NATIONAL OPEN UNIVERSITY OF NIGERIA

CIT204: COMPUTER APPRECIATION AND APPLICATION TO AGRICULTURE

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CONTENTS

COURSE GUIDE

INTRODUCTION

A computer is an electronic device that manipulates information, or data. It has the ability to process, store, retrieve and disseminate information. It is rapidly becoming the universal machine of the 21st century. The early computers were very large in size and too expensive for an individual to buy. They were however restricted to the industries, research centres, laboratories and institutions of learning. They could only be programmed by few computer engineers. The basic applications at that time were confined to complex calculations in few disciplines such as mathematics, science and engineering.

Today, the application of computer is no longer confined to the laboratory, mathematics, and sciences, but in various areas such as the world of information explosion, knowledge-based society and information age. Computers have become integrated in every works of live. Computer is rapidly becoming a universal working tool of the 21st century. The application of computer excels in sciences, social sciences and arts focusing on: science, space science, aviation, engineering, social sciences, financial institutions, military, education, humanities, manufacturing, and transportation.

The emergence of the global economy and the technological change processes has serious implications for the nature and purpose of educational institutions. The combination of computers and telecommunication systems gave birth to what is today known as Information and communication technology (ICT). ICT is therefore used for acquisition, processing, storage, communication, and management of information.ICT include computers, the Internet, broadcasting technologies (radio and television), and telephony. ICT has therefore changed the face of all fields of human endeavor.

Today, literacy is not only measured by the ability of learners to read and write, but their ability to competently become Internet literate, digital literate, social media literate, multimedia literate, communication literate, and networks literate to define, access, manage, integrate, evaluate, create, and communicate information ethically and legally in order to function in acknowledge society. ICT literacy is also seen as the ability of individuals to use ICT appropriately to access, manage and evaluate information, develop new understandings, and communicate with others in order to participate effectively in a competitive society. Why are we so concern about ICT literacy? In addition to the above, there are other three major reasons for measuring ICT literacy, namely:(a) the nature, value, and availability of information has changed enormously, and this change impacts the way we live, learn, and work.(b) To succeed, it is not enough to master technical skills: you must know how to apply them within an information society.(c)There is a lack of information about the ICT literacy of students, and debate about how best to address this issue in academic curriculum.

This course is meant to introduce students to the historical evolution of computers, the functional components of computers, problem solving using flow charts, algorithms, computer programming, statements.

Course Introduction

This course presents an overview of the computer systems and exposes you to the operating systems and application packages. This course covers aspects on computer hardware, computer software, generations of computer and Processor, data communication, data security and virus protection.

What you will learn in this course

This course guide is a two-credit unit course. What to expect as you read through CIT 204: Computer Appreciation and Application to Agriculture (2 Units), it is a two credit units course. The course is the first that a student of Agriculture will offer under computer. This introduces students to the essentials of computer. After the successfully completion of this course, students will be introduced to more advanced aspect of the Computer. The computer appreciation and application to agriculture are presented under 5 modules.

THE COURSE

This course guides students on what to expect from reading this learning material. The study of computers is not only important in education, but a universal tool of the 21st century. This course, presents a systematic approach to the understanding of the computers, its functional components, characteristics and its applications to agriculture.

COURSE AIM

The aim of this course is to provide students with the understanding of the fundamental of computer, functional components of the computer, its characteristics, problem solving and their applications in agriculture.

COURSE OBJECTIVES

The specific objectives of this course are to:

a. Provide basic understanding of the historical development of the computer, the generation, the classification and the characteristics of the computer
b. Expose students to the different categories of computer software, hardware and their uses.
c. Expose students to problem solving with flowcharts, pseudo code and algorithms
d. Introduce students to the computer programming, their languages and their stages of writing computer programs.
e. Expose students to the various areas of application of computers to Agriculture
f. Exposes students to the types of viruses, history, why people developed the viruses and antivirus tools.

WORKING THROUGH THE COURSE

This course requires students to spend a lot of time to read. The material though presented in simple language, coherent and in a logical sequence, requires students to be diligent in their study. The material is comprehensive, but would require students to be fully committed and dedicated to their study. Students are therefore, advised to avail themselves to the opportunity of attending the tutorial sessions where they would have the opportunity of comparing knowledge with their colleagues.

