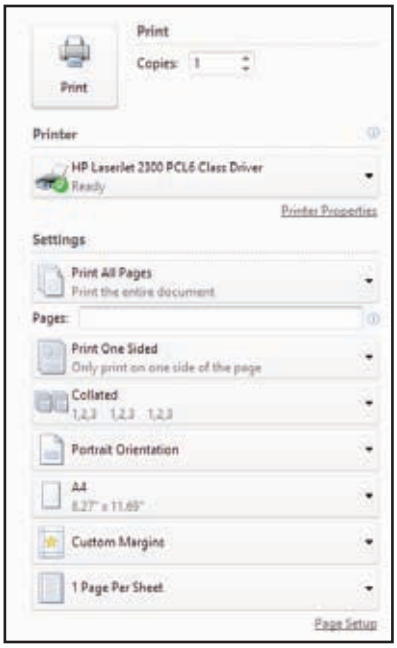


Figure 6.23 - Microsoft Office Print

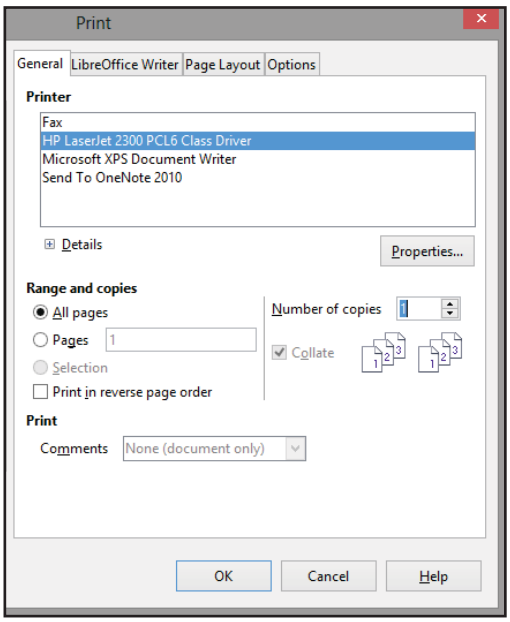


Figure 6.24 - LibreOffice Print

Print dialogue box opened in the word processing software allows to;

- Select the printer
- Print the current page, a few pages or the whole document. (current page, Pages or All)
- Specify the number of copies.

N.B.: Since it is difficult to print documents for each student in the school laboratory, you can save the document with 'pdf' format and. For this purpose,

- File → Print → Microsoft XPC Document

  or

- Writer Adobe PDF → Print → Give a names for the file → Save

6.7 Mail Merge

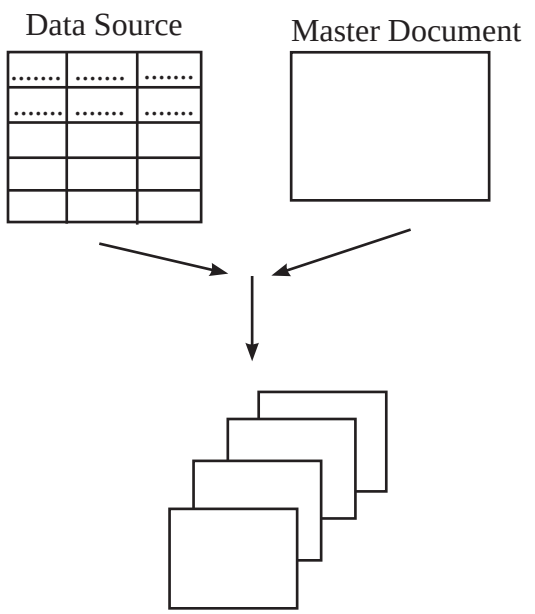
Mail Merge is used to send a invitations, letters or to print certificates to several people. For this process, you can use the data etc saved in address box saved using Mail Merge. User can create address for labels print.

In this lesson you can learn,

- How to create and save the Data Source / Address List.
- How to create letters, labels and post cards using the Data Source.
- How to format a document before printing.

Use Mail Merge:

- Type the document first.



Mail merge process: Letters, Address Label

For Microsoft Word...

- Step 1. Select Mailing Tab.
- Step 2. Select 'Start Mail Merge → Letter'
- To create or select Data Source…
- Step 3. Select 'Select Recipient → Type New List'.
  ∗N.B.: To retrieve saved data, select 'Use Existing list'.
- Step 4. By clicking 'Customize', change the fields in New address list window. Those are,
  a. Add (for a new field)
  b. Delete (to delete a field)
  c. Rename (to change field name)
- Step 5. After changing, click Ok.
- Step 6. Type the necessary data. For this, use
  a. New Entry (for a new address)
  b. Delete Entry (to delete an address)
  c. Find (to find an address which is saved)
- Step 7. After changing, click Ok and save.
- To create Address Block, use
  a. More
  b. Match Field
- Step 8. Click 'Next' or 'Ok' after changes.
- Step 9. Use this tool to add Greeting Line.
- Step 10. After necessary changes click 'Next' or 'Ok'.
- You can use additional fields by using 'Insert Merge Field'. For this, keep the cursor at the necessary place. Then,
- Step 11. Add necessary fields to the document by clicking 'Insert Merge Field'.
- To get letters separately;
- Step 12. Select 'Finish & Merge edit Individual documents'.
- Step 13. Save the prepared documents and print.

For LibreOffice Writer…

- Step 1. Select Tool → Mailing Wizard.
- Step 2. Select 'Select Starting document → Use the current document → Next'.
- Step 3. Select the document type → Letter → Next
- To create or select the Address List,
- Step 4. Select 'Insert Address Block → Select Address List → Create'
  *N.B.: To retrieve data which is saved, select 'Add'.
- Step 5. Change the fields as required for the document by clicking 'Customize' in 'New address List' window. For this, use
  a. Add (for a new field)
  b. Delete (to delete an unnecessary field)
  c. Rename (to change the name of the field)
- Step 6. After changes, click Ok.
- Step 7. Type the necessary data. For this,
  a. New (for a new address)
  b. Delete (to delete an address)
  c. Find (to find an address which is saved)
- Step 8. After changes click Ok. Then save it in a proper place with a proper name.
- Step 9. Click Ok again.
- Step 10. Follow step 2, 3, 4 respectively which are in 'Insert address block' window.
  a. To decide Address Block. This can be used for
  b. More
  c. Match Field
- Step 11. After necessary changes click Next.
- Step 12. Use this window to create a salutation. Do necessary changes.
- Step 13. Click Next.
- Step 14. To place your address, use 'Adjust layout of address block and salutation' window. Click Next.
- Step 15. Use Preview and edit the document window to select the people who get letters and to get a preview of the document.
- Step 16. Personalize document allows you to find addresses and to make one document.
- Step 17. Connect to Mail Merge Menu by clicking Return to Mail Merge Wizard. Go ahead while clicking Next.
- Step 18. Use 'Save, Print or send document window' for various savings and printing.
  a. Save starting document – to save the initial letter
  b. Save merged document – to save the merged letter
  c. Print merged document – to print the merged letter
  d. Send merged document as E-mail – to email the merged letter

Activity

Open the Word Processing software and perform the following.

1. Type the letter shown in Activity 10. However, do not type the words and symbols which appear in between <...>. Keep one space. Then save the document in your folder as 'Assign10'.

Computer Resouce Centre
Senkadagala
28. 04.2014
‹Title› ‹First Name› ‹Last Name›
‹Address Line 1›
‹Address Line 2›

Teacher Parent Interact day

Please take this opportunity to discuss the progress of your child ‹child's Name› by meeting the class teacher on ‹Date› at ‹Time› at the classroom.

Principal

Activity 10

2. Use Mail Merge. For Data source / Address List, enter data of 10 people as shown in the table below.

Title	Firts Name	Last Name	Address 1	Address 2	Child-Name	Date	Time
Mr.	Chaminda	Sampath	Pelawaththa	Battaramulla	Yawaha	26.06.2014	9.00 am
Mrs.	Pushparani	Chandrabose	Mattakkuliya	Colombo	Derwin	26.06.2014	9.30 am
Mr.	Mohamed	Amith	Hills Street	Dehiwala	Sharmila	26.06.2014	10.00 am

Activity

1. Open the Word Processing software and prepare the following.
   - Certificates
   - Invitation cards
   - Forms
   - Letters
   - Announcements
   - A banner

2. Save the document you have prepared. Creat a PDF file.

6.7.1 Shortcut Keys

Shortcut keys are used for the efficient use of the application. The following are some of the shortcut keys. User can save time using the shortcut keys.

Shortcut Key	Function
Ctrl + N	Get a new document
Ctrl + S	Name the document and to save
Ctrl + O	Open a document
Ctrl + A	Select the document
Ctrl + C	Copy letters / objects
Ctrl + X	Cut letters / objects
Ctrl + V	Paste letters / objects
Ctrl + H	Replace words
Ctrl + HOME	Get the cursor to the opening of the document
Ctrl + END	Get the cursor to the end of the document

Summary

What is Word Processing, benefits of using a Word Processing software

- Types of software (Commercial and Free and Open Source)
- Graphical User Interface of a Word Processing software

Important things in preparing a new document

- Preparing a new document
- Methods of saving
- Opening a file which is saved

Preparing a document'

- Page Setup
- Methods of selecting
- Formatting – text formatting, paragraph formatting, using bullets and numbers, shading, adding borders

Formatting the document

- Adding and changing shapes and images
- Using symbols
- Adding Header and Footer, Page Numbers
- Creating columns
- Inserting and changing tables

Proof reading and Printing

- Finding and correcting spelling and grammar errors
- Using Thesaurus
- Finding and replacing words
- Printing documents

Mail Merge

- Preparing Data Source
- Adding fields to the Mail Merge
- Printing.

7 Electronic Spreadsheet

In this chapter you will learn

- fundamental functions and operations of spreadsheets
- identifying the components of a worksheet
- entering and editing data in a worksheet
- simple mathematical operators and building a formula using values
- use of function and cell address for writing formulae
- formatting a worksheet
- use of relative and absolute cell addresses,
- creating charts.

7.1 Introduction

Perhaps in our day-to-day life or at work we need to perform calculations. We use various methods to perform such calculations. Depending on the nature of calculations we use our fingers or mental calculations to perform simple calculations while we use calculators or paper based systems to compute complex calculations. In order to do calculations easily and accurately let us learn how electronic spreadsheets can be used.




We usually use a square ruled book to perform systematic calculations. Every page in this book consists of pages with rows and columns. Electronic Spreadsheets which consist of multiples of rows and columns based on this model of square ruled books.

Using Electronic Spreadsheets we can accurately and efficiently perform the following activities:

- Simple and complex calculations
- Presentation of data in charts
- Show data in ascending and descending order
- Segregate only the required data
- Check the validity of data
- Protection of data using passwords
- Saving for future use

7.1.1 Electronic Spreadsheet Application Software

The table 7.1 below illustrates some of the Electronic Spreadsheet Application Software developed by different companies.

Table 7.1 - Some Spreadsheet Applications and the and organizations

Software	Company
Excel	Microsoft Corporation
Numbers	Apple Inc
Libreoffice Calc	The Document Foundation
Openoffice Calc	Apache Foundation

7.1.2 Using Spreadsheet Software

Out of the many spreadsheet software, we discuss only about Microsoft Office Excel 2010 and LibreOffice Calc in this unit. Please note that the method of starting an spreadsheet software may vary according to the operating system and its versions.

For Microsoft Office Excel 2010

Start → Programs→ Microsoft Office→ Microsoft Office Excel 2010

For LibreOffice Calc

Start → Programs → LibreOffice LibreOffice Calc →

7.1.3 The user interface and the components of Microsoft Excel 2010

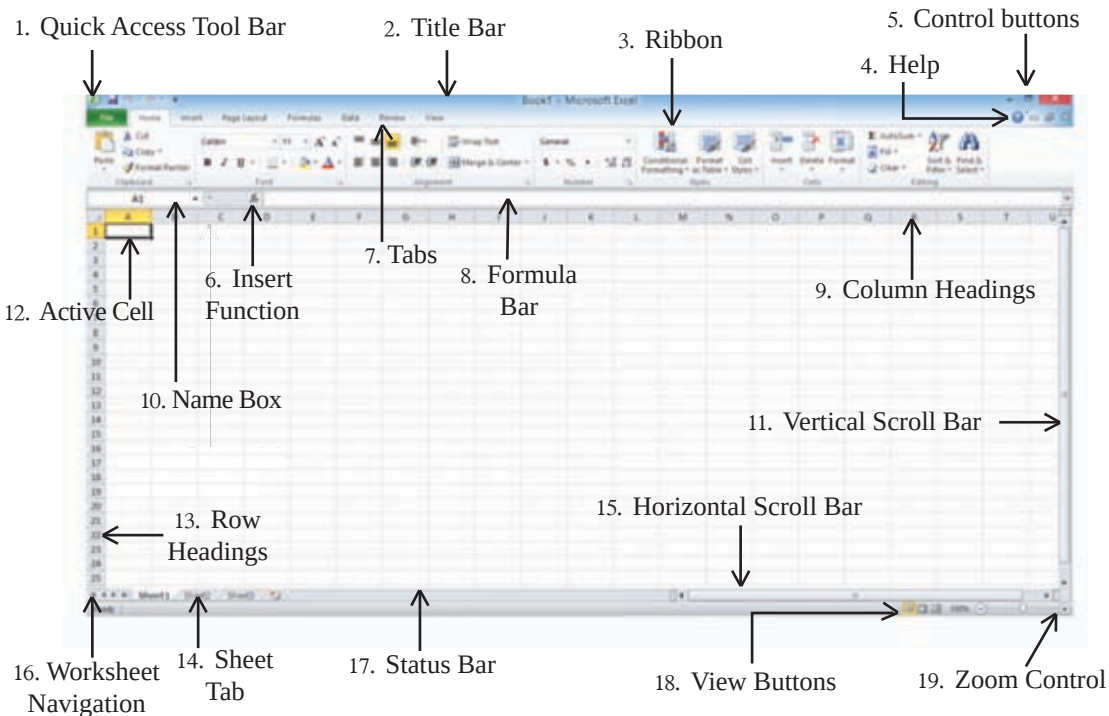


Figure 7.1- The user interface of Microsoft Excel 2010

Table 7.2 - Components of Microsoft Excel 2010

Component	Funtion
1. Quick Access Tool Bar	Contains commonly used commands such as Save , Print Preview, Undo , New etc
2. Title Bar	Shows the name of the Application Software
3. Ribbon	Contains a toolbar with, Home, Insert, Page layout
4. Help	Provides help functions
5. Control Buttons	To minimize, open or to expand the worksheet window
6. Insert Functions	Opens dialog box to create formulae.
7. Tabs	Changes ribbon
8. Formulae Bar	Views the formula and displays the contents of a cell.

9. Column Heading	Shows column name
10. Name Box	Shows active cell address
11. Vertical Scroll Bar	Scrolls the worksheet vertically
12. Active Cell	Displays the cell in which data is entered
13. Row Heading	Shows row number
14. Sheet Tabs	Represents the worksheet
15. Horizontal Scroll Bar	Scrolls the worksheet horizontally
16. Sheet Tab Scroll Button	Changes the worksheet
17. Status Bar	Displays the status of the worksheet
18. View Button	Enables to change the view of the worksheet
19. Zoom Control	Zooms in or zooms out the view of a worksheets

7.1.4 The user interface and the components LibreOffice Calc

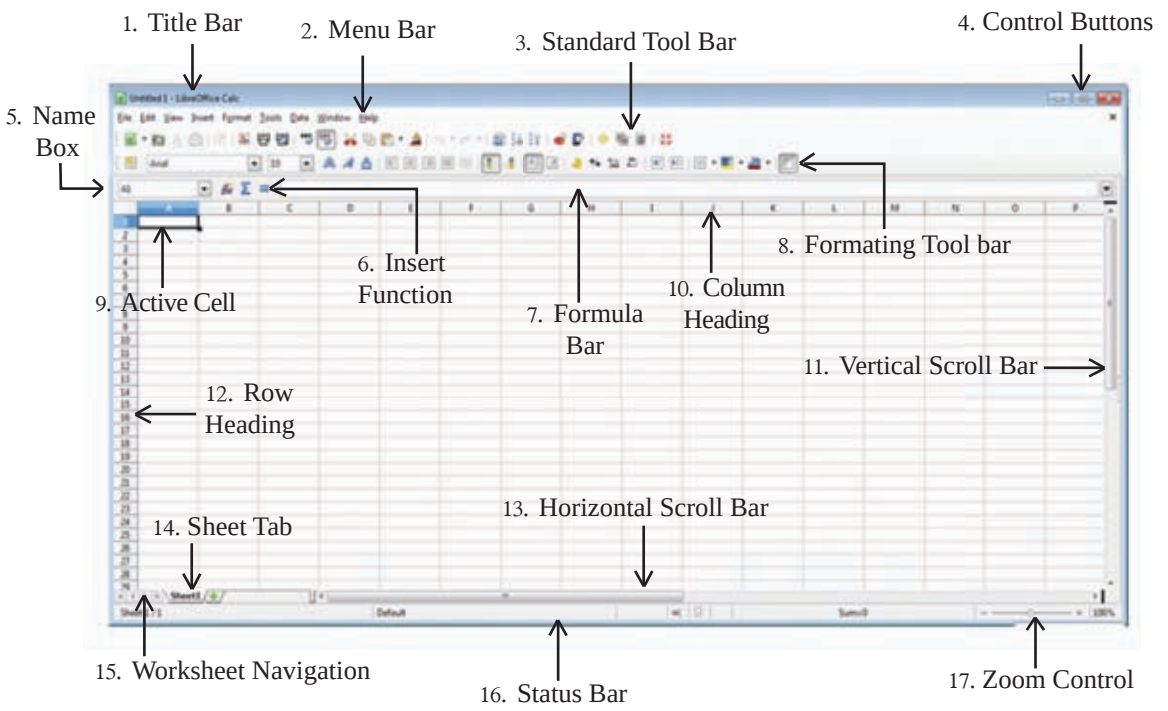


Figure 7.2 - User interface of LibreOffice Calc 4.1

Table 7.3 - Components of LibreOffice Calc 4.1

Component	Funtion
1. Title Bar	Shows the name of the application software
2. Menu bar	Helps to select commands
3. Standard tool bar	Useful to select standard tools
4. Control buttons	Minimizes, opens or to maximize the worksheet window
5. Name box	Shows the address of the active cell
6. Insert Functions	Opens dialog box to make formulae.
7. Formulae bar	To view formula and display the contents of a cell.
8. Formatting tool bar	Helps to format worksheet
9. Active cell	Displays cell in which data is entered
10. Column heading	Shows column name
11. Vertical scroll bar	Scrolls worksheet vertically
12. Row heading	Shows row number
13. Horizontal scroll bar	Scrolls worksheet horizontally
14. Sheet tabs	Represents worksheet.
15. Tab scroll button	Changes worksheet.
16. Status Bar	Displays the status of worksheet.
17. Zoom Control	Zooms in or zooms out view of a worksheet

7.1.5 Worksheet

A worksheet is made up of a multitude of cells made by columns and rows on a two dimensional plane. Each worksheet is denoted by a sheet tab.

7.1.6 Naming the columns in a worksheet

Each column of a worksheet is assigned an English letter or a combination of letters as shown below: See Figure 7.3

A,B,C,D,.....upto Z
AA,AB,AC.AD,AE,.....upto AZ
BA,BB,BC,BD,BF.....upto BZ

7.1.7 Naming the rows in a worksheet

Each row of a worksheet is assigned a row number as 1,2,3,4,5... etc as shown below: See Figure 7.3

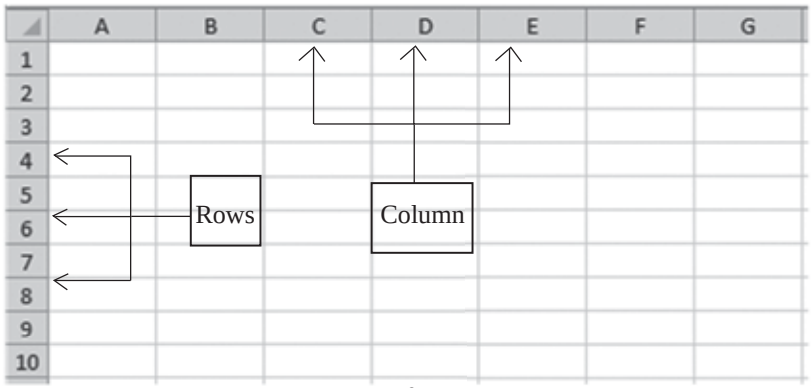


Figure 7.3 - Positions of rows and coumns in a worksheet

Usually the number of rows and columns of a worksheet is a power of two.

Worksheet application	Number of rows	Number of columns
Microsoft Excel 2003	65536 (2^{16})	256 (2^{8})
Microsoft Excel 2007/2010	1048576 (2^{20})	16384 (2^{14})
LibreOffice Calc 4.1	1048576 (2^{20})	1024 (2^{10})

7.1.8 Active Cell

It is needed to select the cell before entering data in it. A currently selected cell is called an active cell. B3 is the active cell in the worksheet below. An active cell always has a thick border. See Figure 7.4

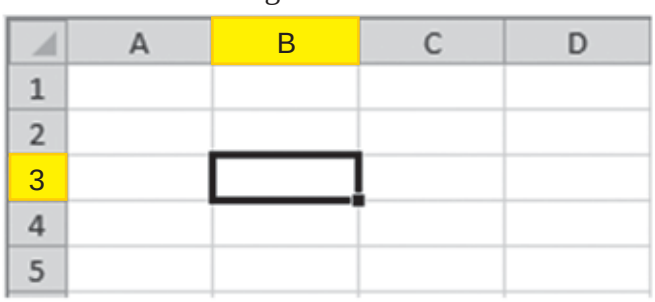


Figure 7.4 - Active cell in a worksheet

7.2 Scrolling in a worksheet

In order to enter data the cell, it should be selected. Active cell in a worksheet can be moved and selected by the keys or a combination of keys.

Key/combination of keys	Result
Arrow keys	Move a single cell in any direction (left, right, up, down)
Ctrl + Arrow Keys	Moves the cell to the end of the data range in a particular direction
Home	Moves to column A along the row where the active cell is
Ctrl + Home	Moves the cell to A1 position
Ctrl + End	Moves to bottom right cell of the data range
Page Up	Moves the worksheet one screen up
Page Down	Moves the worksheet one screen down

7.2.1 Cell Address

A cell address is denoted first by the column letter and secondly by the row number. The address of the active cell is displayed in the name box.

Ex: A cell at D column and 3rd row would be named D3. See Figure 7.5

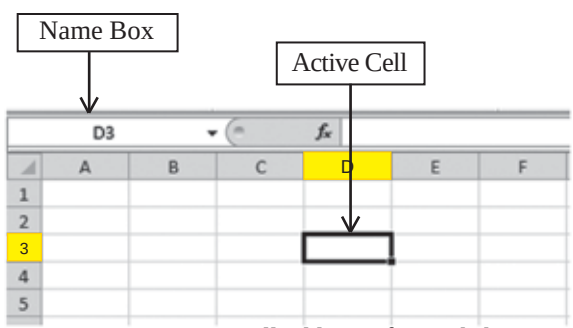


Figure 7.5 - Cell address of a worksheet

Activity

The cell address KD74 is situated in row number ……. and column letter …….

7.2.2 Range of Cells

A block of adjacent cells in a worksheet which is highlighted or selected is called a range of cells. Observe the worksheets below.

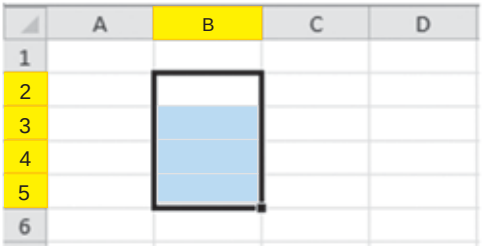


Figure 7.6 - A range of cells in a column (B2:B5)

This range of cells consists of the cells namely B2, B3, B4, B5. The range of cells starts in B2 and ending in B5. Column letter is constant in a cell range along a column. The cell range in figure 7.6 is represented by B2:B5.

This range of cells is represented as A3:C3. The range in Figure 7.7 consists of the cells A3, B3, C3. This range of cells is represented as A3:C3. Row number is constant in a cell range along a row.

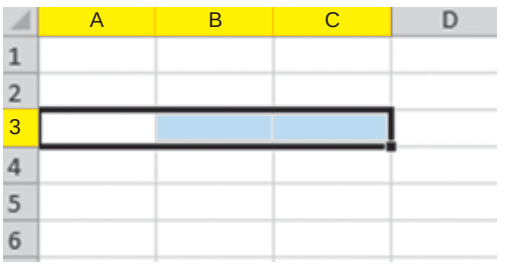


Figure 7.7 - A range of cell in a row

For this cell range in Figure 7.8, cells; B2, B3, B4, C2, C3, and C4 are included.

The cell range in figure 7.8 is represented by B2: C4 The column letter and the row number vary in a range of cells spanning several rows and columns.

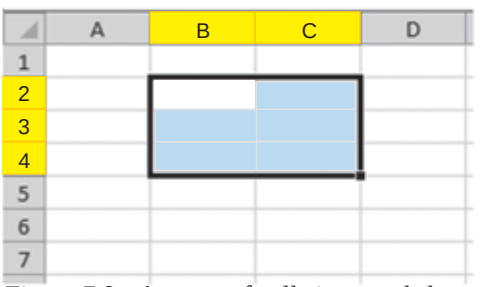


Figure 7.8 - A range of cells in a worksheet spanning several rows and columns

Note: The control key is used to select more than one 'range of cells' in a worksheet. The control key is marked 'Ctrl' on the key board.

Activity

Answer the questions based on the worksheet shown on Figure 7.9

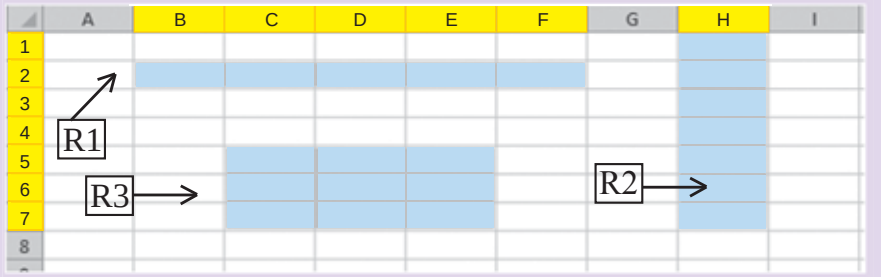


Figure 7.9 - Range of cells in a worksheet

(1) What is the address of the first cell represented by R1cell range?
(2) What is the address of the last cell represented by R1cell range?
(3) Write the cell range represented by R1.
(4) Write the cell range represented by R2.
(5) What is the name of the cell range along a row?
(6) What is the name of the cell range along a column?
(7) Write the cell range represented by R3.
(8) Give the number of cells in the cell range represented by R3.

7.2.3 Entering Data

Before entering data in a worksheet, we need to select the required cell. We can enter the data once it is selected. The contents of a cell would be either a label, value or formula.

1. Label

A combination of letters, numbers, special symbols or the text entered using a keyboard are called labels. By default the labels are left aligned.

Figure 7.10 below shows how labels are left aligned.

Note: The telephone numbers would not be displayed in the same way as shown below. (The first letter '0' is not displayed). You need to specify the range of cells where the telephone numbers to be entered as 'Text'. Formatting cells would be discussed in a later lesson.

	A	B	C	D	E	F
1	Name	District	Province	Telephone Number	E - mail	
2	Piumi Kaushalya	Kegalle	Sabaragamuwa	03512232438	Piumi@gmail.com	
3	A.Mallikadevi	Kandy	Central	08350632867	maldevi@yahoo.com	
4	Dilisha Gamhewa	Colombo	Western	01278643563	Dilesha@hotmal.com	
5	Hakeem Anver	Matara	Southern	01369589596	anwerhac@live.com	
6						

Figure 7.10 - labels in a worksheet are left aligned

2. Values

The data with numerical figure are called values. By default value is right aligned. Figure 7.11 shows various ways how data are represented as values.

	A	B
1	Integer	23
2	Decimal	5.72
3	Fractional	3 1/4
4	Percentage	65%
5	Scientific	4.37E+04
6	Date	5/12/2007
7	Time	2.45 PM
8	Currency	Rs 400.00

Figure 7.11 - values are right aligned

Note: When entering fraction numbers a space needs to be entered after the whole number.

3. Formulae

The expressions beginning with an equals '=' mark using values, cell address and functions are called a formula. When a formula is entered in a cell in a worksheet the value of the equation is displayed in the cell and the formula is shown in the formula bar.

Example: Getting the total value of cells A1 and B1 into cell C1 (See Figure 7.12)

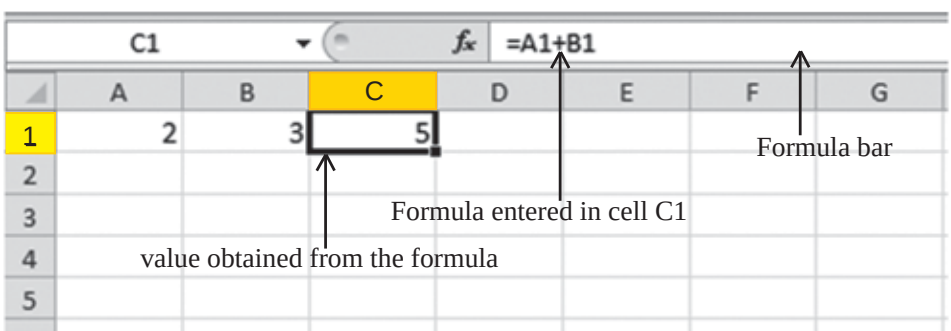


Figure 7.12 - showing values and formula

7.3 Mathematical operators used in formulae

Operator	Meaning
+	addition
-	subtraction
*	multiplication
/	division
^	exponentiation (power)

Note: The order of evaluation can be changed by using brackets. (The expressions within the brackets are evaluated first).

Operator precedence:

First	( )	
Second	^	
Third	* , /	
Fourth	+ , -	reduce top to bottom.

7. 3.1 Simple calculations using values and operators

Table 7.4 below shows a few formulae written using values and operators

Table 7.4 - Writing simple formul

Operator		Formula	Result
Addition	(+)	= 2+4	6
Subtraction	(-)	= 5-2	3
Multiplication	(*)	= 4*5	20
Division	(/)	= 12/6	2
Exponentiation	(^)	= 2^4	16

There can be more than one operator in a formula. Let us learn how to evaluate the operators in order. See the tables 7.5 and 7.6

Table 7.5 - Use of brackets in simple equations

Formula	Evaluation method	Result
= 2+4*3	= 2+12	= 14
= (2+4)*3	= 6*3	= 18
= 4*3^2	= 4*9	= 36
= (4*3)^2	= 12^2	= 144

Table 7.6 - Methods of evaluation of equations

Examples	= 5+2*3^2/6-3	= 5+2*3^2/(6-3)	= 8/2*3-2^3+5
Steps of evaluation	= 5+2*3^2/6-3	= 5+2*3^2/(6-3)	= 8/2*3-2^3+5
	= 5+2*9/6-3	= 5+2*3^2/3	= 8/2*3-8+5
	= 5+18/6-3	= 5+2*9/3	= 4*3-8+5
	= 5+3 - 3	= 5+18/3	= 12-8+5
	= 8-3	= 5+6	= 4+5
Answer	= 5	= 11	= 9

Note: When brackets are not used operators in the same level such as multiplication (*) and subtraction (-) and addition (+) and subtraction (-) are executed from left to right.

Activity

Evaluate the following equations.

(1) = 6-4/2 (6) = 4+5*2^3 (11) = 5/2+1^3*4
(2) = 5*4+3 (7) = 8/4*2 (12) = 3-4*3/2
(3) = 3+4*5 (8) = -4/2+2 (13) = 6/3*2^1-3
(4) = 2^5+3 (9) = 1+2^2*3 (14) = 3*(2+4)/9+1
(5) = 3+5^2 (10) = 3*4/2 (15) = 2^3/(5-1^3)*5

7.3.2 Formulas with cell addresses and operators

The main advantage of entering formulae using cell addresses and operators is when the values of the cells concerned change, the results obtained by the formulae also get updated accordingly.

Example 1

In order to calculate the perimeter and area of a rectangle, let us enter the length and breadth of the rectangle in cells A2 and B2 respectively. The formulae to derive the perimeter are entered in cells C2,C3,C4 and the formula to derive the area is entered in cell D2. See Figure 7.13

	A	B	C	D
1	Length of the Rectangle	Breadth of the Rectangle	Perimeter	Area
2	45	24	=A2+A2+B2+B2	=A2*B2
3			=A2*2+B2*2	
4			=(A2+B2)*2	
5				

Figure 7.13 - The perimeter and area of a rectangle

Activity

Create a worksheet in your spreadsheet application based on the image 7.13. Observe the changes in values obtained from the formulae in column C and D when you enter different values in cells A2 and B2.

Important: In cell D2 if you write the formula D2=A2*B2 it would be taken as a label and hence calculations do not happen. Therefore it is important to remember that nothing should be written on the left side of the equal sign ('='). (See image 7.15).

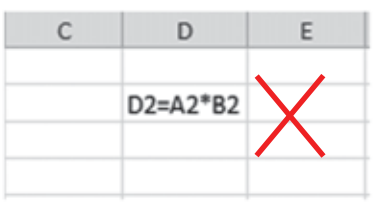


Figure 7.14 - The incorrect way of writing the formula

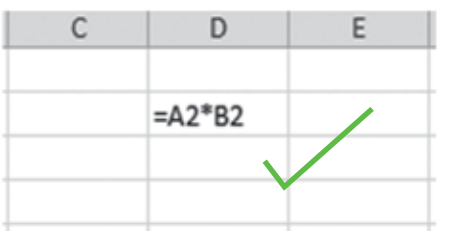


Figure 7.15 - The correct way of writing the formula

Example 2

See the formulae in the worksheet given in Figure 7.16 when the price of each pencil and book are given.

	A	B	C
1	Price of a Book	48	
2	Price of a Pencil	12	
3	Price of book and pencil	=B1+B2	
4	Difference between the price of a book and a pencil	=B1-B2	
5	Price of 4 books	=B1*3	
6	Price of 4 books and 2 pencils	=B1*4+B2*2	
7			

Figure 7.16 - Price calculation

Activity

Prepare the worksheet shown in Figure 7.16 using a Spreadsheet application. Change the values in cells B1 and B2. Observe the results obtained from the formulae in cells B3, B4, B5 and B6.

Example 3

Calculating the area and volume of a cube when the length of one side is given. (See Figure 7.17)

	A	B	C
1	Side length of the Cube	8	
2	Side area of the Cube	=B1^2	
3	Total area of the Cube	=6*B1^2	
4	Volume of the Cube	=B1^3	
5			

Figure 7.17 - Finding the area and volume of a cube

Activity

Create a the worksheet shown in Figure 7.17 using a Spreadsheet application. Change the values in the cell B1 and observe the results obtained from the formulae in the cells B2, B3 and B4.

Note: The results obtained from a formula (based on cell addresses) always get updated when the values of these cells mentioned in the formula change.

Activity

Study the worksheet (Figure 7.18) and the table 7.7 containing formulae. Now calculate the result of each formula shown in table 7.7 in accordance with the Precedence of Operators and write the results under the 'results' column.

	A	B	C	D	E
1	7	5	4	2	
2	3	1	9	4	
3	6	2	4	8	
4					

Figure 7.18 - Worksheet with data

Formula	Result
=A1+B1	12
=C1+C2+C3	17
=B2+C3+B3	7
=A2*C1	12
=C2/A2*D1	6
=B3^A2+D1	10

Table 7.7

Formula	Result
=A1*B1-D2	
=D1-C2/A2	
=B3^C3-A3	
=A1*C1/C3	
=D2*C4*E1	
=A3/B3+A2*D1	
=A1+(B2*C2)-B3+C2/B2	
=B2-B3+B1*(D1+D2^B1)	
=A2^B3-C2+A3*(B3+C1)	
=A3/C3*(D2*D1)	
=D3/C3/B3*A3+B2	
=(D3/(A1+B2))^C2	

7.4 Use of functions to do calculations

When there is a large quantity of data it becomes a difficult and complex task to write formulae using only the cell addresses. In this kind of situation functions are used. The spreadsheet applications contain different functions to meet the requirements of different fields. Let us learn some of basic functions which are commonly used. (See table 7.8)

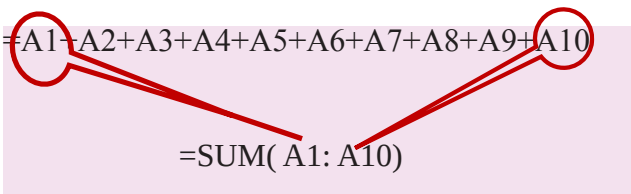
Table 7.8

Name of function	Syntax	Use
SUM	=SUM(Number1,Number2.....)	Adds the values contained in a range of cells.
AVERAGE	=AVERAGE(Number1,Number2.....)	Finds out the average of the values contained in a range of cells.
MAX	=MAX(Number1,Number2.....)	Finds out the largest value contained in a range of cells.
MIN	=MIN(Number1,Number2.....)	Finds out the smallest value contained in a range of cells.
COUNT	=COUNT(Number1,Number2.....)	Counts the number of cells within a range of cells.

For example, look at the methods 1 and 2 given below. In order to find out the sum of the values of cells A1 to A10, method 1 uses cell addresses whereas method 2 uses a function. The same results are obtained from both methods. However, when there is a large range of cells, the formula shown by method 2 is simple and easy compared to both the methods.

=A1+A2+A3+A4+A5+A6+A7+A8+A9+A10 ⟶ ①

=SUM(A1:A10) ⟶ ②



Only the starting cell address and the last cell address in a function need to be included.

Create a function based formulae based on the worksheet given in 7.19.

	A	B	C	D
1	2	6	4	
2	5	3	7	
3	5	9	12	
4				

Figure 7.19 - Worksheet

Let us identify the various ways in which a function can be used.

SUM function (See table 7.9)

Table 7.9

Formula	Details	Result
= SUM(A1,B1,C1)	The sum of cells A1,B1 and C1	12
= SUM(A1:C1)	The sum of cells in the range of cells from A1 to C1	12
= SUM(A1:C1,B2)	The sum of cells in the range of cells from A1 to C1 and B2	15
= SUM(B1:C2)	The sum of cells in the range of cells from B1 to C2	20
= SUM(A1:A3,C1:C3)	The sum of cells in the range of cells from A1 to A3 and C1 to C3	35

AVERAGE function (See table 7.10)

Table 7.10

Formula	Details	Result
= AVERAGE(A1,B1,C1)	The average of cells A1, B1 and C2	4.00
= AVERAGE(A1:C1)	The average of cells in the range of cells from A1 to C1	4.00
= AVERAGE(A1:C1,B2)	The average of cells in the range of cells from A1 to C1 and B2	3.75
= AVERAGE(B1:C2)	The average of cells in the range of cells from B1 to C2	5.00
= AVERAGE(A1:A3,C1:C3)	The average of cells in the range of cells from A1 to A3 and C1to C3	5.83

Note: When the average is calculated a decimal number with several decimal places may be used. You need the required decimal places in the relevant cell range.

MAX function (See table 7.11)

Table 7.11

Formula	Details	Result
= MAX(A1,B2,C1)	Finds out the largest value among cells A1,B2 and C1	4
= MAX(A2:C2,B3)	Finds out the largest value among the range of cells from A2 to C2 and the cell B3	9
= MAX(A1:C1)	Finds out the largest value among the range of cells from A1 to C1	6
= MAX(A1,B1:C2)	Finds out the largest value among the range of cells from A1 to B1 and the cell C2	7

MIN function (See Table 7.12)

Table 7.12

Formula	Details	Result
= MIN(A1,B2,C1)	Finds out the smallest value among cells A1, B2 and C1	2
= MIN(A2:C2,B3)	Finds out the smallest value among the range of cells from A2 to C2 and the cell B3	3
= MIN(A1:C1)	Finds out the smallest value among the range of cells from A1 to C1	2
= MIN(A1,B1:C2)	Finds out the smallest value among the range of cells from B1 to C2 and the cell A1	2

COUNT function (See Table 7.13)

Table 7.13

Formula	Details	Result
= COUNT(A1,B1)	Counts the number of cells that contain numbers among cells A1, B1	2
= COUNT(A1:C1)	Counts the number of cells that contain numbers in the range of cells from A1 to C1	3
= COUNT(A1:A4)	Counts the number of cells that contain numbers in the range of cells from A1 to A4	3
=COUNT(A1:C1,B2)	Counts the number of cells that contain numbers in the range of cells from A1 to C1 and B2	4
= COUNT(B1:C3)	Counts the number of cells that contain numbers in the range of cells from B1 to C3	6
=COUNT(A1:A3,C1:C3)	Counts the number of cells that contain numbers in the range of cells from A1 to A3 and the range of cells from C1 to C3	6

Activity

The Figure 7.20 shows marks obtarned in different terms by ICT students of grade 6.

	A	B	C	D	E
1	Student Name	Term 1	Term 2	Term 3	
2	K.Bhanu Somarathna	57	79	66	
3	Wasantham Jayaraj	45	57	60	
4	Mohommad Niyas	89	ab	76	
5	R.Ganga Kumari	71	62	78	
6	P.Vasuki Devi	60	70	65	
7	M.M.Fawsiya	42	58	67	
8					

Figure 7.20 - Marks scored by grade 6 students for ICT

Provide answers using functions.

1) What is the formula to be inserted in E2 to find the total marks scored by K. Bhanu Somarathne?
2) What is the formula to be inserted in E3 to find the average marks scored by Wasantham Jayaraj?
3) What is the formula to be inserted in cell B8 to find the highest score made in 1st Term.
4) What is the formula to be inserted in cell C8 to find the total number of students who appeared for the Term 2?
5) What is the formula to be inserted in cell D8 to find the lowest score make in the 3rd Term.

7.5 Formatting the worksheet

In order to format the labels and value in a worksheet formatting tool bar or cell formatting window can be used.

7.5.1 Ribbon with formatting tools in Microsoft Excel 2010

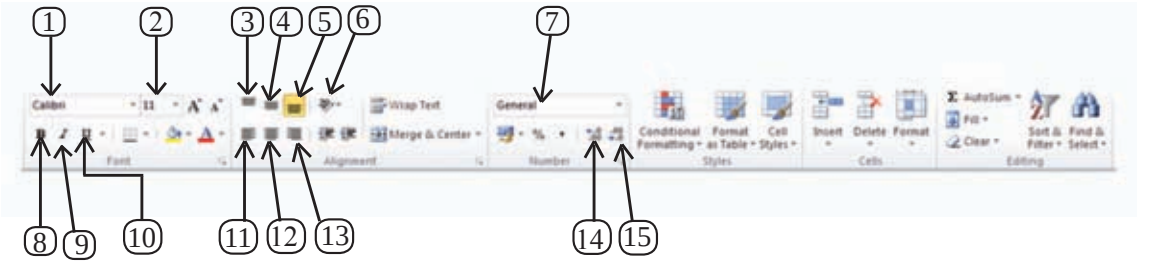


Figure 7.21 - Formatting tools in Microsoft Excel 2010

Table 7.14

No	Tool	Details
1	Font	Apply different font types in a worksheet
2	Font Size	Apply different font sizes in a worksheet
3	Vertical Top Alignment	Align text to the top of a cell
4	Vertical Middle Alignment	Align text to the middle of a cell
5	Vertical Bottom Alignment	Align text to the bottom of a cell
6	Orientation	Rotate the text to diagonal angle or vertical orientation
7	Number Format	Choose how the values in a cell are displayed
8	Bold	Make the selected text bold
9	Italic	Italicize the selected text
10	Underline	Underline the selected text
11	Left Alignment	Align text in a cell to the left
12	Center Alignment	Align text in a cell to the center
13	Right Alignment	Align text in a cell to the right
14	Increase decimal places	Show more precise value by showing more decimal places
15	Decreased decimal places	Show less precise decimal places

7.5.2 Formatting tool bar in LibreOffice Calc

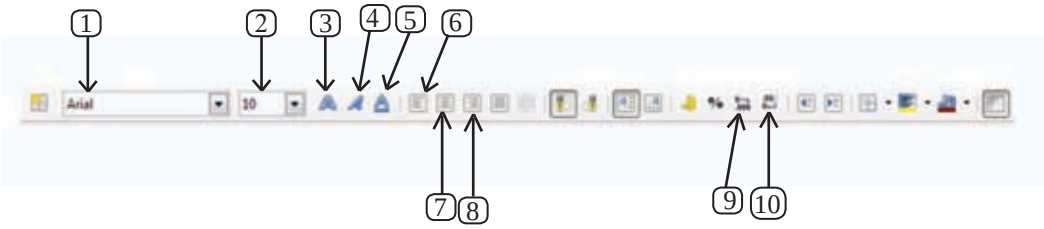


Figure 7.22 - Formatting tool bar in Libre Office Calc 4.1

Table 7-15

No	Tool	Details
1	Font	Apply different font types on a worksheet
2	Font Size	Apply different font sizes on a worksheet
3	Bold	Make the selected text bold
4	Italic	Italicize the selected text
5	Underline	Underline the selected text
6	Left Alignment	Align text in a cell to the left
7	Center Alignment	Align text in a cell to the center
8	Right Alignment	Align text in a cell to the right
9	Increase decimal places	Show more precise value by showing more decimal places
10	Decreased decimal places	Show less precise decimal places

7.5.3 Use of dialog boxes to format values

The Formal Cells dialog box in the tool bar can be used to find more about formatting a cell or range of cell.