THE COURSE MATERIAL

Students will be provided with the following learning materials:

a. Course guide
b. Modules,
c. Study units
d. Self-assessment Exercise
e. Tutor-marked Assignment
f. List of recommended textbooks which will serve as compliments to the course material

COURSE OUTLINE

The course is made up of five modules organized into 24 study units as follows:

MODULE 1: UNDERSTANDING THE COMPUTER

Unit 1 Basic concept of the computer
Unit 2 The History of computer
Unit 3 The generation of the computer
Unit 4 The classification of the computer

MODULE 2 THE COMPONENT OF THE COMPUTER

Unit 1 The hardware component
Unit 2 Component of the computer software
Unit 3 Computer Application

MODULE 3 PROGRAMMING THE COMPUTER

Unit 1 The computer languages
Unit 2 The basic principles of programming
Unit 3 The Flowcharts and the Pseudo code

MODULE 4 THE AREAS OF APPLICATION OF COMPUTER

Unit 1 Application of computer in Education
Unit 2 Application of computer in Agriculture
Unit 3 The application of computer Business and Industry
Unit 4 Application of computer in Science and Engineering Transport, communications, Recreation, government and the Military

MODULE 5 THREATS TO THE COMPUTER

Unit 1 Computer viruses
Unit 2 History of computer viruses
Unit 3 Reasons for creating computer viruses
Unit 4 Characteristics of computer viruses
Unit 5 Types of computer viruses
Unit 6 The most dangerous computer viruses
Unit 7 Mode of transmission of computer viruses
Unit 8 What viruses do
Unit 9 Types of anti viruses
Unit 10 The best antivirus software

Synopses of Module 1: Understanding the computer

Unit 1: This unit presents the definition of the computer, basic understanding of data and information, difference between data and information, methods of data processing, the characteristics of a computer, advantages and disadvantages of the computer.
Unit 2: This unit gives the history of computer.
Unit 3: In this unit, the generation of the computer is presented.
Unit 4. This unit exposed students to the classification of computers based on size, purpose

Synopses of Module 2: The component of the computer

Unit 1**.** In this unit you will be exposed to the component of the input Unit, their types, and their functions
Unit 2. This unit exposes students to the components of the CPU and their functions
Unit 3: This unit exposes students to the primary unit, and their functions

Synopses of Module 3: Programming the computer

Unit 1: This section discusses the secondary unit of the computer and their functions.
Unit 2: This unit exposes students to the output component of the computer and their functions, the auxiliary equipment such as stabilizer, air conditioner, voltage and Uninterruptible Power Supply System (UPS).
Unit 3: This unit discusses the computer operating system, types and their uses.

Synopses of Module 4: The areas of application of computer

Unit 1: This unit introduces the computer application software, their types and functions
Unit 2: In this unit, students will be exposed to the use of computers in agriculture
Unit 3: In this unit you will learn about the application of computer in business and industry.
Unit 4: This unit exposes students to the application of computer in science and engineering, transport, communication, recreation, government and the military

Module 5: **Treats to the computer**

This section deals with threats to the computer as follows:

Unit 1 Computer viruses.
Unit 2 History of computer viruses.
Unit 3 Reasons for creating computer viruses.
Unit 4 Characteristics of computer viruses.
Unit 5 Types of computer viruses.
Unit 6 The most dangerous computer viruses.
Unit 7 Mode of transmission of computer viruses.
Unit 8 What viruses do.
Unit 9 Types of antiviruses.
Unit 10 The best antivirus software.

TEXT BOOKS

More recent editions of these books are recommended for further reading.

Albright, S.C., Winston, W.L. and Zappe, C.J. (2009). Data Analysis and Decision Making using Microsoft Excel. Australia: South-WesternCengage Learning.

Carey, P. and Berk,N.K. (2007). Data Analysis with Microsoft Excel. International Edition Australia: Bbooks/Cole.

Cram, C.M., Friedrichsen, L. and Wermers, L. (2012). Microsoft Office 2010. Australia. Course Technology.

Doyle, S.(2003). ICT for You. London: Edexcel.

Gusen, J.N. (2010).Computer Made Easy. Jos. University Press.

Gusen, J.N. Ramson, E. (N. and Ugwuanyi, F.O.(2009). Introduction to Computer Studies. In Gusen, J.N. *et al* Eds.). Introduction to Computer Studies. Pankshin: Aureka Academic Foundation, FCE Pankshin

Gusen, J.N. (2014). 2,523 Questions and Answers on ICT. Jos: Deka Enterprises.

Heathcote, P.M.(2000). "AS" Level ICT. Great Britain. W.M. West Midland.

Holding, H. and Martin, C. (2001). Mastering Microsoft Office. New York. Palgrave Master Series.

Murray, K. Millhollon, M. and Melton, B. (2007). Microsoft Office: Word 2007 Inside Out. New Delhi. Prentice Hall of India.

O'Leary, T.J and O'leary, L.I. (2010). Microsoft Office 2010: A case approach/Complete Excel. New York. McGraw-Hill International Edition.
Shelly, G.B., Cashman, T. J. and Quasney, J.J. (2008). Microsoft Office Excel, 2007: A comprehensive Concepts and Techniques. Australia. Thomas Course Technology.
UNESCO, (2003). Internet in Education: Supporting Materials for Educators.
Winston, W. L.(2009). Microsoft Excel: Data Analysis and Business Modeling. New Delhi: Microsoft Office, Easter Economy Edition

In addition to the above books, you can browse on the Internet to get additional materials on the topics covered in this course.