Figure 7.23 - 'Format Cells' dialog box

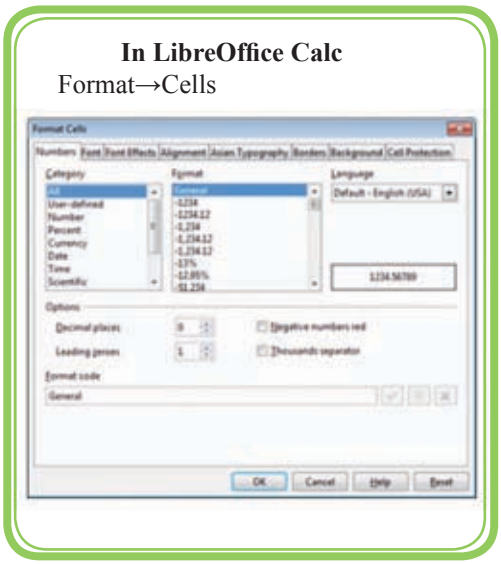


Figure 7.24 - 'Format Cells' dialog box

7.5.4 Formatting a range of cells with decimal places

When division of numbers are performed, different numbers of decimal places are made. In such instances it is necessary to format the number to a fixed number of decimal places.

	A	B	C
1	Before Formatting	After Formatting with two decimal places	
2	2.4	2.40	
3	1.857142857	1.86	
4	3	3.00	
5	6.666666667	6.67	
6			

Figure 7.25 - Formatted to two decimal places

Follow the steps below in order to follow a cell to the required number of decimal places.

In Microsoft Office Excel 2010

1. Select the range of cells
2. Open the 'format Cells dialog' box
3. Click the 'Number' tab
4. Select the 'Number'
5. Change the decimal places as required
6. Click 'OK'

In LibreOffice Calc

1. Select the range of cells.
2. Open the 'Format Cells dialog' box
3. Click the 'Number' tab
4. Select the 'Number'
5. Change the decimal places as required
6. Click 'OK'

7.5.5 Formatting a range of cells to be seen as labels.

A telephone number consists of 10 digits. But in spreadsheets the zero ('0') inserted as the first digit will not be displayed. This is because the telephone number is stored as a numeric value. Therefore, there is need to format the whole range of cells where the phone numbers are to be inserted as 'text'. See figure 7.26 and column D of figure 7.10

	A	B	C
1	Display as values	Inputs after the Formatting	
2	714365759	0714365759	
3	778746853	0778746853	
4			

Figure 7.26 - Formatting a range of cells as Text

Follow the steps below in order to format a range of cells as text.

In Microsoft Office Excel 2010

1. Select the range of cells.
2. Open the 'Format Cells' dialog box
3. Click the 'Number' tab
4. Select 'Text'
5. Click 'OK'
6. Enter numbers

In LibreOffice Clac

1. Select the range of cells
2. Open the 'Format Cells' dialog box
3. Click the 'Number' tab
4. Select 'Text'
5. Click 'OK'
6. Enter numbers

7.5.6 Formatting a range of cells as percentage

When a number is divided, a quotient can be represented as percentage by formatting. The monthly profit earned by a school book shop in the first term is given below in table 7.27

	A	B	C	D
1	Month	Income	As Percentage	
2	January	Rs. 24,500.00	36.62%	
3	February	Rs. 14,000.00	20.93%	
4	March	Rs. 21,600.00	32.29%	
5	April	Rs. 6,800.00	10.16%	
6				

Table 7.27 - Formatting of a range of cell percentage

Follow the steps below in order to format a range of cells as a percentage

In Microsoft Office Excel 2010

1. Select the cell range.
2. Open the 'Format Cells' dialog box
3. Click the 'Number' tab
4. Change the decimal places required
5. Click 'OK'

In LibreOffice Calc

1. Select the range cells.
2. Open the 'Format Cells' dialog box
3. Click the 'Number' tab
4. Select the percentage category
5. Click the 'Ok'

7.5.7 Formatting a range of cells as scientific notations

Spredsheets can be used to calculate very small to very large numbers. Sometimes it is somewhat difficult to understand or express these numbers. But when these numbers are converted into scientific format, all numbers can be represented by common format which is easy to understand.

	A	B	C
1	Description	Value	Scientific Format
2	One Tera bytes in bits(2^43)	8796093022208	8.80E+12
3	Floppy disk capacity in Terabytes(1.44/2^20)	0.000001373291015625	1.37E-06
4			

Figure 7.28 - Scientific Format

Follow the steps below in order to format a range of cells as a percentage.

In Microsoft Office Excel 2010

1. Select the cell range.
2. Open the 'Format Cells' dialog box
3. Click the 'Number' tab
4. Select 'Scientific'
5. Change the decimal places as needed
6. Click 'OK'

In Libre Office Celc

1. Select the range of cells
2. Open the 'Format Cells' dialog box
3. Click the 'Number' tab
4. Select 'Scientific'
5. Change the decimal places as needed
6. Cilick 'OK'

7.5.8 Formatting of a cell range as scientific

In a computer (Date) 5/12/2014 means that it is 12th date of May 2014. This is the American Format; (mm/dd/yyyy) (mm-month, dd-date, yyyy-year). Date can be displayed in many different formats in a spreadsheet. See figure 7.29

	A	B
1	Display Date as different formats	
2	5/12/2014	
3	Friday, September 12, 2014	
4	05/12/14	
5	12-May-14	
6		

Figure 7.29 - various date formats

Follow the below steps in order to format a cell range.

In Microsoft Office Excel 2010

1. Select the range of cells.
2. Open the 'Format Cells' dialog box
3. Click the 'Number' tab
4. Select the 'Date'
5. Select the date format
6. Click 'OK'

In LibreOffice Calc

1. Select the range of cells.
2. Open the 'Format Cells dialog' box
3. Click the 'Number' tab
4. Select the 'Date' category
5. Select the date format
6. Click 'OK'

7.5.9 Formatting a range of cells to display times.

Time is indicated in a computer as 10;35;53 AM. The common format of this is hh;mm;ss AM/PM. See Figure 7.30. Here, hh means hours, mm means minutes and ss means second.

	A	B
1	Display Time as different formats	
2	10:35:53 AM	
3	10:35:53	
4	10:35 AM	
5	10:35	
6		

Figure 7.30 - Various time formats cell range

Follow the below steps in order to format a range of cells to display time.

In Microsoft Office Excel 2010

1. Select the cell range.
2. Open the 'Format' Cells' dialog box
3. Click the 'Number' tab
4. Select the 'Time'
5. Select category time should be displayed
6. Click 'Ok'

In Libre Office Calc

1. Select the cell range
2. Open the 'Format Cells' dialog box
3. Click the 'Number' tab
4. Select the 'Time' category
5. Select category Time should be displayed
6. Click 'Ok'

7.5.10 Formatting a cell range to display currency

When a number denotes a monetary value the currency form such as; Dollar, Rupees should be displayed in front of the number. See column B of figure 7.28

In Microsoft Office Excel 2010

1. Select the cell range.
2. Open the 'Format Cell' dialog box
3. Click the 'Number' tab
4. Select the 'Currency'
5. Click 'Ok'

In Libre Office Calc

1. Select the cell range.
2. Open the 'Format Cells' dialog box
3. Click the 'Number' tab
4. Select the 'Currency'
5. Click 'Ok'

7.5.11 Formatting alignment of a cell range

The labels and values can be aligned to the left, center or right of a cell range.

Left Alignment Center Alignment Right Alignment

Follow the steps below in order to format a range of cells for alignment.

In Microsoft Office Excel 2010

1. Select the cell range
2. Open the 'Format Cells' dialog box
3. Click the 'Alignment' tab
4. Select left, right or center
5. Click 'Ok'

In Libre Office Calc

1. Select the range of cells
2. Open the 'Format Cells' dialog box
3. Click the 'Alignment' tab
4. Select left, right or center
5. Click 'Ok'

Activity

Create the worksheet shown in figure 7.31 using formatting tools and formulae.

	A	B	C	D	E	F	G
1		Usage of School Library as Section wise					
2	**Section**	**January**	**February**	**March**	**Total**	**Average**	
3	*Art*	14	20	16	50	16.67	
4	*Commerce*	10	13	14	37	12.33	
5	*Scince*	18	20	17	55	18.33	
6	Total	42	53	47			
7	Average	14.00	17.67	15.67			
8							

Figure 7.31 - Worksheet with various formats

1. Center align column A and row 2.
2. Make row 2 Bold.
3. Underline the heading in row. Make the font size 16.
4. Italicize cells A3, A4, A5.
5. Use function SUM and write a formula in B7 to calculate the total for the month of January.
6. Use function AVERAGE and write a formula in B7 to calculate the average for the month of January.
7. Copy the formulae in B6 and B7 and use them to calculate the total and average for other remaining months.
8. Use SUM function to get total of Arts Section in the cell E3.
9. Use AVERAGE function to get average of Arts section in the cell F3.
10. Copy the formulae in E3 and F3 and use them to calculate the total and average for other remaining departments.

7.6 Relative and absolute cell reference

7.6.1 Copying a formula

A class teacher to calculates the total and average of each student after the examinations of a term. However, using an electronic spreadsheet would make this task efficient. This is because one can copy the formulae once apply it to many other instances. Hence let us look at the steps on how to copy formulae along rows and columns.

7.6.2 Fill handle of a cell

The small black square in the bottom – right corner of the selected cell or range is called a fill handle. See figure 7.32

Figure 7. 32 - fill handle

7.6.3 Use of fill handle for copying formulae

Follow the steps below to copy formulae using the fill handle.

1. Select the cell which contains the formula.
2. Click the small black square in the bottom-right corner of the selected cell.
3. Drag the fill handle up to the required cell.

7.6.4 Use of copy and paste commands for copying formulae

Follow the following steps to copy formulae using the copy – paste commands which contains the formula.

(1) Select the cell.
(2) Copy the contents of the selected cell (Ctrl+C).
(3) Select the cell to which the formula is to be pasted.
(4) Paste the contents on the selected cell (Ctrl+V).

7.6.5 Relative and absolute cell reference

A cell address (reference) consists of a column letter and a row number. In a formula such a cell address is always called as a relative reference. The dollar sign ($) when sign is placed before a row number absolute row is obtained, when ($) mark is placed before a column name an absolute column is obtained, when ($) is placed before column name and row uumber absolute column and row absolute can be obtained.

Example

H2 - Relative cell reference
H$2 - Row absolute cell reference
$H2 - Column absolute cell reference
$H$2 - Row and column absolute cell reference

7.6.6 Relative cell reference

If the row number and the column letter of the adjacent cells change accordingly when a formula is copied, such cell addresses are called relative cell reference.

Example

When the formula A1+B1 entered in C1 is dragged down along column C and dragged sideways along row 1, the cell references change accordingly as shown in image 7.33 below. Hence the cell references A1 and B1 could be considered relative cell reference.

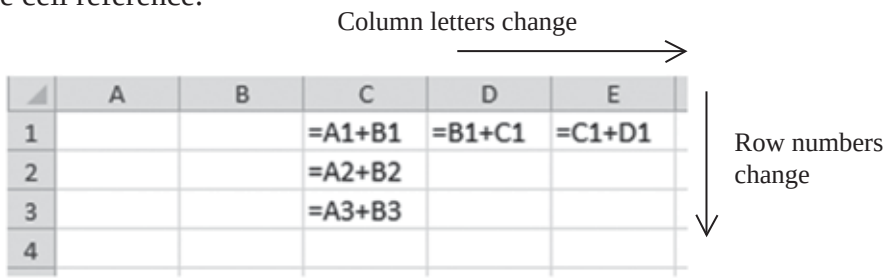


Figure 7.33 - worksheet with reletive cell reference

7.6.7 Row absolute cell reference

If the row number of the cells remain unchanged when a formulae is dragged sideways along a row, it is called row absolute cell reference.

Example

When the formula= A$1+ B$1 entered in C1, and is dragged down along column C and dragged sideways along row 1, as shown 7.34 only the column letters change relatively while the row numbers remain unchanged. Hence the cell reference A$1 and B$1 can be called row absolute cell reference.

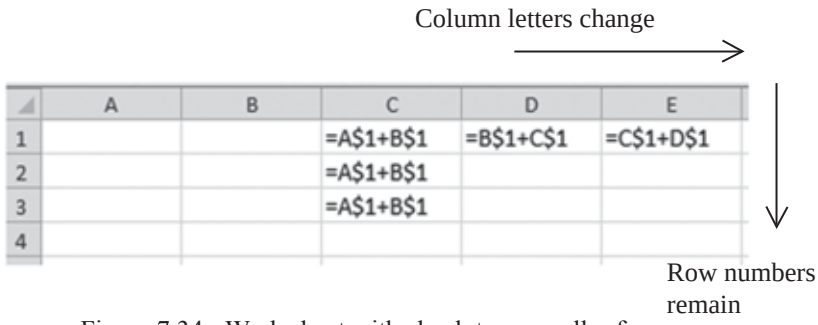


Figure 7.34 - Work sheet with absolute row cell reference

Example 2

See worksheet 7.35 where the price of many pencils are derived when we know the price of the pencil.

	A	B	C
1	Pencil	Price of a Pencil	Amount(Rs)
2	1	10.00	10.00
3	2		20.00
4	3		30.00
5	4		40.00
6	5		50.00
7	6		60.00

Figure 7:35 - Relative and absoute cell reference

=A2*B2 is the formula we need to enter in C2 to calculate the price of pencils along the column C relative to the number of pencils. Note that we cannot calculate the price of pencils by copying along column C. When the formula is being copied A2 should relatively change into A3,A4,A5 etc. But the cell B2 should always remain constant within the formula. Hence the correct formula to be written in cell C2 is = A2*B$2.

7.6.8 Column absolute cell reference

If the column letter of the cells remain unchanged when a formula is dragged down along a column, it is called column absolute cell reference.

Example 1

When the formula = $A1+$B1 entered in C1 is dragged down along column C and dragged sideways along row 1, as shown in figure 7.36 only the row numbers change relatively while the column letters remain unchanged. Hence the cell reference $A1 and $B1 can be called column absolute cell reference.

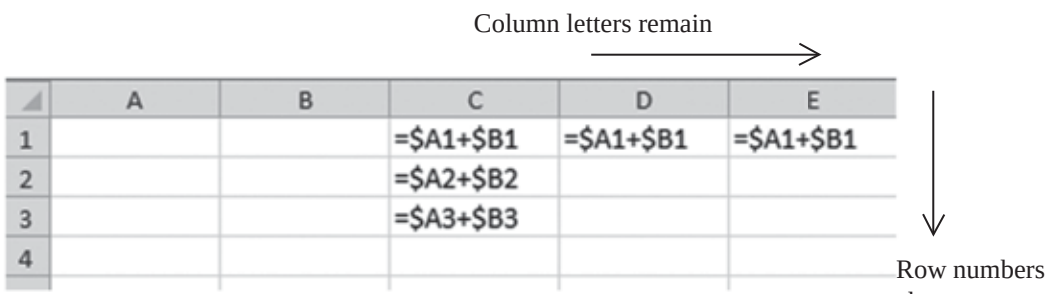


Figure 7.36 - Worksksheet with column absolute cell reference.

Example 2

= SUM ($B2:B2) is the formula to be entered along row 3 at the end each Over, to calculate the total runs. This is shown in figure 7.37 below.

	A	B	C	D	E	F	G	H
1	No. of Overs	1	2	3	4	5	6	
2	Runs per Over	13	14	10	7	15	11	
3	Total	=SUM($B2:B2)	27	37	44	59	70	
4								

Figure 7.37 - Worksheet with absolute cell reference and function column

When the formula is copied along row 3 it would appear as shown in figure 7.38 below.

	A	B	C	D	E	F	G
1	No. of Overs	1	2	3	4	5	6
2	Runs per Over	13	14	10	7	15	11
3	Total	=SUM($B2:B2)	=SUM($B2:C2)	=SUM($B2:D2)	=SUM($B2:E2)	=SUM($B2:F2)	=SUM($B2:G2)
4							

Figure 7.38 - Worksheet with column absolute cell reference including formulae

7.6.9 Row and column absolute cell reference

If the row numbers and column letters of the cells remain unchanged when a formula is dragged sideways along a row, such cell addresses are known as row and column absolute cell reference.

Example 1

When the formula =A$1+$B$1 in C1 is copied along column A and row 1, the cell references do not change as shown in worksheet figure 7.39

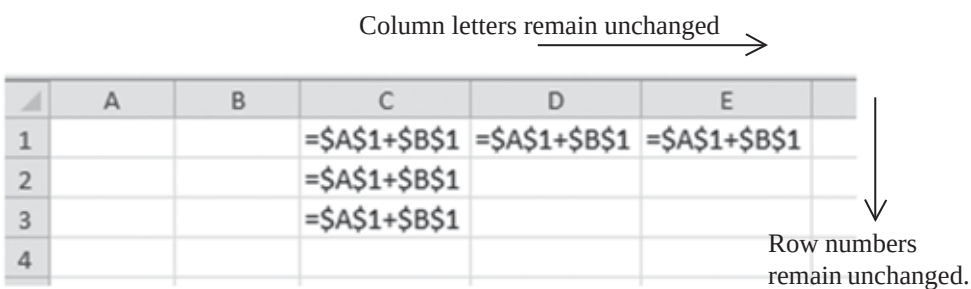


Figure 7.39 - Worksheet with row and column absolute cell reference

Hence when a formula with row and column absolute cell reference is copied along a row or column, the references within the cell remain unchanged.

Example 2

As per worksheet in figure 7.40, the prices of books as per quantity are to be calculated from D4 to 14 and prices of books as per the number of dozens are to be calculated from C5 to C10. Let us write all the formulas so that the relevant prices are displayed at once when we enter the unit price of a book in cell C1. We have C1 has to remain unchanged when the formula is copied along row 4 and along C. Hence we have to enter $C$1, within the relevant formula.

	A	B	C	D	E	F	G	H	I
1		Price of a book							
2				No of books					
3				1	2	3	4	5	6
4			Price	=D3*$C$1	=E3*$C$1	=F3*$C$1	=G3*$C$1	=H3*$C$1	=I3*$C$1
5	No of Dozens	1	=12*B5*$C$1						
6		2	=12*B6*$C$1						
7		3	=12*B7*$C$1						
8		4	=12*B8*$C$1						
9		5	=12*B9*$C$1						
10		6	=12*B10*$C$1						
11									

Figure 7.40 - Row and Column absolute cell reference

Activity

1. How would the formula appears when formulae are copied.

	A	B	C	D
1	=D2*$E2+G$2	=E2*$E2+H$2	=F2*$E2+I$2	=G2*$E2+J$2
2	=D3*$E3+G$2			
3	=D4*$E4+G$2			
4	=D5*$E5+G$2			
5	=D6*$E6+G$2			

	A	B	C	D
1	=K3-M2+N4			
2				
3				
4				
5				

	A	B	C	D
1	=E2*F$2+$G2			
2				
3				
4				
5				

	A	B	C	D
1	=$G$2*$F2+G$2-H2			
2				
3				
4				
5				

2. Write the difference between absolute and relative cell addresses.

7.7 Creation of charts using spreadsheets

It is not easy to comprehend, compare, analyze or present data when they are represented as numbers. But when data are presented in the form of charts they become an effective tool to communicate. Let us learn how spreadsheet applications are used for this purpose.

Given below are the various types of charts.

Table 7.16 - Types of charts

Type of chart	basic form	Purpose of chart
Column Chart		Comparing classes of data items in group. Group comparison
Bar Chart		Comparing classes of data items in group. Group comparison
Line Chart		Comparing classes of data items in group. Group comparison
Pie Chart		Comparing classes of data items as percentage.
XY Scatter Chart		Comparing data in pairs

Activity

Write down two examples use for the chart types in Figure 7.15.

Let us use the worksheet below to create a column chart and a pie chart.

	A	B	C	D	E	F	G	H
1	Name	Maths	Science	English	History	Sinhala	Total	
2	Ravidu	54	68	51	91	74	338	
3	Nadeshean	67	42	47	65	51	272	
4	Dinithi	78	56	72	52	53	311	
5	Ashwar	54	63	43	67	29	256	
6	Dilki	60	76	89	87	63	375	
7	Jayani	62	54	68	82	51	317	
8								

Figure 7.41- Worksheet with chart

Follow the steps below to create charts.

In Microsoft Office Excel 2010

1. Select the range of data (A1:F7)
2. Insert → Chart
3. Select the type of chart
4. Select the chart

In LibreOffice Calc

1. Select the range of data (A1:F7)
2. Insert → Chart
3. Select the type of chart
4. Select the chart
5. Click finish.

Follow the steps below to give a title to the chart.

In Microsoft Office Excel 2010

1. Select the type of chart
2. Layout→ Chart Title→ Above chart
3. Type a title

In LibreOffice Calc

1. Select the type of chart
2. Insert → Title
3. Type a title
4. Click OK

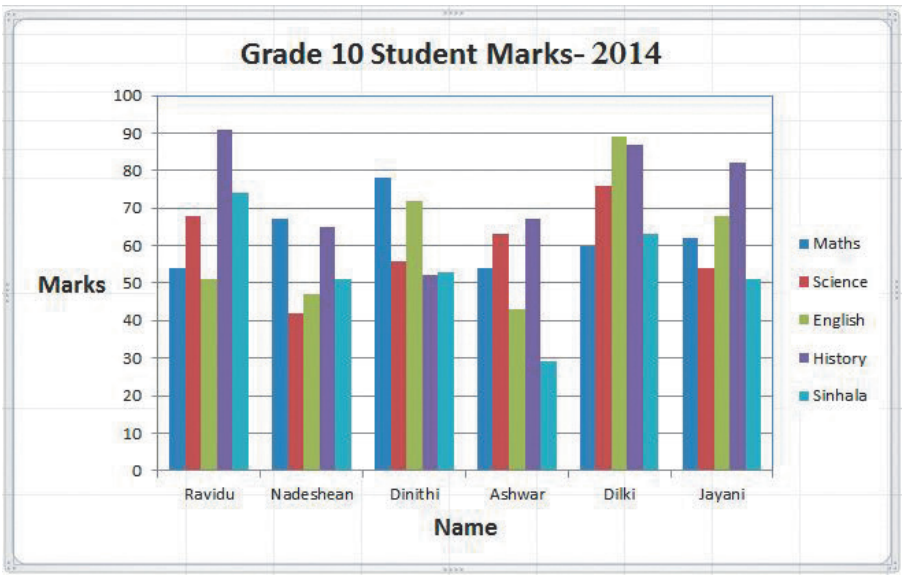
Follow the steps below to name the axis of the graph.

In Microsoft Office Excel 2010

1. Select the type of chart
2. Layout→ Axis Title
3. Name Axis Type (Vertical or Horizontal)

In LibreOffice Calc

1. Select the type of chart
2. Insert → Title
3. Name Axis
4. Cilck OK



Let us display the marks of the students in a pie chart

In Microsoft Office Excel 2010

1.Select the data ranges A1:A7 and G1:G7
2. Insert→ Chart → Pie chart

In LibreOffice Calc

1.Select the data ranges A1:A7 and G1:G7
2. Insert→ Chart → Pie chart

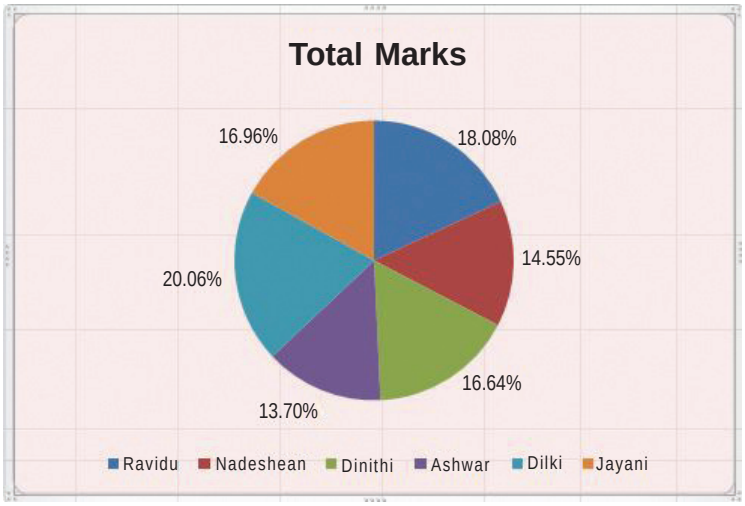


Figure 7.43 - Total Marks of students

Example: Drawing Y=X2-5X-3 quadratic function chart

	A	B	C	D	E	F	G	H	I	J	K	L
1	X	-2	-1	0	1	2	3	4	5	6	7	
2	Y	11	3	-3	-7	-9	-9	-7	-3	3	11	
3												

1 Step: Enter the values 2 to 7 in axis as shown in worksheets.

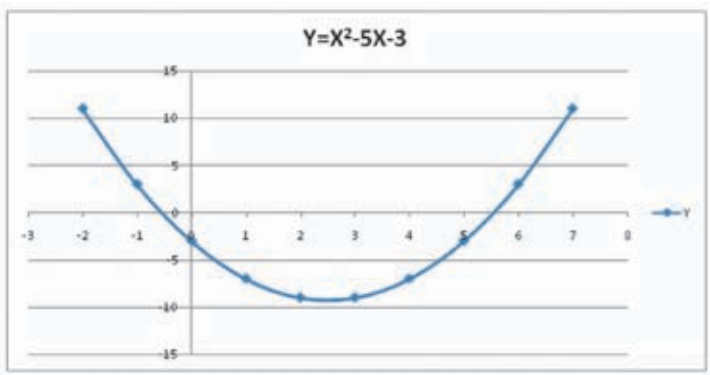
2 Step: Enter the formula below in cell B2.

= B1 ^2-5*B1-3

3 Step: Copy the formula entered in B2 upto K2

4 Step: Mark A1:A2 a data range

5 Step: Insert → Chat → XY Scatter



Exercise

1) Provide answers based on the worksheet below.

	A	B	C	D	E
1	1	2	3	4	
2	5	6	7	8	
3	9	10	11	12	
4	13	14	15	16	
5					

Figure 7.44

(1) Name the cell range where 2,6,10,14 are present.
(2) Name the cell range where 9,10,11,12 are present.
(3) Name the cell range where 6,7,8,10,11,12 are present.
(4) Write the formula in A5 using only cell addresses to calculate the total of the values from A1 to A4.
(5) Write the formula in A3 using function to calculate the total of the values from A3 to D3.
(6) Write how you would copy the formula in E3 to E4
(7) Write the formula in A5 using function to calculate the average of the values from A3 to D3.

Activity

Create the below worksheet using a spreadsheet. Those who were absent are marked 'ab'.

	A	B	C	D	E	F	G	H
1	Name	Maths	Science	English	History	Sinhala	Total	Average
2	M.Saman Kumara	54	68	51	91	74		
3	K.Rajarathnam	67	81	47	65	ab		
4	A.Dinithi Udeshika	78	56	72	52	53		
5	M.U.Mifraj	ab	63	69	67	89		
6	A.Dilki Ridmika	60	76	89	87	ab		
7	T.Jayani Saranga	62	54	68	82	51		
8								
9	Maximum Marks							
10	Minimum Marks							
11	No. of Present Students							
12	Average Marks of a Subject							
13								

Figure 7-45 - Marks List

Use a single function and create the formulae

(1) Enter the formula in G2 to calculate the total marks scored by Saman Kumara

(2) Enter the formula in H2 to calculate the average scored by Saman Kumara.

(3) Enter the formula in B9 to find out the highest score obtained for Mathematics.

(4) Enter the formula in B10 to find out the lowest score obtained by students in each subject.

(5) Enter the formula in B11 to find out the number of students present for each subject.

(6) Enter the formula in B12 to find out the average score of each subject

Summary

- A worksheet is composed of vertical columns and horizontal rows in two diamentional plane.
- Columns in a worksheet are named with English letters or combination of English letters.
- Rows in a worksheet are named with numbers.
- Cells are named firstly by column letter and secondly by row number.
- Cell content is either a label, value or a fomulae.
- A formulae is initiated with equals sign (=).
- There is a presedence of operators.
- Formulas are made with cell addresses, operators and functions.
- Formatting tools are used to format labels and values.
- The fill handle is used to copy formulae.
- Dollar sign ($) is used to make absolute cell reference.
- Several chat types are available in spreadsheet applications.

8 Electronic Presentations

By completing this lesson you will acquire a sound understanding of:

- what is a presentation
- the characteristics of a good presentation
- creating an attractive multi-media presentation using the basic tools of presentations software
- slide background, slide templates, slide layout planning
- inserting suitable images or pictures into slides of presentation,
- inserting animations into slides.

Amara :- Shyama, for this year's ICT day, our teacher suggested that we make a Presentation which portrays the history of our school and also how ICT is used in our school.

Shyama :- Amara, then what do we do for it?

Amara :- I think we all must get together and make a good presentation. Then we can show it at the auditorium during the event using the new multimedia projector.

Shyama :- That's a good idea. We can even take photographs and videos of the school using the teacher's digital camera and insert them too into the presentation.

Amara :- Yes, Shyama. Not only that we can animate the school emblem, the flag etc and make beautiful slides too.

Shyama :- Also we can give print outs of the presentation to the guests. Can we?

Amara :- Yes, Shyama.. Let's go to the teacher right now and get his ideas on how to make a good presentation.

8.1 What is meant by 'presentation?

People make presentation to share their views, opinions, ideas and knowledge with a larger group of people. During this process they may use different techniques, methods, gestures and tools to impart knowledge and to justify one's points to the audience.

The Slide Projector and Overhead Projector (OHP) were common tools for presentation. The mechanism of overhead projector (See image 8.1.1) is different to that of a slide projector. The transparent sheets used in a overhead projector have to be pre-prepared. But notes can be written on the transparent sheet using a pen even when the presentation is going on. However the contents of the transparent sheet once made cannot be erased and used again. Also it cannot present a video or an audio. Since this was a simple device the presenters widely used the OHP's to do effective presentations.

Figure 8.1.1 - OHP
(Over Head Projector)

Figure 8.1.2 - Slide Projector

A completely different process has to be followed in order to make the slides required for a slide projector. The images taken by a camera have to be prepared in a lab and fixed on to the slides. Here too, one cannot include audio or video in the slides.

But with the advent of computer technology video cameras and multimedia projectors have become common tools of presentation today.

The advantages of the multimedia projector is that we can display the presentations which are made quickly using a computer, and the ability to include multimedia contents such as audio and video. We can include multimedia contents such as numbers, letters, pictures, graphics, images, movies and videos, tables and graphs, voice and sound in a presentation. Since this presentation contains multiple types of contents, it is called a multimedia electronic presentation.

Figure 8.1.3 - Multimedia Projector

The multimedia projector which was bulky in the early days is becoming smaller in size with many new features.

Activity

1. Make a list of features how traditional presentation differ from electronic presentation and compare their pros and cons. Also point out how you can use the electronic presentations in your educational activities.
2. Make a list of all possible multimedia contents which can be included in a e-presentation.

8.2 The characteristics of a good quality presentation

We need a good quality presentation in order convey the message clearlry to the audience. We can improve the quality of a presentation by paying attention to its contents. Hence, let us look at the features to which we need to pay attention to improve the quality of a presentation.

* **Number of lines**

  It is important to consider the number of lines, as same as font size. The most appropriate number of lines per slide are 6-9. If more than that are added, it may take more time to read or font size may become too small.

* **Font-size**

  The distance between the screen and the audience is an important factor to decide on the font size of the texts of a presentation. It is an accepted norm to keep the font size at 32 points or more. It is easier for the audience to read the contents of such font size.

Think of a presentation you had watched; how many of these points were considered there? Pay attention to these features when you watch presentations in the future.

* **Correct use of grammar and language**

It is a must that you double check the grammar, spellings and use of language by reading the slides carefully.

* **Inserting images, drawings, tables or graphs**

  It is not suitable to insert more than two images, drawings, tables or graphs in each slide. It may become confusing if we insert too many images, drawings, tables or graphs in one slide.

* **Use of colours**

The use of colours in a presentation is a very important factor. We can use dark colours, bold letters or use of different fonts to emphasize certain points. The use of dark red colour throughout the slide is a not a good practice since it may be uncomfortable for the viewers' eyes. But you can use red for some words, numbers, points etc which need attention. It is important to pay attention to the contrast of background and foreground colours also.

* **Animation and videos**

It is ideal to use one animation or video in each slide. If you use more than one, the overlap of sounds may cause confusion to the viewer.

* **Pay attention on target group**

When using multimedia it is important to pay attention to meeting the objectives of the target audience. We have to prepare the contents of a presentation such that it does not divert the attention of the audience away from the objectives. Otherwise, the viewer may lose the attention. For example if the audience's attention is attracted towards a particular animation included in the slide, the whole objective of the presentation might be lost.

Activity

1. Make a list of all the points which are important to make an effective presentation.
2. Make an e-presentation based on these points to educate your classmates.

8.3 Presentation Software

A software which helps to create presentations with multimedia contents is called a presentation software.

Some of the popular presentation software are listed below. There are two categories of software,

- free and open source software
- proprietory/commercial software

Software name	Name of developing organization	Open source / Proprietory (Commercial)
Apple Keynote	Apple Inc.	Proprietory software
Corel Presentation	Corel Corporation	Proprietory software
LibreOffice Impress	Document Foundation	Open Source software
Microsoft PowerPoint	Microsoft Corporation	Proprietory software
Open Office.org Impress	Apache Corp.	Open Source software

If MS Office software is not installed in your computer then it may not be easy for you to make a presentation. But today you can make your presentation even when there is no Office in your computer by searching the web. For example by using MS Office 365 Powerpoint, Google Presentation or Microsoft SkyDrive Powerpoint you can complete your task. Not only that you have provision to even save your work in the cloud in the internet.

Search web and find out the features available online of the other presentation software.

8.4 Fundamentals of presentation software

Making presentations using Power Point software of MS Office package and Impress software of LibreOffice Package are given below;

Starting Microsoft Office PowerPoint

You can start MS PowerPoint 2010 as shown below.

Start → All Programs → Microsoft Office → Microsoft Office PowerPoint 2010 (This may change depending on the type of Operating System)

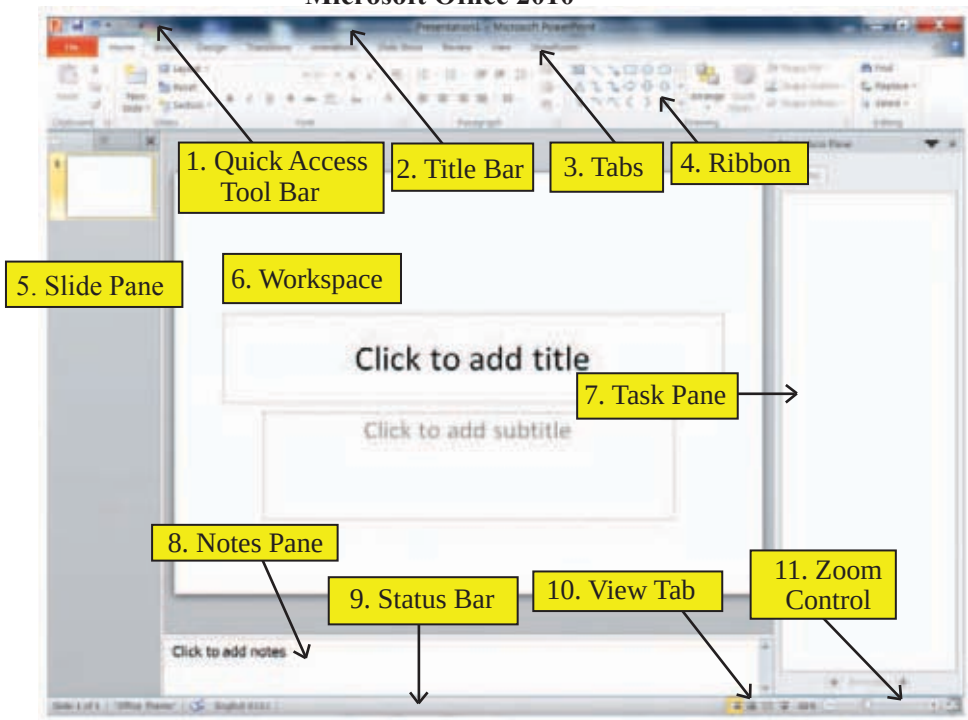


Figure 8.4.1 - Microsoft Office PowerPoint 2010 work space

The menus and tools of starting screen of Power Point are shown above. You can see that many of the tools available in MS Word software.

1. **Quick access tool bar -** This is found on the left hand side of the title bar. Using this bar you can execute commands faster and easier. You can also add the frequently used commands to this bar. This can be done using the drop down menu found at the right hand end of the quick access tool bar. The user can change the quick access tool bar according to his/her needs.

2. **Title bar -** This bar is found at the top of the Microsoft office window. It displays the name of the presentation (which is open) along with the name of the software. The icons on the right end of this bar are Minimize, Maximize/ Restore and Close buttons.

3. **Tabs -** The tool bar in this software is called a Ribbon. Each item in the tab is denoted by icons. (Ex: There are many groups within Home tab. Font is one of the groups.) There are many tools related to fonts within that (Figure 8.4.2). The user can change the tab according to his/her needs.

4. **Ribbon -** The menu bar is designed to be user friendly. The menus in it are called tabs here. The speciality is that each item in the tab is denoted by icons and grouped as categories. The user can change the tab according to his/her needs.(Figure 8.4.3)

Figure 8.4.2 - Ribbon

5. **Slide Pane -** This is the vertical pane at the left side hand of the window. When this pane is viewed one can see the slides in small size. But when you click the required slide using the mouse, the slide will be displayed as a large slide in the middle of the window. Now you can do editing or changes to complete the slide.

6. **Workspace** - Presentation is created at this location.

7. **Task pane -** This pane is useful to add some features to the presentation. For example, it is very useful when we import animations within the slides.

8 **Notes Pane -** This pane is used to insert some notes about the slide of the presentation. The notes in the Notes Pane are not visible to the audience when the presentation is run.

9. **Status bar -** Important information about the presentation such as the total number of slides in the presentation, the slide number of the selected slide, the selected language etc are displayed here.

10. **View Tab -** The type of view can be changed (how a slide is shown) using the icons in this tab. The icons are described below: (Figure 8.4.3)

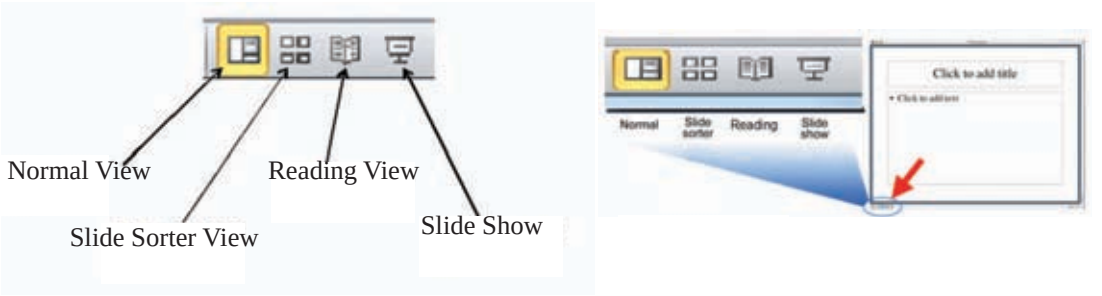


Figure 8.4.3 - View Tab

- **Normal View -** This is the view you get in interface. You can create the presentation in this view.

- **Slide Sorter View -** All the slides of the presentation are displayed together as mini slides. You can change the order of the slides at this view. You can change back to Normal View when you double click on any particular mini slide.
- **Reading View -** In this view, you can see the slide the same way as it is displayed on the screen. You can read all the texts in the slide very clearly. You can use Escape (Esc) button to go out of this mode.
- **Slide Show -** You can view the selected slide on the full screen. This mode is also used to run a presentation to the audience. Also F5 key can be used to start the presentation from the first slide.

11. **Zoom control -** This tool is used to zoom in or zoom out the slide

8.5 Starting LibreOffice

You can start LibreOffice 4.1 Impress as shown below.

Start → All Programs → LibreOffice 4.1 → LibreOffice Impress → LibreOffice Impress 2010 (This may change depending on the type of Operating System)

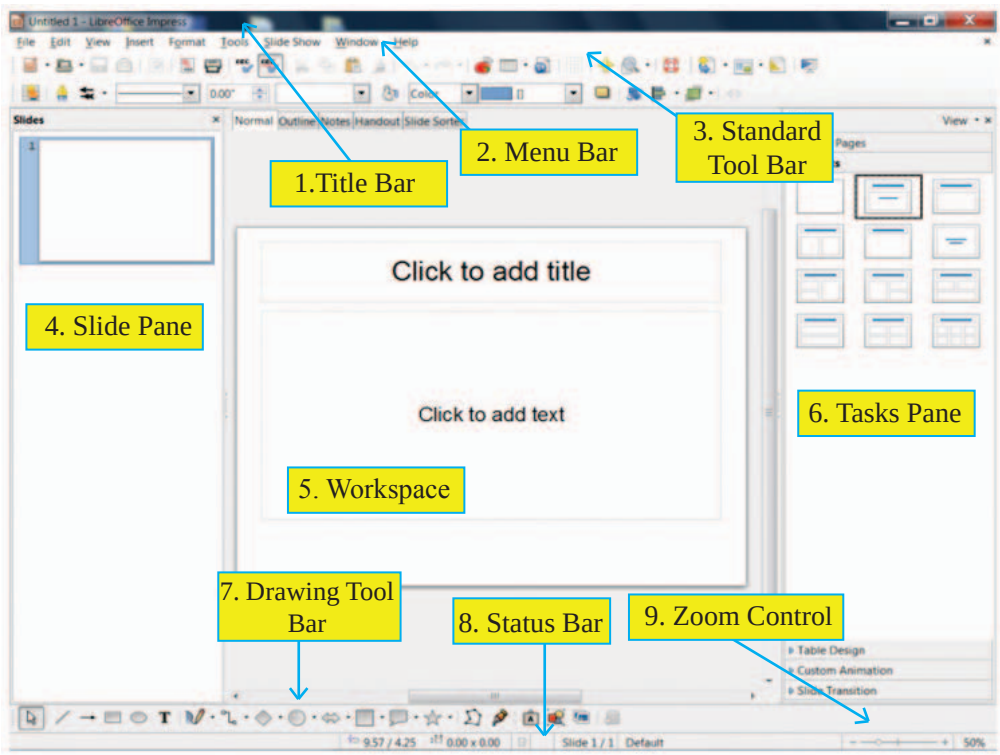


Figure 8.5.1- LibreOffice 4.1Impress work space

The menus and tools of starting screen of LibreOffice Impress are shown above. You can see that many of the tools in this screen are also found in LibreOffice word processing software too.

1. **Title bar -** This bar is found at the top of the Microsoft office window. It displays the name of the presentation (which is open) along with the name of the software. The icons on the right hand end of this bar are Minimized, Maximize/Restore and Close buttons.

2. **Menu Bar -** All the commands required to create the presentation are found here.

3. **Standard ToolBar -** Each menu of the menu bar are placed here as icons for ease of operations.

4. **Slide Pane -** This is the vertical pane an the left hand side of the window. When this pane viewed one can see the slides in small size. But when you click the required slide using the mouse, the slide will be displayed as a large slide in the middle of the window. Now you can do editing or effect changes to complete the slide.

5. **Workspace -** Presentation is created at this location.

6. **Tasks Pane -** Task pane is made of 5 components. All the 5 components are NOT open at the start. You need to click on the relevant word in order to open it. (Figure 8.5.2)

Figure 8.5.2 - Tasks Pane

- **Master Pages -** You can make the presentation and the style using this. There are a few default slide master pages available.

- **Layouts -** Earlier made layouts are kept saved by the software. You can select one of them and improve on it or do changes to them.

- **Table Design -** This gives styles for creating tables. You can change style according to your choice.

- **Custom Animation -** There are many animation features for the texts, drawings etc in a slide. Using this feature you can add, change or remove animation features.

- **Slide Transition -** You can change the way how transition from one slide to another happens. There are many alternatives available. Editing features such as speed of transition, sound effects, automated transition etc can be added.

7. **Drawing Tool Bar -** This provides the various tools required to make drawings on a slide.

8. **Status bar** - Important information about the presentation such as the total number of slides in the presentation, the slide number of the selected slide, the selected language etc are displayed here.

Figure 8.5.3 - Status bar

9. **Zoom control** - This tool is used to zoom in or zoom out the slide

8.6 Microsoft Office Presentation…

Setting Slide Size

The size of the slides of a presentation should be changed according to the theme. We can change features such as type of the slide, length and breadth, slide orientation etc.

- Design → Page Setup (See Figure 8.6.1)

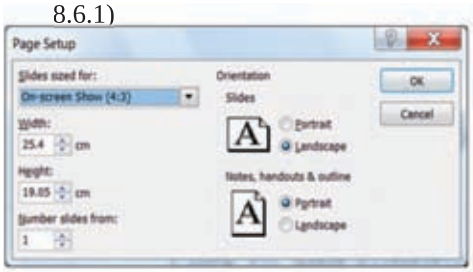


Figure 8.6.1 - Page setting window in MS Power Point

LibreOffice Impress...

Setting Slide Size

- Format → Page

The size of the slides of a presentation should be changed according to the theme. We can change features such as type of the slide, length and breadth, slide orientation etc.
(See Figure 8.6.2)

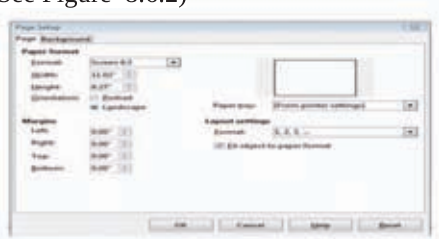


Figure 8.6.2 - Task Pane

Office Theme / Slide Layouts

After finishing the required changes to the size of the slide, we can start selecting the OfficeThemes /Slide Layouts.There are a few differences between MS Office and LibreOffice.

Microsoft Office Presentation...

- Home → New Slide or Layout → Office Theme. See Figure 8.6.3 of the interface you get on the above execution.
- You can select one of the themes from the templates given. If you need a theme other than the given layouts then you can select a new one from 'Slides from Outside'.
- Reuse Slides – using this feature you can use the theme from a finished presentation to make a new one.