ASSESSMENT

There are three components of assessment for this course. The Self-Assessment Exercise, Tutor- Marked Assignment (TMA), and the end of course examination.

SELF-ASSESSMENT EXERCISE

This is an assessment that you have to test your personal knowledge and skills of the overall course taught. This course is already embedded within the unit and you are neither submitting them to your tutor nor are they marked by your tutor.

TUTOR-MARKED ASSIGNMENT

The Tutor-Marked Assignment (TMA) is the continuous assessment component of your course. It accounts for 30%of the total score. You will be given six (6) TMA's to answer. They must be answered before you are allowed to sit for the end of course examination. The TMA's would be given to you by your facilitators at the appropriate time during the course. They are returned to you after you have done the assignment.

END OF COURSE EXAMINATION

This examination concludes the assessment for the course. It constitutes 70% of the whole course. You will be informed of the time for the examination. It may or not coincide with the university semester examination.

SUMMARY

This course intends to introduce you to the basic understanding of computers and its application in education, business and agriculture. By the time you complete studying this course, you should be able to answer basic questions such as:

- What is a computer?
- What are the evolutionary trends in the development of the computer?
- What are the different functional components of a computer?
- What are the different categories of computer software?
- What are the characteristics of computers?
- What are the classifications of the computer?
- What are the generations of the computer?
- What are areas of the application of computer to agriculture?
- What are the types of flowcharts?
- What are the functions of flowcharts?
- What is computer programming?
- What are the types of computer programming?
- What are the generations of computer programming?

- What are the reasons for studying the computer programming languages?
- Why are many computer programming languages in the world?
- What are the classifications of computer programming languages?
- What are the challenges of teaching computer programming?
- What is a virus?
- Why do people create virus?
- What virus can do?
- What is antivirus?
- What types of antivirus are available?
- How do you prevent viruses from entering your computer?

We wish you success in this course. We do hope that this course will give you a good head start in the understanding and use of computers. Best wishes as you enjoy the course.

MODULE ONE

Unit 1: UNDERSTANDING THE COMPUTER

Contents

1.0 Introduction

Computer is fast becoming the universal machine of the 21st century. Early computers were large in size and too expensive to be owned by individuals. Thus, they were confined to the laboratories and few research institutes. They could only be programmed by computer engineers. The basic applications were confined to undertaking complex calculations in science and engineering. Today, computer is no longer confined to the laboratory. Computers have become embedded in almost every aspect of our live. Computing is fast becoming ubiquitous. Its application transcends science, engineering, communication, education, space science, aviation, financial institutions, social sciences, humanities, the military, transportation, manufacturing, extractive industries to mention but a few. This unit presents the background information about computers.

2.0 The objectives

By the end of this unit, students should be enable to:

(a) Define the term Computer
(b) Explain the concept of data and information
(c) Identify the type of data
(d) Differentiate between data and information
(e) Explain the philosophy of data processing
(f) Discuss the objective of data processing
(g) Explain the function of data processing
(h) Identify the approach to data processing
(i) Discuss the methods of data processing
(j) Explain the advantages of a computer
(k) Discuss the disadvantages of a computer
(l) Describe the characteristics of a computer

3.0 Main content

3.1 The concept of Computer

A computer is basically defined as a tool or machine used for processing
data to give required information. It is capable of:

a. taking input data through the keyboard (input unit)
b. storing the input data in a USB, CD-ROM, hard disk or other secondary medium

c. processing it at the central processing unit (CPU) and
d. giving out the result (output) on the screen or the Visual Display Unit (VDU).

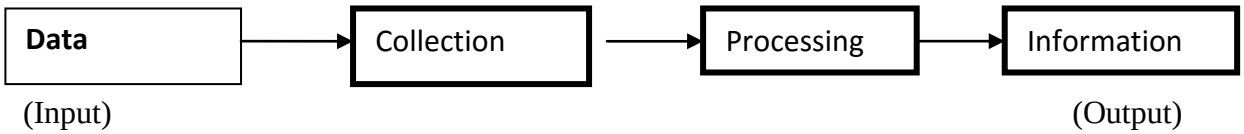

Fig. 1. Schematic diagram to define a computer

3.2 Data and its Types.

Data: The term data is referred to facts about a person, object or place e.g. name, age, complexion, school, class, height etc.