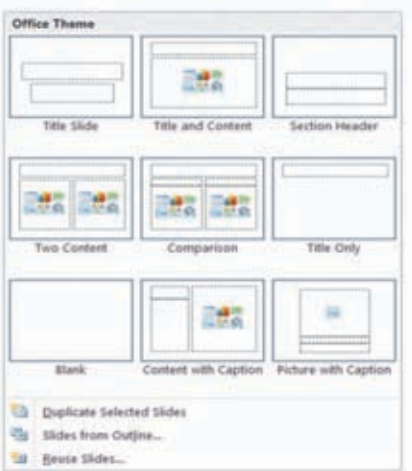


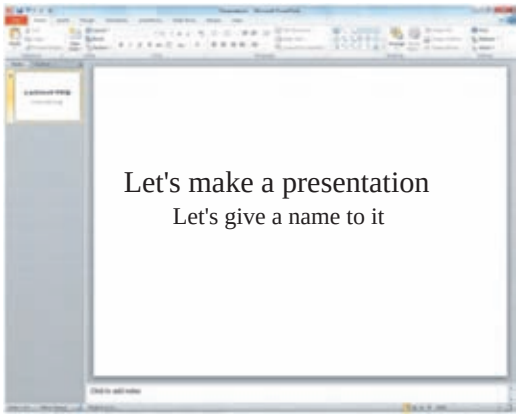
Figure 8.6.3 - Office Theme

LibreOffice Impress...

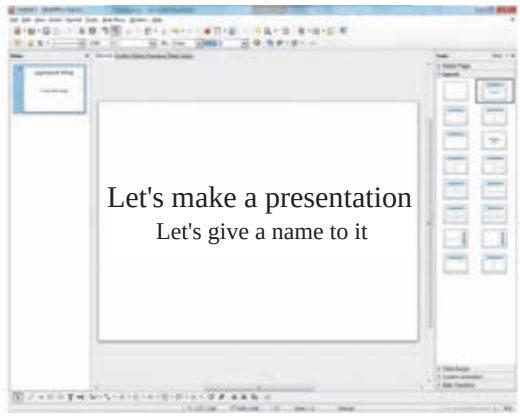
- Format → Slide Layout… → Layout (by following this method you can select slide layouts also called themes. Click mouse on it. You can choose a slide templetes required for presentation. (See Figure 8.6.4)
- Format → SlideLayout→ Master Pages (This helps us to choose an already avialable theme. There are so many elegant themes available by default.

Figure 8.6.4 - Slide Layouts

- Select the Title Slide to give a title to the theme of your presentation. Now you can type a Title and Sub-Title to suit your presentation.(See Figure 8.6.5)



Microsoft Office Presentation



LibreOffice Impress

Figure 8.6.5 - Title Slide

- Now perform following.

Microsoft Office Presentation...

- Home → Select New Slide or Layout Office Theme. Enter a new theme.
- In the menu bar click Slide Show → From Beginning. The presentation is shown full screen. You can do this by pressing F5 too. Now you can view the presentation. Click again and go to the earlier screen.

LibreOffice Impress...

- Format → Slide Layout… → (Select and enter slide layouts also called themes).
- In the menu bar click View → Start from first Slide. The presentation is shown full screen. You can do this by pressing F5 too. Now you can view the presentation. Click again and go to the earlier screen.

- **Saving an presentation**
  - File → Save As → Folder Name → File Name (Enter name to the file) → Save (You can save your presentation in a secondary storage location so that you can open it whenever you need it)

Microsoft Office Presentation...

- 'File → Save As → My Documents' → Type the file name → Click 'Save' The presentation is saved in the hard disk.

LibreOffice Impress...

- 'File → Save As → My Documents → File Folder'
- Type the file name and click 'Save'.

- **Opening an existing presentation**

Microsoft Office Presentation...

- Start → All Programs → Microsoft Office → Microsoft Office PowerPoint 2010 → File → Open →
- Select the name of e-presentation saved and open it.

LibreOffice Impress ...

- Start → All Programs → LibreOffice 4.1 → LibreOffice Impress → File → Open →
- Select the name of e-presentation saved and open it.

- **Slide Background**

The software provides options for making the required Slide Background too. This offers user friendly ways to add colours to background, shapes/ objects and/ or images/ drawings.

Microsoft Office Presentation...

- Design → Background Styles
- Styles in Background Styles can be added to the background. See Figure 8.6.6
- Background → Format Background
  (Try to add different colours, shapes/objects and/ or images/drawings)

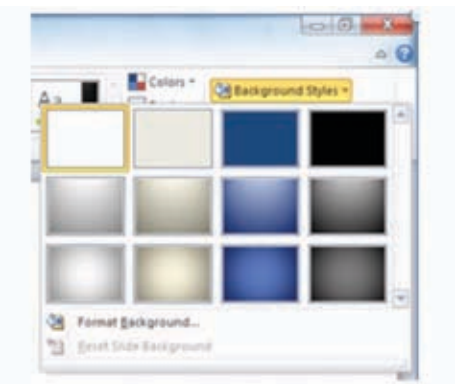


Figure 8.6.6 - Background Styles

LibreOffice Impress...

- Format → Page → Background

This helps to add colours or shapes to the background. See Figure 8.6.7

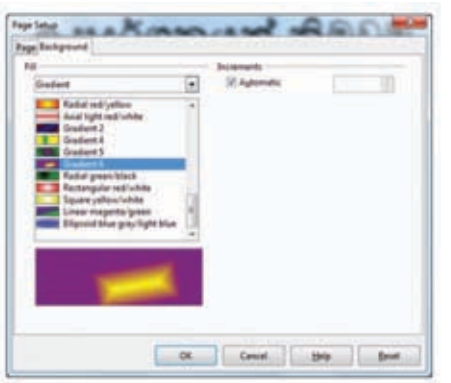


Figure 8.6.7 - Background colours

- **Adding text to slides of presentation**

Microsoft Office Presentation...

Adding text to slides

- The location which is denoed as CLICK TO ADD TITLE is called a Place Holder. Click at such a place and start typing in. You can enter the required texts.

Typing at a place where there is no Place Holder.

- Insert → TextBox (TextBox)
  Click tools and drag at the relevant point. Then start typing in the text.

(You can make all these font based changes here which you have learned under MS Word)

LibreOffice Impress...

Adding text to slides

- The location which is denoed as CLICK TO ADD TITLE is called a Place Holder. Click at such a place and start typing in. You can enter the required texts.

Typing at a place where there is no Place Holder.

View → ToolBars → Drawing → By this you can get a drawing Tool into the window. Using the Tool Tip here click on Text tool box and then drag at the relevant place on the slide. Then start typing in the text.
(You can make all these font based changes here which you have learned under LibreOffice Writer)

- **Inserting objects in slides**

You can insert objects before or after typing. There a few different types of objects that can be included are;

- Shapes / Objects
- Clip Art
- Pictures

- **Inserting Objects in slides**

Microsoft Office Presentation...

- Insert → (Illustration) Shape → Select the shape from the drop down menu by clicking the mouse and drag on slide. After that we can expand or shrink the size of the image by dragging the small handles at the 4 corners off the shape. (See Figure 8.6.5)

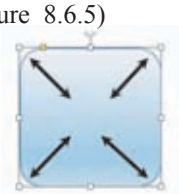


Figure 8.6.8 - change size using mouse

LibreOffice Impress...

View → Tool Bars → Drawing → (You can get a drawing Tool box into the window. Using the Tool Tip in here click on the shape and then drag at the relevant place on the slide. After that we can expand or shrink the size of the image by dragging the small handles at the 4 corners off the shape. (See Figure 8.6.6)

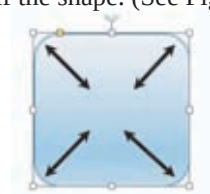


Figure 8.6.9 - change size using mouse

Changing the colours of Shapes/Objects

We can draw various shapes inside the slides of presentation and make templates or type texts on it. You have to follow the following steps for this.

Microsoft Office Presentation...

- Right click on the shape. Then select 'Format Shape' from the menu that appears. Then change options in the dialog box and select suitable colours, images etc to the shape.

LibreOffice Impress...

- View → Tool Bars → Line and Filling → You can get 'Line and Filling' tool box into the window. Select the image to colour. Then select 'Area Style/Filling' using the Tool Tip and colour.

- **Inserting Clip Art / Gallery Theme into a slide**

We can insert images which are already available in the presentation software. Use the following steps for this purpose.

Microsoft Office Presentation...

- Insert → Clip Art → then search for a required clip art by typing in the name. Then click on the required clip art. After that you can expand or shrink the clip art using the small handles in it.

LibreOffice Impress...

- Drawing Tool Bar → Gallery → or in menu bar Tools → Gallery
- Open the folders under New Theme in the 'Gallary' dialog box. Drag the required clip art to the slide. After that you can expand or shrink the clip art using the small handles in it.

Inserting Pictures

You can insert pictures into presentation from the computer or from external sources.

Microsoft Office Presentation...

- Insert → Picture → Select the required image
- Expand or shrink the picture using the small handles in it as we did earlier.

LibreOffice Impress...

- Insert → Picture → From File … Select the required image from file
- Insert → Picture → Photo Album … Click 'Add' on the album dialog box then click 'Insert slides' and enter the pictures into the slide.

Activity

1. Open the saved presentation with name 'MyFirstPresentation' which you created before.
2. Add a new slide and insert suitable Shape, Clip Art and image.
3. Add another two slide to the presentation and insert a suitable video clip and audio clip.

- **Slide Transition Effects**

Microsoft Office Presentation...

- Select a style under Transition Tab (Transition to This Slide). Make an attractive slide inserting different slide transition to each slide.
- Transition → (Transition to This Slide) → Effect Options → Experience the animated direction
- Transition → Sound → Insert sound effects for the selected slide transition.
- Transition → Sound → Apply to All Slides → If you want to insert the same sound effects for all the slide transitions.

LibreOffice Impress...

- Format → Slide Layout… → OR (Tasks Pane) → Slide Transition.
- Apply to Selected Slide (Select a suitable slide)
- Modify Transition → Speed → (change the speed of transition.)
- Modify Transition → Sound → (Insert sound effects for the selected slide transition)
- Modify Transition → Advanced Slide → On mouse Click / Automatically After → (Select whether transition happens automatically or on mouse, click.)
- Modify Transition → Apply to All Slides → (Whether you want to apply the same transition style throughout the e-presentation.)

- **Inserting Animation**

We can apply animation to texts, shapes, drawings, pictures or any other object in the slides. Select an object and do the following steps.

Microsoft Office Presentation...

- Animation → (Animation) (try adding some animation effects from a group of animation effects.)
- Animation → (Timing) → Start (Select whether transition happens automatically or on mouse click.)
- Animation → (Timing) → Duration/ Delay → Start (Set transition time in auto transition mode (See Figure 8.6.10)

LibreOffice Impress ...

- Format → Slide Layout … → (Tasks Pane) → go to Custom Animation
- Custom Animation → Modify effect → Add → (Using the Custom Animation window add animations to the selected object. There are several animation options such as Entrance, Emphasis, Exit, Motion Paths, Misc, Effects in that window. These options give various animation effects. See Figure 8.6.11)

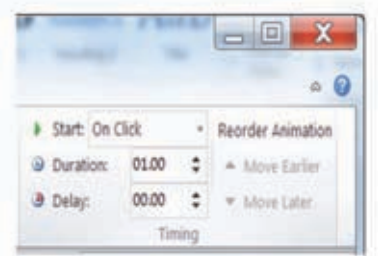


Figure 8.6.10 - Animation timing

- Animation → (Advanced
- Animation) → Animation Pane →
- (Get the animation window. Using this you can delete or change any animations already applied or modify the animations or activate animation by a button or shape. Try making these changes)

Figure 8.6.11 - applying animations

Custom Animation → Modify effect → Change → (Can change a previously selected style) Custom Animation → Modify effect → Remove → (Can delete a previously selected style

- **Inserting Sounds**

We can insert a sounds file into an presentation. Follow the steps below.

Microsoft Office Presentation...

- Insert → Media → Audio (There are 3 options namely: Media from File .. , Clip Art Audio…and Record Audio)
- Media from File .. → (insert a Media File from computer or from outside.)
- Record Audio → (Save sounds recorded using a microphone into computer's memory. Click the Record Audiooption. Click the button with a brown dot in the dialog box)

LibreOffice Impress...

- Insert → Movie and Sound → (Select the sound clip and add animation to the sound clip)
- Even sound clips recorded using a microphone also can be inserted into the e-presentation)

- **Inserting Video**

Microsoft Office Presentation...

- Insert → Media → Video (There are 3 options namely: from File .., Video from Web Site .. and Clip Art Video …)
- Video from File .. → (insert a video file from the computer or from outside)
- Video from Web Site.. (Insert video file from the internet)
- Clip Art Video… → (insert clip art video)

LibreOffice Impress...

- Insert → Movie and Sound → (Open the video clip from the dialog box)
- Enlarge the video clip to the required level
- Apply animation to that video clip.

Activity

1. Open the saved presentation with name 'MyFirstPresentation' which you created before.
2. Insert the following animations.
    - Slide Transition
    - Custom animation for the inserted objects.

- **Printing a presentation**

▫ File → Print → Through this we can send a command to the printer to print the presentation. Perform the following actions by using the options in the dialog box.

Microsoft Office Presentation...

- Printer :- (Select a printer conncted to the computer. see Figure 8.6.12)
- Settings :- (Should all slides be printed? You have options to print only the selected or few slides selected by their slide numbers)

Figure 8.6.12 - Printing

- Can change the size of the print (larger or smaller) on paper.

LibreOffice Impress...

General → Printer :- (Select the printer)

- Range and copies :- (Should all slides be printed ? You have options to print only the selected or a few slides selected by their slide number.)
- Number of copies :- (decide the number copies needed.)
- Print :- (Using the box infront of Document, you can get customized print outs. See Figure 8.6.13)

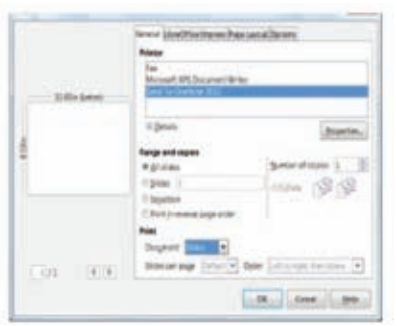


Figure 8.6.13 - Printing

- Can change the size of the print (larger or smaller) on paper.

- Presentation can be projected and printed as a handout.
- A printed copy of the presentation can be given to the audience.
- The handouts that are obtained by 'File → Print' can be distributed to the audience. This provides facility to note down important notes besides the slides. (Figure 8.6.14)

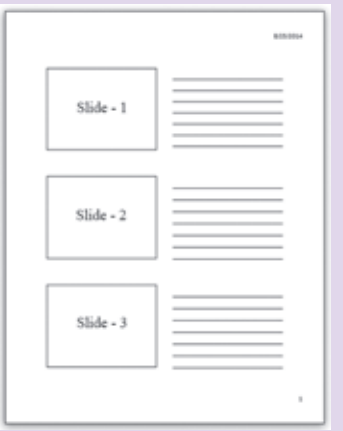
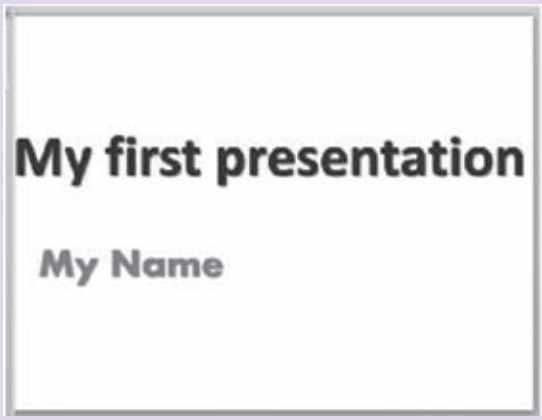


Figure 8.6.14

Activity

1. Use the following the steps to create a new presentation.
2. Select a suitable layout and use topic and subtopics.
3. Find out more features available in presentations which you believe are important, in addition to the features mentioned above.
4. Make a creative presentation about a lesson you have studied in order for other students to understand the lesson easily. Include pictures, relevant charts, animations, sound clips, video clips, different background colours and slide transitions.



5. Select one of your favourite lessons which is difficult to explain on a black board. Create a presentation using multimedia and feature.

Green computing ...

Green computing is the study and practice of designing, manufacturing, using, and disposing of computers, servers, and associated subsystems — such as monitors, printers, storage devices, and networking and communications systems — efficiently and effectively with minimal or no impact on the environment.
The environmental effects of computing should be addressed Green use, green disposal, green design, and green manufacturing. Green computing can also develop solutions that offer benefits by aligning all IT processes and practices with the core principles of sustainability, which are to reduce, reuse, and recycle; and finding innovative ways to use IT in business processes to deliver sustainability benefits across the enterprise and beyond.

Modern IT systems rely upon a complicated mix of people, networks, and hardware; as such, a green computing initiative must cover all of these areas as well. A solution may also need to address end user satisfaction, management restructuring, regulatory compliance, and return on investment. There are also considerable fiscal motivations for companies to take control of their own power consumption.

Read the information on Green Computing given above and find out more books, magazines, and web and make a presentation with the help of your teacher.
Also include the points below into your presentation.

- A suitable title with animation
- Images
- A video clip
- A sound clip
- Menu to help the user
- Buttons for slide transition
- A conclusion slide on Green Computing

Summary

- To differentiate manual presentations and electronic presentations.
- Characteristics of good quality presentations.
- Creating an attractive presentation using the basic features of a presentation software.
- Creating a presentation with slide background, slide templetes, slide layouts.
- Inserting pictitres and diagrams in a presentation.
- Applying transitions to slides.
- Printing a presentation.

9 Database

In this chapter you will learn;

- definition of database
- advantages of using a database
- special characteristics of a database
- using fields to create tables
- identifying key fields
- relational databases
- relationships between tables
- using queries to get data
- using data forms
- using reports to furnish information

9.1 Database Concept

Chapter one included a description on what data and information are. This chapter covers saving data in an organized manner.

Higher the amount of data it becomes difficult to keep in our memory. On such occasions writing these data is one method. That is called manual database. The other method is to maintain the data on an electronic medium. This is called an electronic database. Data can be retrieved efficiently when needed if it is saved on a database in a systematic way. Hence, the database is needed to save a large amount of data and to retrieve them very efficiently.

Examples

It would be easy for you to remember names of your friends, but it would be difficult to retain all their phone numbers in your memory. You can get these details easily when needed if you write names and phone numbers in a book (Figure 9.1) or save them in a mobile phone (Figure 9.2). Thus, the phone book can be considered a simple database.

Figure 9.1 – telephone numbers (manual)

Figure 9.2 – telephone numbers (electronic)

Defining a Database - Collection of organized data can be defined as a database

9.1.1 Advantages of Databases

- **More efficient in retriving information.**

  Required information can be found very quickly as data is properly organized in tables in a database.

- **Easy to obtain copies.**

  Electronic databases can be copied very easily.

- **Smaller physical space to store data.**

  Though more physical space is needed to maintain a manual database, a small space is sufficient to save data on an electronic medium.

- **Data analysis can be carried out efficiently.**

  Only the necessary data can be selected and processed.

- **Data can be shared.**

  The same database can be used in different application software.

- **Independence of data.**

  Though database and software are connected, database tables can be updated without changes to the application software. Therefore, data and software are independent.

9.1.2 Features of a Database

- Minimal data redundancy

If the same data is stored in several tables, this is called data redundancy.

For instance, the name of a student may be recorded separately in the admission card and the library membership card. When a name is changed, that name should be edited separately in all documents. Given below is an example where the name 'Firosa Lai' is changed as 'Firosa Rafeeq'.

Table 9.1 - Admission table

Student Number	Name	Date of Birth	Date of Admission	Name of the Guardian
100	Manoj Dayarathne	2/9/2008	1/1/2014	G. Dayarathne
101	Firosa ~~Lai~~ Rafeeq	4/2/2008	1/1/2014	K. Fais

Table 9.2 - Library table

Student Name	Name of the Book	Borrowed Date	Return Date
Firosa ~~Lai~~ Rafeeqa	Folk Songs	2/9/2014	16/9/2014
Manoj Dayarathne	Drama	3/9/2014	17/9/2014
Firosa ~~Lai~~ Rafeeq	Basic Maths Concept	3/9/2014	17/9/2014
Manoj Dayarathne	Drama	4/9/2014	18/9/2014

However, by storing related database in tables, data redundancy can be minimized. In the following table, a student name is recorded only in one table.

Table 9.3 - Relational Database

Student Number	Name	Date of Birth	Date of Admission	Name of the Guardian
100	Manoj Dayarathne	2/9/2008	1/1/2014	G. Dayarathne
101	Firosa ~~Lai~~ Rafeeq	4/2/2008	1/1/2014	K. Fais

Student Number	Book Number	Borrowed Date	Return Date
101	2222	2/9/2014	16/9/2014
100	3333	3/9/2014	17/9/2014
101	1111	3/9/2014	17/9/2014
100	3333	4/9/2014	18/9/2014

Book Number	Title	Author's Name
1111	Basic Maths Concept	Sivathasan Ramanathana
2222	Folk Songs	Jayantha Bandara
3333	Drama	Padmamali Menike

- **Data consistency :** By minimizing data redundancy, the same data being saved in various tables can be reduced or prevented. This enables to maintenance of data consistency.

  If you consider the example above, student data, data about books and usage of books are saved separately in different tables. As such data such as name of a student or a book should be recorded only once. Thus, data consistency is maintained.

- **Increases efficiency :** Since database tables are properly organized, saving and reading data can be carried out efficiently. Hence, efficiency is higher.

  As per example above, let us consider the change of name from Firosa Lai to Firosa Rafeeq. If the same data (Firosa Lai) are recorded in different tables, more time is spent to find all these places. This leads to inefficiency. However, in related databases data consistency increases speed. Hence, efficiency is increased.

- **Increases accuracy :** Since data redundancy can be minimized in a database, data consistency is maintained. This increases accuracy.

  Let us consider the example above where Firosa Lai is changed to Firosa Rafeeq. If several places are corrected, one mistake would lead to inaccurate information.

However, in the above database only one table is need to be updated to change Firosa Lai to Firosa Rafeeq. This ensures data consistency. Therefore, the accuracy of data is very high.

- **Increases validity :** Properties of fields can be assigned when a database is planned. Validity can be checked at the data entry stage. This increases the validity of the database.

For instance, field attributes can be imposed as fees to be indicated in two decimals with minimum fees being 1000 which is mandatory.

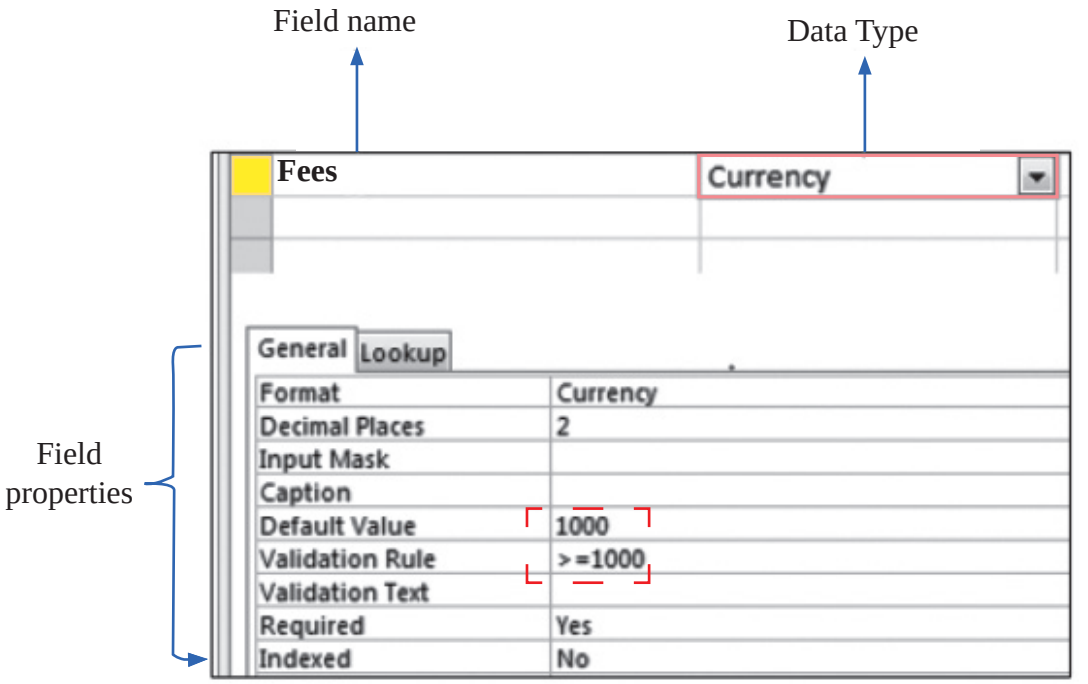


Figure 9.3 - Properties of data type

- **Security :** Unauthorized access can be controlled by using a password and encypting the database. This increases security.

Data encrypting is translating data in such a way that unauthorized personnel cannot read it. In the following figure 9.4, data available in Employee table are encripted so as it cannot be understood by an unauthorized person.

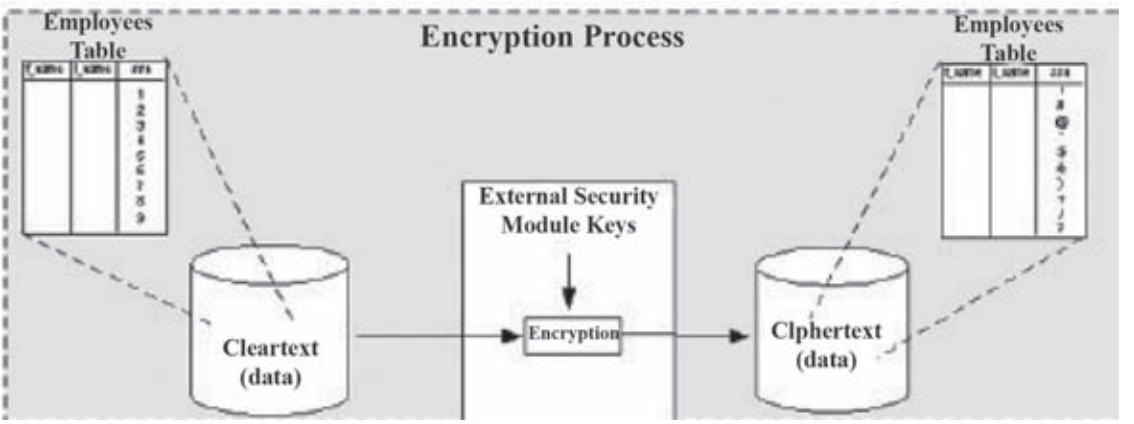


Figure 9.4 - Data Encription

9.1.3 Electronic and Manual Databases

In an electronic database, data can be saved in a very small space which consists of an audio or video medium. Given below is a comparison of electronic and manual databases. (Table 9.4)

Table 9.4 – comparison of manual and electronic database

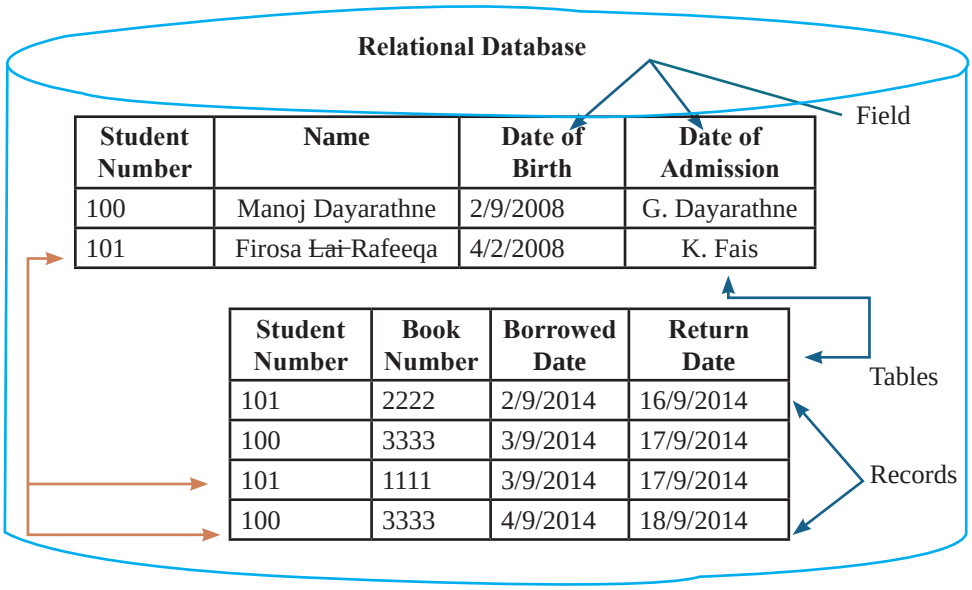
Manual Database	Electronic Database
Less efficient	More efficient
Less accurate	More accurate
Less credible	More credible
Difficult to analyse data	Easy to analyse data
Should present in the order of input	Can change the data input order
Difficult to delete unnecessary data	Easy to delete unnecessary data
Difficult to update data	Easy to update data
More space is needed to save data	A very small space is needed to save data
More man power is needed	Less man power is needed

9.1.4 Introduction to Relational Database

A collection of fields related to one person or object is called a record.

A collection of records is called a data table.

A collection of related tables is called a relational database.



Student Number	Name	Date of Birth	Date of Admission
100	Manoj Dayarathne	2/9/2008	G. Dayarathne
101	Firosa ~~Lai~~ Rafeeqa	4/2/2008	K. Fais

Student Number	Book Number	Borrowed Date	Return Date
101	2222	2/9/2014	16/9/2014
100	3333	3/9/2014	17/9/2014
101	1111	3/9/2014	17/9/2014
100	3333	4/9/2014	18/9/2014

Let us learn how a related database is built step by step. A collection of fields make a record, a collection of records make a table and a collection of tables make a relational database.

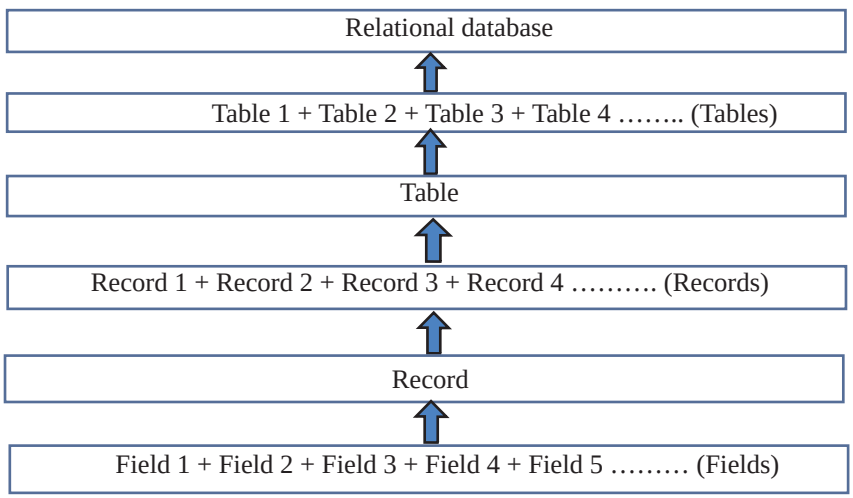


Figure 9.5

Example

Student record book is a very important document for every student. Biodata of a student and the marks obtained for each subject with the rank in all three terms in all grades are included.

Table 9.5 – Biodata form

Admission No : 1426	Admission No : 1427	Admission No : 1428
Name : Kavindu Prabashwara	Name : Meenadevi Ramanathan	Name : Mohommad Malikkar
Date of Birth : 2005.05.23	Date of Birth : 2005.08.12	Date of Birth : 2005.02.07
Gender : Male	Gender : Female	Gender : Male
Tel No : 0352287571	Tel No : 035 22 35696	Tel No : 0352815402

Five details related to each student are given above. Thus, data such as Kavindu Prabashwara, Meenadevi Ramanathan, Mohommad Malikkar represent one field. To name such a field, a 'field name' is used.

Let us create a table recording details under each field name. (Table 9.6)

Table 9.6 - Student Records

Admission No	Name	Date of Birth	Gender	Student Phone Numbers
1426	Kavindu Prabashwara	2005.05.23	male	0352287571
1427	Meenadevi Ramanathan	2005.08.12	female	0352235696
1428	Mohommad Malikkar	2005.02.07	male	0352815402

A column of the table represents one field. Thus, the above table consists of five fields. They are admission number, Name, Data or Birth, Gender and Telephone number.

A collection of fields makes a record. Hence, the above table has three records.

Field Names

Record

Column

Table 9.7 - Componants of Data Table

Admission No	Name	Date of Birth	Gender	Telephone No
1426	Kavindu Prabashwara	2005.05.23	male	0352287571
1427	Meenadevi Ramanathan	2005.08.12	female	0352235696
1428	Mohommad Malikkar	2005.02.07	male	0352815402

Row

There is the possibility of entering the same data again in the columns such as Name, Date of Birth, Gender and Tel No. However, a datum entered in the column of Admission No will not be repeated. Hence, the field Admission No is more suitable to uniquely identify a record.

What are the books borrowed by Firosa Rafeeq? Let us learn how this is found in relevent tables.

Table 9.6

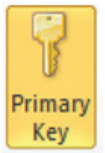
Student Number	Name	Date of Birth	Date of Admission	Name of the Guardian
100	Manoj Dayarathne	2/9/2008	1/1/2014	G. Dayarathne
101	Firosa Rafeeq	4/2/2008	1/1/2014	K. Fais

Student Number	Book Number	Date Borrowed	Date Returned
101	2222	2/9/2014	16/9/2014
100	3333	3/9/2014	17/9/2014
101	1111	3/9/2014	17/9/2014
100	3333	4/9/2014	18/9/2014

Book Number	Title	Author's Name
1111	Basic Maths Concept	Sivathasan Ramanathan
2222	Folk Songs	Jayantha Bandara
3333	Drama	Padmamali Menike

9.1.5 Primary Key

A column (or a combination of columns) which enables to identify a record uniquely is called primary key.



Example - National Identity Card Number
School Admission Number

Figure 9.6

observation

Special attributes of a primary key

- Should not be empty (data being there is mandatory)
- No duplicate values (same values do not exist)

For instance, study the table given below which consists of data on a few books.

Table 9.7 - Book Table

Accession No	Title	Author's Name	Price of Book	Number of Books
2131	Let's Access Internet	Mahesh Gankanda	Rs.275.00	10
2132	Computer Studies	Suranimala Basnayaka	Rs.300.00	5
2133	Essay Writing	Nimali Bogoda	Rs. 225.00	12
2134	Education Psychology	Dayanath Jayasekara	Rs.400.00	6
2135	Tamil Language Learning	Raj Sudakaran	Rs.225.00	8
2136	Computer Studies	Mohommad Niyas	Rs.150.00	4
2137	Sinhala Tamil Dictionary	Raj Sudakaran	Rs.325.00	6

In this table,

- Accession numbers do not have duplicates (unique)
- Both authors Suranimala Basnayaka and Mohommad Niyas have authored Computer Studies.
- Raj Sudakaran has authored both Tamil Language Learning and Sinhala Tamil Dictionary.

- The price of both books Essay Writing and Tamil Language Learning is the same.
- Both books Education Psychology and Sinhala Tamil Dictionary have six copies.

According to these details, the Accession Number is the most suitable fields for the primary key.

Note: The Primary key of a table is underlined to identify as unique. (table 9.8)

Table 9.8

Accession Number	**Title**	**Author's Name**	**Price of the Book**	**Number of Copies**

9.1.6 Composite Primary Key

The primary key which consists of two or more columns of a table uniquely identifies a record is called Composite Primary Key.

Example
Look at the table given below about the captain and vice captain of a school.

Table 9.9 – Sports Table

Year	**Sport**	**Captain**	**Vice Captain**
2013	Cricket	Rashmi Senarathne	Mubharak Husein
2013	Football	Jaliya Saranga	Vinothen Raj
2013	Volleyball	Ahammed Nawas	Sudesh Tharanga
2014	Cricket	Mubharak Husein	Bhanu Dayarathne
2014	Football	Jaliya Saranga	Ahammed Nawas
2014	Volleyball	Bhathiya Gamlath	Sudesh Tharanga

Composite Key

Both the year and sport are needed to uniquely identify a record.

Since the column data of this table containes duplicate. There is no single column to uniquely identify records. There should be a definite captain and a vice captain for a sport in a year. Hence, as far as the combination of two columns; year and sport is considered, identity of records exists. Hence, combination of both fields 'year' and 'sport' can be considered as the primary key. The composite key made of the combination of these two columns is suitable for the primary key in this table. When indicating the composite primary key, fields are separately underlined. (Refer Table 9.10)

Table 9.10

Year	Sport	Captain	Vice Captain

The composite primary key of this table = Year + Sport

9.1.7 Foreign Key

If a field (or a combination of fields) of one table can be used to uniquely identify rows of another table, this/these field/s is/are called the foreign key.This key builds connection of two tables.

Table 9.11 – Student Table

Registration Number	Name	Date of Birth	Date of Admission	Name of the Guardian
100	Manoj Dayarathne	2/9/2014	1/1/2014	G. Dayarathne
101	Firosa Rafeeq	4/2/2014	1/1/2014	K. Fais

Primary Key

When considering the tables 9.11 and 9.12, Registration Number is the primary key of 9.11 - Student Table where as Registration Number is the foreign key of 9.12 - Subject Table. Further, a separate primary key is available for subject table and that is candidate number.

Foreign Key

9.12 - Subject Table

Candidate No	Maths	Science	Sinhala	English	Registration No
449683	B	A	C	C	100
449697	A	B	B	A	101

observation

Special features of a foreign key

- Builds a connection between two tables.
- The related data of the primary key field exist in the other table.
- Foreign key of one table is the primary key of the other table.

Example

Given below in Table 9.13 are ICT subject marks of three students scored in the first term.

Table 9.13 – First term marks

Admission No	Name	Date of Birth	Marks	Term	Year
1426	Kavindu Prabashwara	2005.05.23	69	1	2014
1427	Meenadevi Ramanathan	2005.08.12	82	1	2014
1428	Mohommad Malikkar	2005.02.07	47	1	2014

When entering marks of these students scored in the second term, the fields such as admission number, name and date of birth should be entered again. (Refer Table 9.14)

Table 9.14 – Second term marks

Admission No	Name	Date of Birth	Marks	Term	Year
1426	Kavindu Prabashwara	2005.05.23	69	1	2014
1427	Meenadevi Ramanathan	2005.08.12	82	1	2014
1428	Mohommad Malikkar	2005.02.07	47	1	2014
1426	Kavindu Prabashwara	2005.05.23	79	2	2014
1427	Meenadevi Ramanathan	2005.08.12	68	2	2014
1428	Mohommad Malikkar	2005.02.07	66	2	2014

Recording column data repeatedly is called data duplication.

Disadvantages of data duplication

(i) Inability to select a primary key field to maintain identity of records.

(ii) Inability to analyse data properly.

Though the number of students who have scored above 60 marks is 5 as per the above table, the actual number of students in the class is 3. Hence, a proper data analysis cannot be done.

(iii) Reduced efficiency

When entering marks of several years in the above table, more time is spent to enter the admission number, name and date of birth of the same student. This reduces efficiency.

(iv) Possibility to get inaccurate data is high.

There can be errors in entering the same data repeatedly. Mohommad Malikkar can be recorded as Mohommad Malakkar in another place. These mismatches can lead to inaccurate data. Hence, accuracy becomes low.

(v) Difficult to input data.

To enter the marks of a student, his/her name and date of birth should be entered repeatedly.

(vi) Possibility to make errors in deleting data.

As there are several records related to a student, there can be errors in deleting data.

(vii) Difficult to update data.

As there are several records related to one student, attention should be paid to each record in updating it.

These difficulties are created as all data are stored in one table. Hence, to minimize such difficulties, a table can be divided into several tables.

Let us create two tables: Student Table and Marks Table, by removing the fields which cause data duplication.

Let us create Student Table (Table 9.15) which consists of Admission Number, Name and Date of Birth.

In the Student Table, there is the possibility of data in Name and Date of Birth fields being duplicated. However, data does not duplicate under Admission Number. Hence, Admission Number is more suitable to identify records uniquely. Therefore, the primary key of the Student Table is the Admission Number.

Table 9.15 – Student Table

Admission No	Name	Date of Birth
1426	Kavindu Prabashwara	2005.05.23
1427	Meenadevi Ramanathan	2005.08.12
1428	Mohommad Malikkar	2005.02.07

Let us create a Marks Table (Table 9.16) which consists of the Admission Number, Marks, Term and Year.

Table 9.16 – Marks Table

Admission No	Marks	Term	Year
1426	69	1	2014
1427	82	1	2014
1428	47	1	2014
1426	79	2	2014
1427	68	2	2014
1428	66	2	2014

There is only one datum in the Student Table related to Admission Number of Marks Table.

Hence, the field of the Admission Number is the primary key of the Student Table and foreign key of the Marks Table.

9.2 Creating a Simple Database Manually

Data type : a type of data related to one field is called a data type. Let us learn about some commonly used data type.

- Numeric: used for calculations. Exists in several forms.
  - Integer: plus or minus whole numeric figures.
    E.g.: 12, -23
  - Real: plus or minus numbers with decimal places.
    E.g.: 8.125, -2.64, 4.00
- text: composed of letters, numbers or special characters (Eg- %, *, -). Though numbers are used, it is not used for calculations.
  E.g.: National identity card number –889534731V
  Telephone number –0112785123, 0112 - 985123
- Currency: used to indicate monetary values.
  E.g.: $12.45, Rs.35.00
- Date / Time: indicates dates and time
  E.g.: 12/23/2013, 7.35 a.m
- Boolean: there are only two Boolean (logical) values; True and False.

The size of a field can be changed according to the data type and number of data input to that field.

E.g.: **Field Name (Column Name)** — **Number of fields (Column Width)**

Subject Name	15
Subject Code	5

Data type related to the field should be identified when the table is created.

Field Name	**Data Type**
Accession number of the book	Text
Title	Text
Author's Name	Text
Price of Book	Currency
Number of Books	Number

Activity

(1) Tabulate details of 10 books in your library under the fields mentioned above.

(2) Create a table which is suitable to enter marks scored by the students in your class. Include Admission Number, Name and the Marks for subjects you study in this table.

Mention the most suitable data type for the fields in Table 9.17 given below.

Table 9.17

Field	Data Type
Admission Number	
Date of Admission	
Subject Code	
Doctor's Fee	
Department Name	
Number of Passengers	
Is Registered?	

(3) Explain with examples the importance of selecting the most suitable data type for fields.

9.3 Converting a Manual Database to an Electronic Medium

Let us learn electronic databases with the purpose of converting a manual database to an electronic medium.

Definition

A collection of objects which facilitates planning and maintenance of the database to the user is called a Database Management System (DBMS). This consists of several objects like tables, queries, forms and reports. (Refer Figure 9.7)

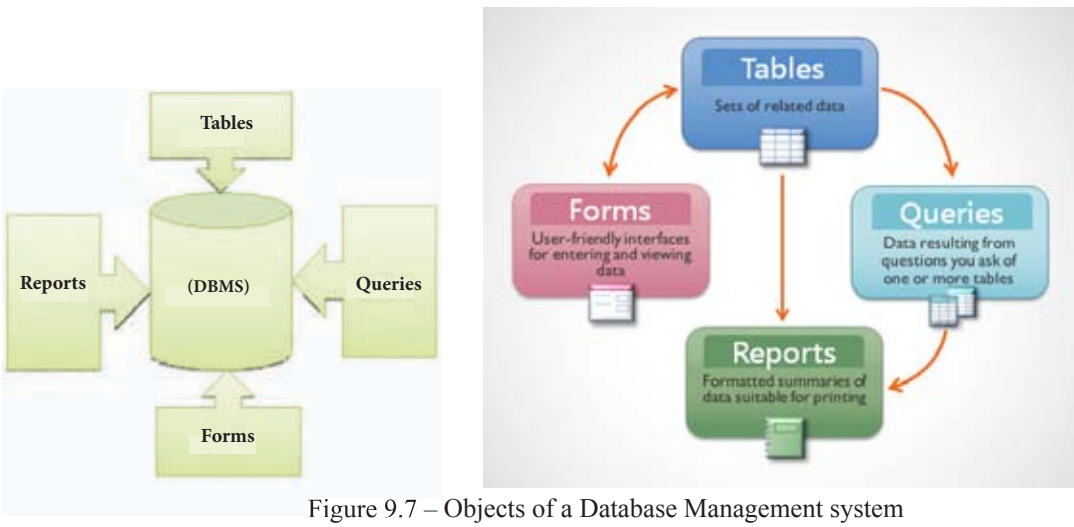


Figure 9.7 – Objects of a Database Management system

9.3.1 Database Management System Software

Given below in Table 9.18 are some DBMS software manufactured by various companies.

Table 9.18 – Various database management systems and manufacturing companies

Software	Manufacturing Company
Access	Microsoft Company
Base	The Document Foundation
Oracle	Oracle Corporation

9.3.2 Using of Database Management System Software

In this unit, only Microsoft Office Access and LibreOffice Base software are discussed.

1. Starting DBMS software

Please note that the commands used to run software can be different according to the operating system.

For Microsoft OfficeAccess...

Start→ Programs → Microsoft Office → Microsoft Office Access → Blank Database → Select Folder and Type Name → Create

For LibreOffice Base...

Start → Programs → LibreOffice → LibreOfficeBase → Create a new database → Next → Finish → Select Folder and Type Name → Save

2. Planning a Data Table

Open database software and plan a table with the fields and data types as given in 9.8. Name the table as 'Library'.

For Microsoft OfficeAccess...

Create → Table Design → Give the field name and data type → Design properies → Save the table

For LibreOffice Base...

Select 'Table' in Design View → Give the field name and data type → Design Properties → Save the table.

Library

Field Name	Data Type
Accession_Number	Text
Title	Text
Auther	Text
Price	Currency
Number_of_books	Number

Figure 9.8 – Fields and data types of 'Library' table.

3. Creating the Primary Key for a Data Table

Data should not be duplicated to uniquely identify rows of a table. Identity of records can be maintained by using a column or a combination of columns of a table as a primary key field. Convert the field of 'Accession Number' in the above figure 9.8 to the primary key field.

For Microsoft OfficeAccess...

Give field name and data type → Select the row/ rows that should be made as Primary key → Click on Primary key → save the table.

For LibreOffice Base....

Give field name and data type adjust properties → Right click on the line which contains the field need making primary key → Select Primary key → save the table.

Library

Field Name	Data Type
Accession_Number	Text
Title	Text
Auther	Text
Price	Currency
Number_of_books	Number

Figure 9.9 - Library Table with the Primary Key

4. Entering Data to the Table

The table view should be changed to input data to a prepared table.

For Microsoft Office Access...

Select the table from 'All Access Objects' window → Select' Data Sheet View' → Enter data → Close the table.

For LibreOffice Base...

Double click the table under Tables or select Open by clicking the right button → Enter data → Close the table.

Enter data into the Library Table as shown in Figure 9.10

Library

Accession_Number	Title	Auther	Price	Number_of_books
2131	Access the Internt	Mahesh Gankanda	Rs. 275.00	10
2132	Computer Language Study	Suranimala Basnayaka	Rs. 300.00	5
2133	Eassy Practice	Nimali Bogoda	Rs. 225.00	12
2134	Educationl Psychology	Dayanath Jayasekara	Rs. 400.00	6
2135	Learn Tamil Language	Raj Sudhakaran	Rs. 225.00	8
2136	Computer Language Study	Mohamed Niyas	Rs. 150.00	4
2137	Sinhala Tamil Dictionary	Raj Sudhakaran	Rs. 325.00	6

Figure 9.10 - Records of Library Table

9.4 Creating a Relational Database

You have studied the Primary Key and Foreign Key of a table in unit 9.1. Rather than keeping all the data in a single table, it is easier, more efficient and productive to input, update and delete data if those are recorded separately in different tables. Hence, let us study this section well to break a data table into several simple tables and to build relationships between these.

When creating a relational databases, several type of relations can exist among tables. They are known as one-to-one, one-to-many and many-to-many.

9.4.2 One-to-one Relationship

If only a row of a table is related to a row of another table, it is called a one-to-one relationship.

Two tables exist as A and B. A row in table A is related to one row in Table B and a row in Table B is related to one row in Table A.

Example

Given below is Table 9.19 which includes the marks students scored of the Grade 5 scholarship exam.

Table 9.19– Scholarship Marks

Admission No	Name	Date of Birth	Index No	Marks
1426	Kavindu Prabashwara	2005.05.23	23234	151
1427	Meenadevi Ramanathan	2005.08.12	23876	186
1428	Mohommad Malikkar	2005.02.07	23758	172
1429	Rashmi Janodara	2005.06.16	23765	193

Let us tabulate data in Table 9.19 into two tables: Table 9.20 – Marks Table and Table 9.21 – Students Table.

Table 9.20 – Marks Table

Index No	Marks	Admission No
23234	151	1426
23876	186	1427
23758	172	1428
23765	193	1429

Table 9.21 – Students Table

Admission No	Name	Date of Birth
1426	Kavindu Prabashwara	2005.05.23
1427	Meenadevi Ramanathan	2005.08.12
1428	Mohommad Malikkar	2005.02.07
1429	Rashmi Janodara	2005.06.16

A record of the Marks Table is related to only one record of the Student Table. A record of the Student Table is related to only one record of the Marks Table as well.

The primary key of the Student Table is the Admission Number and it is the foreign key of the Marks Table. The Primary key of the Marks Table is the Index Number. The relationship built between these two tables through the foreign key is one-to-one. (Figure 9.11)

Student Table

Admission No	Name	Date of Birth

Marks Table

Index No	Marks	Admission No

An arrow is drawn from the foreign key to the primary key to indicate the relationship.

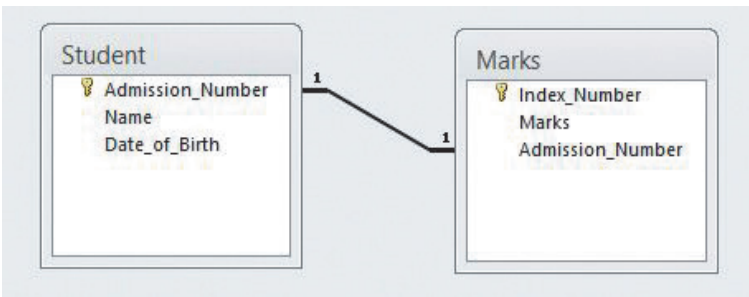


Figure 9.11 – Indicating one-to-one relationship

9.4.2 One-to-many Relationship

If each record of a table is related to several records of the other table, this is called a one-to-many relationship.

If the tables are A and B, and if B is the related table, the following Table 9.22 shows one-to-many relationship.

Table 9.22 – Features of a one-to-many relationship

Table A	Table B (Related table)
A record in Table A can be related to several records in Table B.	A record in Table B can be related to only one record in Table A.
There can be records which are not related to records of Table B.	There cannot be records which are not related to records of Table A.
Data in the column which includes the primary key cannot duplicate.	Data in the column which includes the foreign key can duplicate.
Having a record in Table B related to a record in Table A is not mandatory.	It is mandatory to have at least one row in Table A which is related to Table B.

Example

Refer Table 9.23 given below which includes personal data of students and payments of service and facility fees.

Table 9.23 - Service and facility fees

Admission No	Name	Date of Birth	Receipt Number	Payment Date	Fees	
1426	Kavindu Prabashwara	2005.05.23	1000	2014.01.04	40.00	
1427	Meenadevi Ramanathan	2005.08.12				→ R
1428	Mohommad Malikkar	2005.02.07	1001	2014.01.06	120.00	
1426	Kavindu Prabashwara	2005.05.23	1002	2014.01.12	80.00	

In this table, the fields 'Payment Date' and 'Fees' depend on the Field Receipt Number. Further, data is unique in the Receipt Number Field. The reason for this is that receipt numbers will not be same. Anyway, there can be incomplete records in the table as receipts should be issued in the order of payment. (Indicated as R in the table) Further, data duplication can also be seen here.

Hence, let us break this table into two tables: Table 9.24 –Student Table and 9.25 – Fees Table.

The Receipt Number is the primary key of the Fees Table. Admission Number is the primary key of the Student Table and the Foreign Key of the Fees Table.

Table 9.24 – Student Table

Admission No	Name	Date of Birth
1426	Kavindu Prabashwara	2005.05.23
1427	Meenadevi Ramanathan	2005.08.12
1428	Mohommad Malikkar	2005.02.07

Table 9.25 - Facility Fees Table

Receipt Number	Payment Date	Fees	Admission No
1000	2014.01.04	40.00	1426
1001	2014.01.06	120.00	1428
1002	2014.01.12	80.00	1426

If a student can pay fees a maximum of three times, there can be 0, 1, 2 or 3 rows in Facility Fees Table related to a record of the Student Table

- If number of records is 0, this means fee is not paid.
- If number of records is 1, this means fee is paid once only.
- If number of records is 2, this means fee is paid twice.
- If number of records is 3, this means fee is paid thrice.

Thus, there can be no or several rows in the Fees Table related to a row of the Student Table. Hence, the relationship between these two tables is one-to-many

Student Table

Admission No	Name	Date of Birth

Facility Fee Table

Facility Receipt No	Payment Date	Fees	Admission No

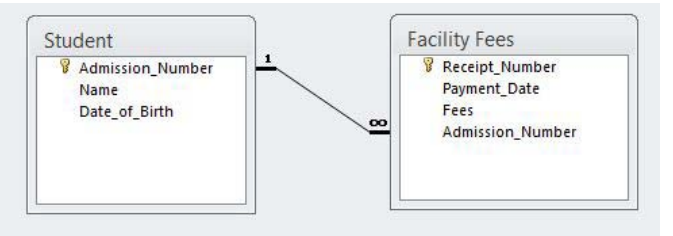


Figure 9.12 - One-to-Many Relationship

9.4.3 Many-to-many Relationship

If a record of a table is related to several records of another table and if a record of that related table is related to several records of the other table, there is a many-to-many relationship between those two tables.

Example

Students take part in sports (team) as an extra curricular activity. There are sports such as cricket, volleyball and football. A student can do at least one of these sports. Further, there should be a team for each sport.

Refer Table 9.26 given below which includes these data. According to this table,

Figure 9.26 – Table of students who do sports

Admission No	Name	Date of Birth	Sport No	Sport	Team	Number of permanent members
1426	Kavindu Prabashwara	2005.05.23	S001	Cricket	A	11
1426	Kavindu Prabashwara	2005.05.23	S002	Football	A	16
1428	Mohommad Malikkar	2005.02.07	S001	Cricket	B	11
1428	Mohommad Malikkar	2005.02.07	S002	Football	A	16
1428	Mohommad Malikkar	2005.02.07	S003	Volleyball	B	06
1429	Janith Asheka	2005.04.15	S001	Cricket	A	11
1429	Janith Asheka	2005.04.15	S003	Volleyball	A	06

There is data duplication in this table. To minimize data duplication, let us break these data into separate tables. Include Sports data into Sports Table (Table 9.27) and student data into Student Table (Table 9.28).

Table 9.27- S tudent Table

Admission No	Facility fees Table	Date of Birth
1426	Kavindu Prabashwara	2005.05.23
1428	Mohommad Malikkar	2005.02.07
1429	Janith Asheka	2005.04.15

Table 9.28 - Sports Table

Sport No.	Sport	Number of permanant Members
S001	Cricket	11
S002	Football	16
S003	Volleyball	6

Many-to-many relationship between Student Table and Sports Table is converted to one-to-many relationships in related databases. For this, another table is needed apart from the two tables given above. (Let us name that table as Students Sports Table – Table 9.30) Let us include Admission Number of Student Table to represent students and Sport Number of Sports Table to represent sports.

Figure 9.29 – Student Table

Admission No	Name	Date of Birth
1426	Kavindu Prabashwara	2005.05.23
1428	Mohommad Malikkar	2005.02.07
1429	Janith Asheka	2005.04.15

Figure 9.30 - Students Sports Table

Admission No	Sport No	Team
1426	S001	A
1426	S002	A
1428	S001	B
1428	S002	A
1428	S003	B
1429	001	A
1429	S003	A

Figure 9.31 – Sports Table

Sport No	Sport	Number of permanent members
S001	Cricket	11
S002	Football	16
S003	Volleyball	6

The Admission Number is the Primary key of the Student Table and the foreign key of Students Sports Table.

The Sport Number is the primary key of the Sports Table and the foreign key of Students Sports Table.

The primary key of the Students Sports Table is Admission Number + Sport Number.

Refer Figure 9.13 which gives relationship when two tables like the Student Table and Sports Table with many-to-many relationships are converted to one-to-many relationships.

Student Table

Admission No	Name	Date of Birth

Students Sports Table

Admission No	Sport No	Team

Sports Table

Sport No	Sport	Number of permanent members

Representing two tables with many-to-many relationships as two one-to-many relationship

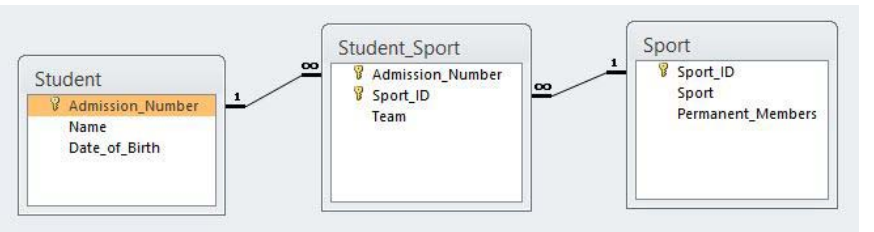


Figure 9.13 - Many-to-Many Relationship

Thus,

There is a one-to-many relationship between the Student Table and the Students Sports Table.

There is a one-to-many relationship between Sports Table and Students Sports Table.

Hence, by using an extra table, many-to-many relationships can be converted to one-to-many relationships.

9.5 Creating a Relational Database Using Database Management System Software

Let us learn how to build relationships between tables using a Database Management System software. For this, create the tables given below: Figure 9.14 – Student Table (using field names and data types given) and Figure 9.15 – Marks Table.

Student

Field Name	Data Type
Admission_Number	Text
Surname_with_Initials	Text
Date_of_Birth	Date/Time
Telephone_Number	Text
Admission_Fees	Currency

Figure 9.14 – Field names and data types of Student Table.

Marks

Field Name	Data Type
Index_Number	Text
Admission_Number	Text
Maths	Number
Science	Number
English	Number
Year	Text

Figure 9.15 – Field names and data types of marks table.

9.5.1 Build up relationship between tables

For Microsoft Office Access...

Select Database Tools → Select Relationship command → Select the table which should be related → Click 'Add' command button. (Indicate the number of tables required) → Drag the Primary Key to the foreign key of the table which should be related (Figure 9.16) → Select 'Enforce Referential Integrity' on 'Edit Relationship' Dialogue Box (Refer 9.17) → Select 'Cascade Update Related Field' and 'Cascade Update Related Records' → Click 'Create' command button.

For LibreOffice...

Select Tools Menu → Select Relationship command → Select the table which should be related → Click Add command button. (Indicate the number of tables required) → Drag the Primary Key to the foreign key of the table which should be related → Right click on Relationship and select Edit → Select 'Update Cascade' under 'Update Option' on Relations Dialogue Box. Select 'Delete Cascade' under 'Delete Option' (Figure 9.18) → Click 'OK' command button.

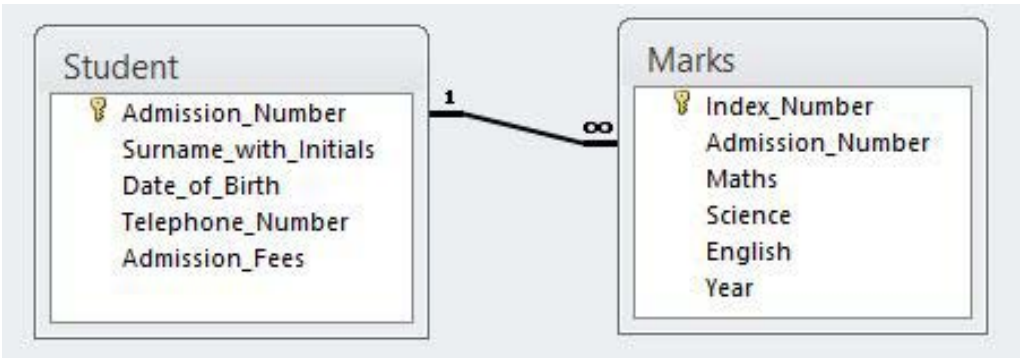


Figure 9.16 - One-to-many relationship between two tables.

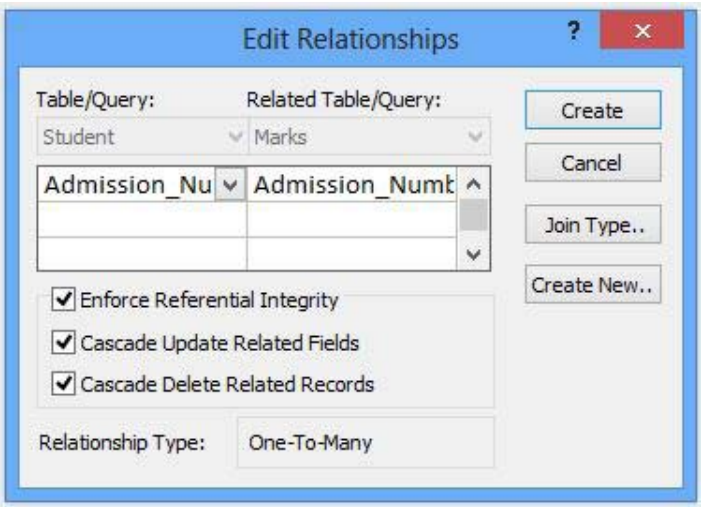


Figure 9.17 – Editing Relationship Dialogue Box (Access)

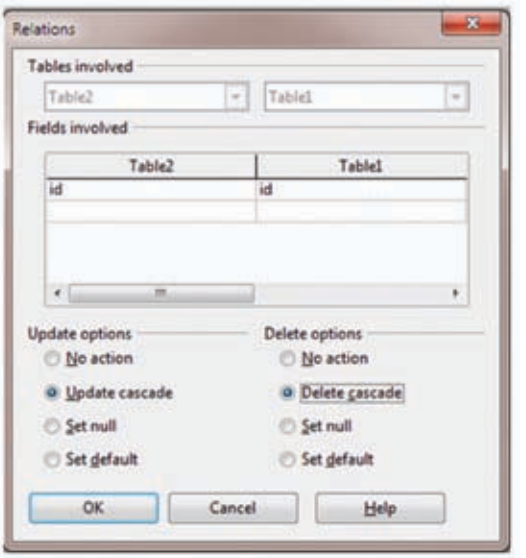


Figure 9.18 – A Relations Dialogue Box (LibreOffice Base)

The Admission Number is the primary key of the Student Table and the Foreign Key of the Marks Table.

observation

Special Features in Related Tables

As soon as the values of a primary key field of the Student Table are updated using 'Referential Integrity,' the foreign key field values of the related table are automatically changed.

Further, when a record of the Student Table is deleted, the related records of the related table are automatically deleted.

First, data should be entered to the student Table. After that, data can be entered to the Marks Table.

After entering the marks to the Student Table, data can be entered to the Marks Table through it.

For this, click on the + mark which is in front of the Admission Number of the Student Table. Then data can be entered to Marks Table easily. (Refer Figure 9.19)

Student

Admission_Number	Surname_with_Initials	Date_of_Birth	Telephone_Number	Admission_Fees
001	Karunajeewa R.J.C	8/10/2003	0715648453	Rs. 560.00

Index_Numl	Maths	Science	English	Year	Click to Add
1001	67	45	78	2013	
1101	56	64	51	2014	

002	Somarathna A.B.G.	3/1/2003	0777876514	Rs. 560.00
003	Rasaputhram S.N.	7/10/2003	0346737785	Rs. 560.00

Index_Numl	Maths	Science	English	Year	Click to Add
1003	37	54	35	2013	
1103	68	60	72	2014	

004	Jayasena L.K.R.	7/11/2003	0112356567	Rs. 560.00
005	Malikkar M.N.M.	9/23/2003	0727543627	Rs. 560.00
006	Radhakrisna T.U.	1/6/2003	0679734355	Rs. 560.00
007	Faslina M.G.	3/27/2003	0417878676	Rs. 560.00

Figure 9.19 – Entering data to Student Table and Marks Table.

9.6 Creating Forms to Entering and Displaying Data

Now you have knowledge about creating a table and entering data to it. Forms are used to enter data to a table in Database Management Systems. Further, forms are used to display entered data as well.

Here, a row of a table is displayed and entered as a record in a form. (Refer Figure 9.18)

Data Table

Name	Address	Telephone No	Email
Anwar	Athurugiriya	0773684949	anvmom@dd.uk
Nimal	Galewela	07184632481	nigl@ya.com
Sudakaran	Kandy	0817587484	suda@gmail.com
Saman	Kegalle		

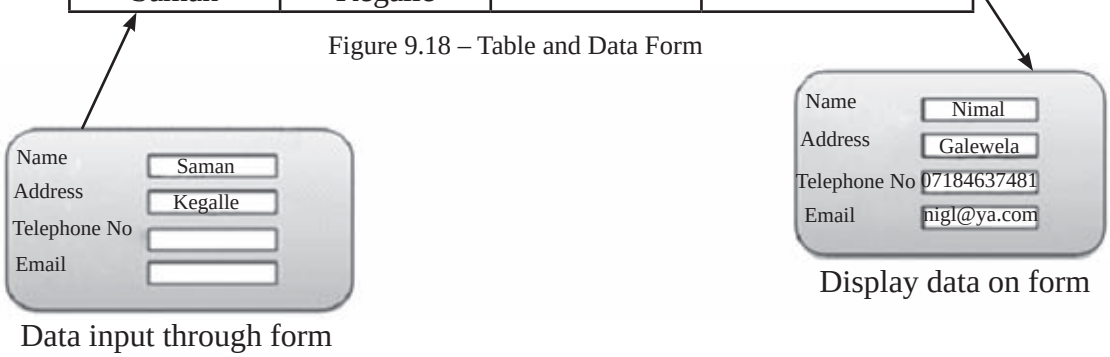


Figure 9.18 – Table and Data Form

Data input through form

Display data on form

Each input record is entered to the last column of the table. Each record of the table can be filled one by one through the form. For this, the Record Navigation Bar of a form is used. (Refer Figure 9.20)

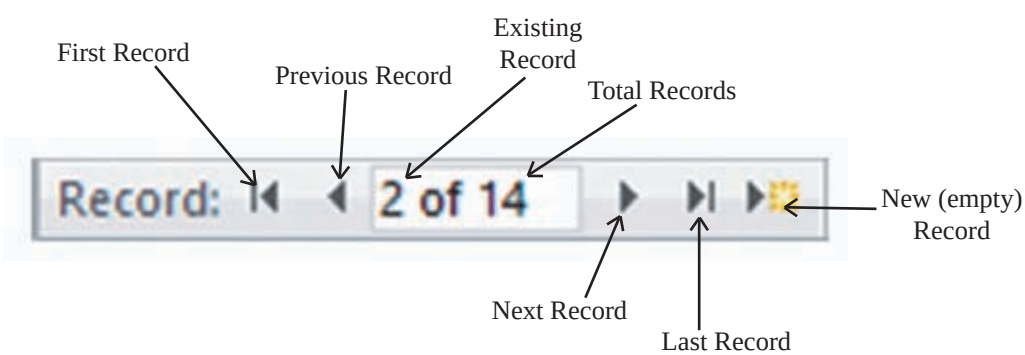


Figure 9.20 – Checking records from a data form.

1. Building a Data Form

For Microsoft Office Access ...

Create → Form Design → Add Existing Fields → Show tables → Select the required table → Drag table fields to the form (Refer Figure 9.21)

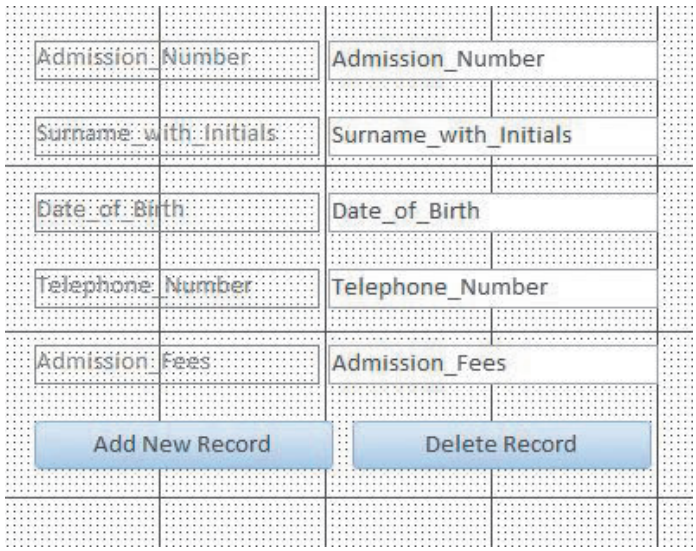


Figure 9.21 –Data form to enter data to the Student

2. Showing Table Records in Data Form

For Microsoft Office Access ...

Home Tab → View → Form View (Refer Figure 9.22)

Figure 9.22 – Showing records in the Student Table

3. Entering Control Wizards to a Form

For Microsoft Office Access ...

Design Tab → Select 'Control Wizards' (Refer Figure 9.23) → Select the button indicated as XXXX → Establish the button in data form → Select Record Operation in Command Button Wizard (Refer Figure 9.24) → Select the Action which should be entered (E.g.: Add New Record) → Give a proper name to the button → Finish

Figure 9.23 – Controlling Tools

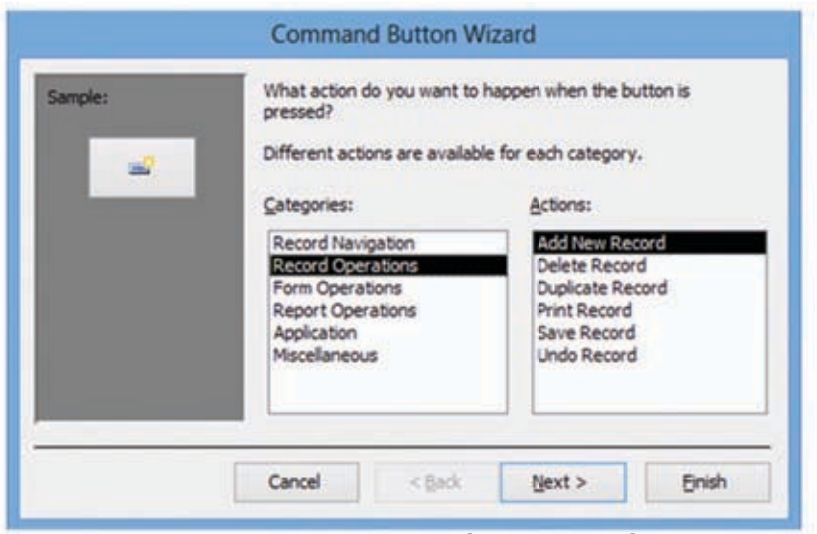


Figure 9.24 – Command Button Wizard

9.7 Designing Query to Get Information

Let us use a query to obtain necessary information from the data of related tables. Query represents data of selected fields (columns) in each table. (Refer Figure 9.25)

Student No	Name	Email
A1	Pubudu	Pu2@gmail.com
A2	Faris	pari@yahoo.com
A3	Kamalan	Kam_n@hotmal.com
A4	Thanuja	Thanu7@slt.lk

Subject No	Subject
B1	Maths
B2	Science
B3	English

Subject	Student No	Marks
A1	B1	67
A2	B3	89
A1	B3	50
A3	B2	75

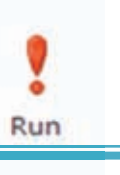
When Name, Subject and Marks are taken by a query from the three table above,

Name	Subject	Marks
Pubudu	Maths	67
Faris	English	89
Pubudu	English	50
Thanuja	Science	75

Figure 9.25 - Obtaining data to a query

For Microsoft OfficeAccess...

Create Tab → Query Design → Select the necessary tables (Refer Figure 9.26) → Select the necessary field from the tables → Run the query



Designing a Query

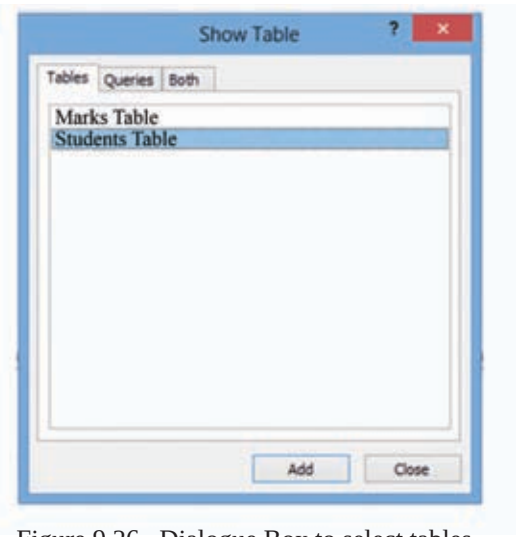


Figure 9.26 –Dialogue Box to select tables

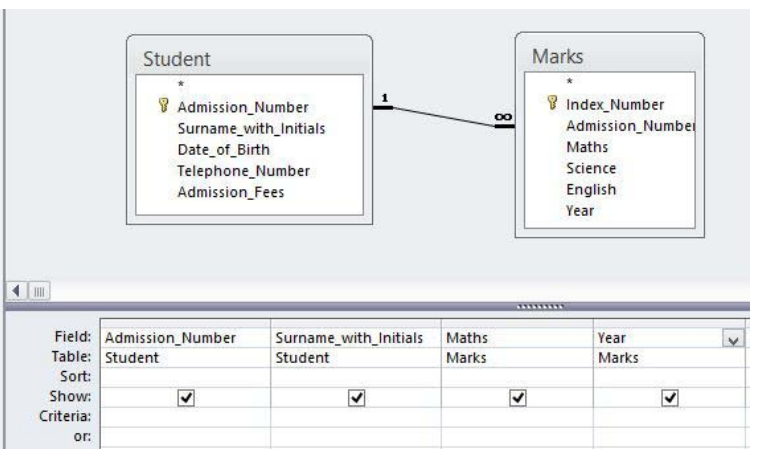


Figure 9.27 – Window to design query

Refer figure 9.28 given below for the information received after running the query.

Admission_Number	Surname_with_Initials	Maths	Year
001	Karunajeewa R.J.C	67	2013
001	Karunajeewa R.J.C	56	2014
002	Somarathna A.B.G.	76	2013
002	Somarathna A.B.G.	66	2014
003	Rasaputhram S.N.	37	2013
003	Rasaputhram S.N.	68	2014
004	Jayasena L.K.R.	87	2013
004	Jayasena L.K.R.	92	2014
005	Malikkar M.N.M.	62	2013
005	Malikkar M.N.M.	76	2014
006	Radhakrisna T.U.	32	2013
006	Radhakrisna T.U.	43	2014
007	Faslina M.G.	70	2013
007	Faslina M.G.	80	2014

Figure 9.28 – Information received after running the query

As shown in Figure 9.28, marks scored by students in 2013 and 2014 are shown. You can obtain marks scored by students in 2014 only (information shown in Figure 9.28) by naming year 2014 as Criteria. (Refer Figure 9.29)

Field:	Admission_Number	Surname_with_Initials	Maths	Year
Table:	Student	Student	Marks	Marks
Sort:				
Show:	☑	☑	☑	☑
Criteria:				"2014"
or:				

Figure 9.29 – Giving Criteria for query

Admission_Number	Surname_with_Initials	Maths	Year
001	Karunajeewa R.J.C	56	2014
002	Somarathna A.B.G.	66	2014
003	Rasaputhram S.N.	68	2014
004	Jayasena L.K.R.	92	2014
005	Malikkar M.N.M.	76	2014
006	Radhakrisna T.U.	43	2014
007	Faslina M.G.	80	2014

Figure 9.30 – Information received after running query with Criteria

Various calculations can be made using fields through query. Let us learn how total marks scored by students are calculated.

Add a new column to the query as Total and build an expression indicating the calculation needed. To get total marks of subject it should be typed as:

Total:[Marks]![Maths]+[Marks]![Science]+[Marks]![English]. This can be typed (Refer Figure 9.31.) or can be performed by building the expression, right click the Mouse button on the column which you expect to get the total and select Build command. Then use the Dialogue Box you get. (Refer Figure 9.32)

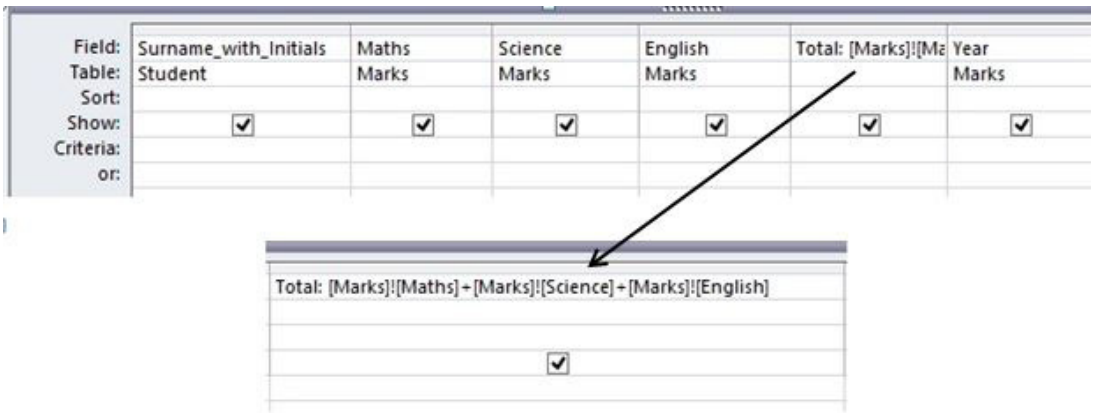


Figure 9.31 – Enlarge 'Total' column in the query

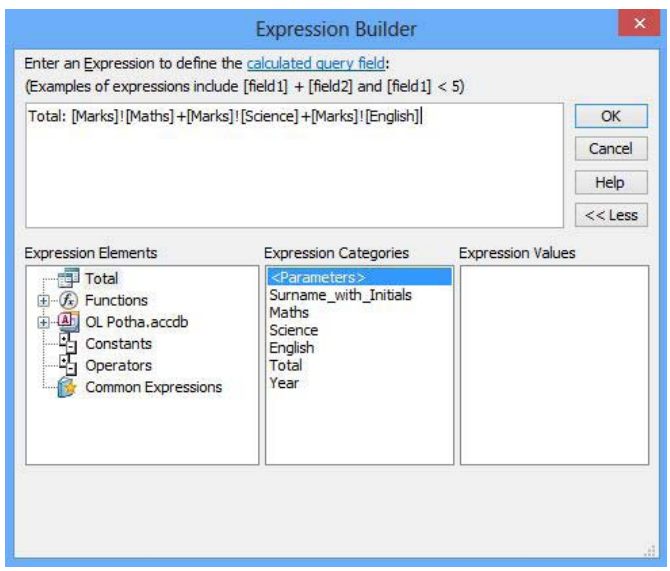


Figure 9.32 – Dialogue Box to build the expression

After running the query built in the way explained above, you get information as given in Figure 9.33 which is given below.

Index_Number	Surname_with_Initials	Maths	Science	English	Total	Year
1001	Karunajeewa R.J.C	67	45	78	190	2013
1002	Somarathna A.B.G.	76	81	55	212	2013
1003	Rasaputhram S.N.	37	54	35	126	2013
1004	Jayasena L.K.R.	87	72	68	227	2013
1005	Malikkar M.N.M.	62	56	43	161	2013
1006	Radhakrisna T.U.	32	45	65	142	2013
1007	Faslina M.G.	70	89	65	224	2013

Figure 9.33 – Marks and total of students scored in 2013

9.8 Designing Reports to Present Information

Reports are used to obtain printed copies of important information received from the data of related tables. Both tables and queries can be used to design reports.

Let us learn how a report is designed using the query given above in Figure 9.33.

Report Wizard can be used to design reports.

For Microsoft Office Access...

Create Tab → Report Wizard → Select the necessary table or query (Refer Figure 9.34) → Select the fields needed for the report from the table or query → Design the report as you need clicking Next button → Finish. Then you will get a report as shown in Figure 9.35.

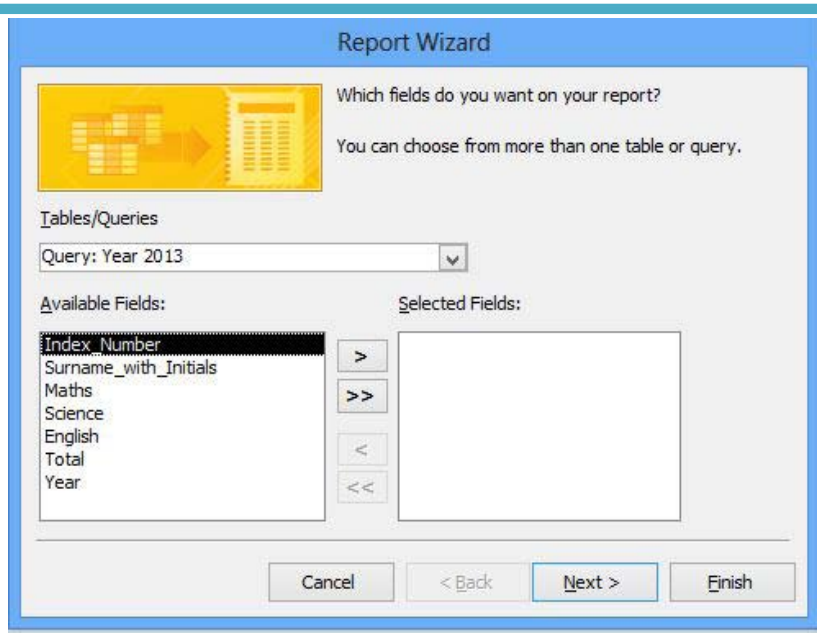
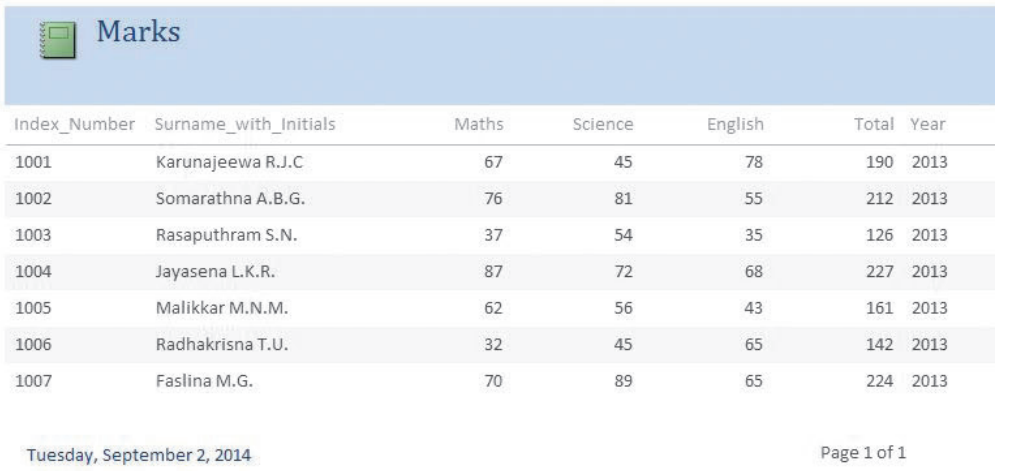


Figure 9.35 - Report Wizard used to design reports



Marks

Index_Number	Surname_with_Initials	Maths	Science	English	Total	Year
1001	Karunajeewa R.J.C	67	45	78	190	2013
1002	Somarathna A.B.G.	76	81	55	212	2013
1003	Rasaputhram S.N.	37	54	35	126	2013
1004	Jayasena L.K.R.	87	72	68	227	2013
1005	Malikkar M.N.M.	62	56	43	161	2013
1006	Radhakrisna T.U.	32	45	65	142	2013
1007	Faslina M.G.	70	89	65	224	2013

Tuesday, September 2, 2014

Page 1 of 1

Figure 9.35 – Report which displays the total marks of students in 2013

Let us learn how numerical values included in a report are calculated.

For this, let us find the total of admission fees paid by the students. Create a table as explained above using Report Wizard including Admission Number, Name and Admission Fees. Then change from Report View to Design View. Then you will get a report layout as shown in Figure 9.36.

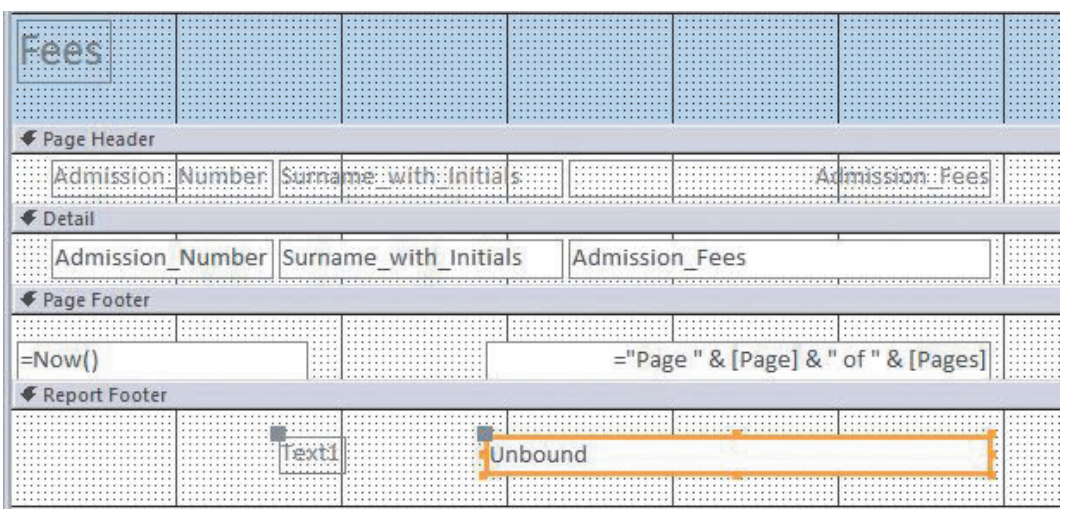


Figure 9.36 – Report plan

Select the tool given as ‘ab’ on the tool barand establish the text box under Report Footer. (Refer Figure 9.37)

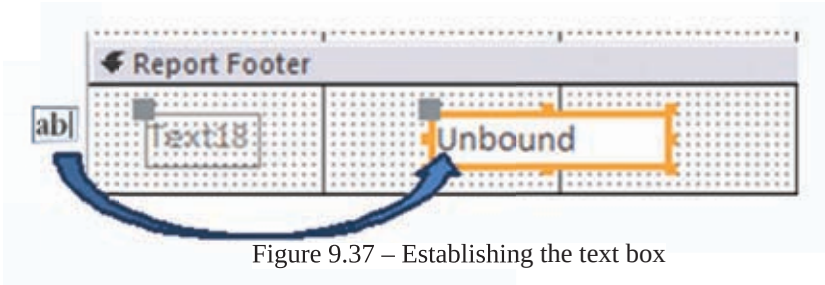


Figure 9.37 – Establishing the text box

The text box is indicated as unbound. The reason for this is there is no field given to it. To get the total of admission fees, get the Expression Builder Dialogue Box to build expressions by clicking the button with three dots in front of the Control Source on Property Sheet. (Refer Figure 9.39)

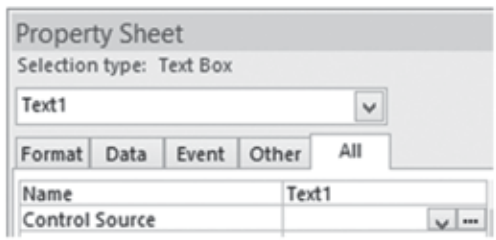


Figure 9.38 - Property Sheet

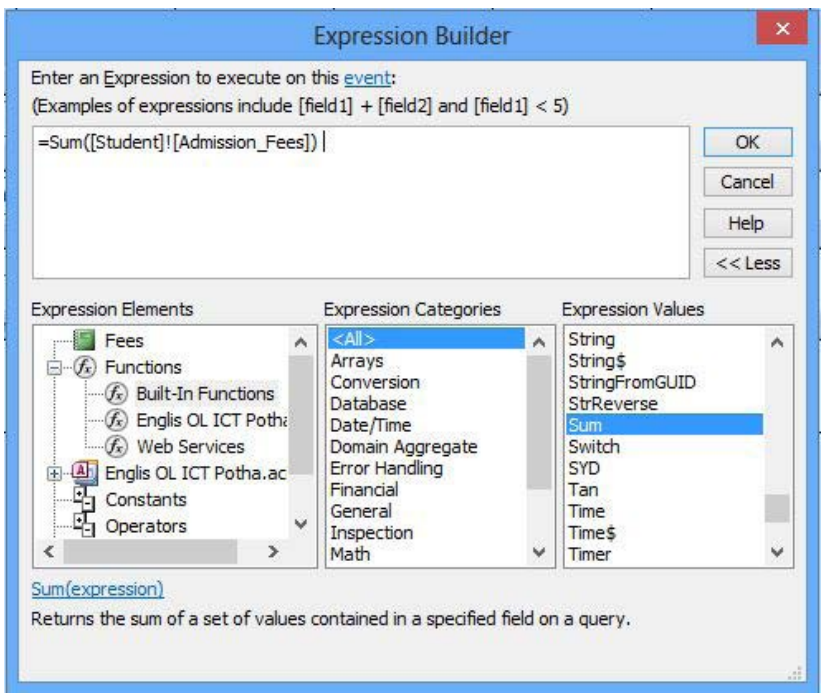


Figure 9.30 – Expression Builder Dialogue Box

To get the total of admission fees, type the expression = Sum ([Student Table]![Admission Fees]) and type OK. Then change the view from Design View to Report View. After that, you will get the report which displays the total of Admission Fees. (Refer Figure 9.40)

Fees

Admission_Number	Surname_with_Initials	Admission_Fees
001	Karunajeewa R.J.C.	Rs. 560.00
002	Somarathna A.B.G.	Rs. 560.00
003	Rasaputhram S.N.	Rs. 560.00
004	Jayasena L.K.R.	Rs. 560.00
005	Malikkar M.N.	Rs. 560.00
006	Radhakrisna T.U.	Rs. 560.00
007	Faslina M.G.	Rs. 560.00
	Total	Rs. 3,920.00

Tuesday, September 2, 2014 Page 1 of 1

Figure 9.40 – Report which displays the total of Admission Fees

Printing the Report

Change the 'Report View' to 'Print Preview'. Click on the tool shown in Figure 9.41. Print the number of copies you need.

Figure 9.41 – Printing tool

Activity

1. Explain the advantages of electronic databases.
2. Explain with examples the features that are available in electronic databases.
3. Compare electronic and manual database.
4. Explain what is meant by data encryption is.
5. Explain relational databases using fields, records and tables.
6. Define primary key and provide three examples.
7. Define composite key and provide three examples.

8. Define foreign key and with three examples.

9. Write five disadvantages of data duplication.

10. a) What is a data type? Provide examples for data types .
    b) Explain the reason as to why 'integer' data type is not the best data type for field that stores telephone numbers.

11. Explain the relationships; one-to-one, one-to-many and many-to-many with two examples for each.

12. Explain what 'objects' are in Database Management Systems and explain the uses of the objects.

Sammary

- Database is defined as the collection of organized data.
- In a table a column is known as a 'Field'
- A raw of a table is known as a 'Record'
- Advantages of electronic database
  - Efficient in searching data.
  - Facilities to get copies.
  - Less storage capacity used for storing data.
  - Efficient analysis of data.
  - Sharing data.
  - Data independence.
- Characteristic of a database.
  - Avoid data redundancy.
  - Consistency of data.
  - Increased efficiency
  - Increased accuracy
  - Increased validity
  - Increase the security of data.
- A column or collection of columns in a table when records can be identified uniquely is called primary key.

- If a field (or a combination of fields) of one table can be used to uniquely identify rows in another table, these fields are called the foreign keys.
- A relationship is built up between two tables by using foreign key.
- Data redundancy means the same data is stored in several database tables.
- The type of data that is relevant to a field is known as data type.
- In a relational database a relationships such as one-to-one, one-to-many and many-to-many can be exist.
- To enter and display data, forms can be used.
- Query is used to obtain information.
- To present data, reports are used.