Types of Data. The most popular way of representing information is in the text form. There are combination of letters, numerals and special character that form this text. However, Yadav (2003) pointed out that there are several other ways in which data can be represented, namely:

a. **Text**. This is a collection of alphabets (both lower and upper case such as A, B, C, D to Z), numerals (0-9), and special characters or alphanumeric such as (*, ?, ", :, #, @, !, %, ₦, &,$ etc). Such data presented in textual form may be written and read. Therefore the information in the text can be determined only after reading and interpreting it.
b. **Image**. These are other form of data type. Images refer to data in the form of pictures, photographs, hand drawings, painting.
c. **Graphics and Animation**. These may be a combination of text, images and sound. A very good example of graphics and animation is Microsoft PowerPoint tools. PowerPoint comes with music, sounds and videos which you can play during slide shows. You can also inside music, sound or video clips wherever you want it on the slide.
d. **Audio**. This is in the form of sounds and voice. The audio can be in form of speech or voice of any person. The value of the sound can be interpreted by hearing. This audio may be processed by the computer such as mixing of sound, modifying the sound parameters like the frequency, pitch and amplitude, bass and so on.
e. **Video forms**. This is another important data format to hold information. Of course, it combines the sound and stack of images which are displayed over a period of time.
f. **Qualitative data**: It indicates the classification and characteristics nature of things such as good, blue and so on.
g. **Quantitative data**: It is expressed in terms of measurable quantities such as 45 degree, F, 100 tons
h. **Numeric Type**: The data types may also be an integer (+, -,) without any fractional part or real number which includes integers and fractions
i. **Floating Point Representation**: These data type consist of 3 components namely, exponent, base or radix, mantissa

Leon and Leon (1999) pointed out that data is not useful until it is subjected to a value added process where:

- ♦ Its form is aggregated, manipulated and organized
- ♦ Its content is analyzed and evaluated
- ♦ It is placed in a proper context for a human user

This means that data is typically manipulated by activities such as calculating, comparing, sorting, classifying and summarizing. These activities are organized, analyzed, and manipulated and converted into information for end users

3.3 Information:

Information is referred to as processed data or a meaningful statement e.g. Net pay of workers, examination results of students, list of successful candidates in an examination or interview etc.

3.4 Comparison of Data and Information.

The differences between Data and Information are as demonstrated in Table 1.

S/N	Data	Information
1	Raw facts or figures	Finished one
2	Unstructured data	Structured data
3	Unprocessed data	Processed data
4	Unorganized data	Organized data

3.5 Philosophy of Data Processing.

The data processing program are research-based and organized for student mastery of keyboarding, formatting, and production skills. Mastery of data processing includes three distinct skills:

a. keyboarding skills
b. formatting skills
c. production skills.

The characteristic of mastery learning can be approached in the following ways:

a. Nearly all students can learn the subject matter
b. The amount of learning in school is a function of the amount of time spent on any given topic in proportion to the amount of time needed and the student's readiness to learn
c. Students should have a major role in their own evaluation
d. Errors are a natural part of the learning process and are not a reason for embarrassment or humiliation

3.6 Objectives of Data Processing.

After the industrial revolution, the needs for research increased. Man had to deal with large volume of data. He had to cope with more and more information. The information collected is to be sorted out, stored and retrieved at short intervals. This necessitated the concept of data processing. The general objectives of Data Processing (DP) are:

- Handling voluminous data in order to enable organization to function smoothly
- Provision of qualitative and quantitative information
- Provision of appropriate and timely information
- Storage and retrieval of different data
- Helps in decision making when accurate and effective data processing systems are utilized
- Improving productivity
- Maintaining performance at optimum level
- Effective office management

3.7 Functions of Data Processing.

The functions of Data processing can be grouped into the following:

3.7.1 Data Handling. The functions of the data handling involve:

- **Recording**. This involves fixing of representations which indicate real activities such as schools records of staff and students, sales transaction and so on.
- **Verification**. After the data has been recorded, their accuracy has to be checked using verifier, or by re-reading.
- **Storage**. Once the data has been recorded, it has to be stored for future use. It is important that all organization have the need to place data in a safe place for future reference. These data can be stored in a secondary backup systems:
  a. Magnetic disk such as hard disk and floppy disk
  b. Magnetic tape
  c. Magnetic drum
  d. Mass storage device such as cartridge
  e. Optical disks such as: Zip, Flash Drive, CD-ROM
- **Retrieval**. Retrieval is the process of recalling data from storage for referral.
- **Reporting**. Reporting allows us to use the data which have been recorded, stored and retrieved. The reports which are preceded are formatted and manipulated in specific ways which allow the contents files to communicate specific meaning to the users.
- **Inquiry**. Inquiry is the data processing function which allows one to inspect or withdraw specified data from a stored file. To inquire is to look into a file. So inquiry may be performed in order to select limited data from a single document or to select an entire document for viewing.
- **Communication**. Data is used only at the location of its physical storage. Data must often be transferred from one location to another. That is between one people to another in order to share resources.

3.7.2 Data Manipulation. The functions of data manipulation involve the changing of data. The listings in this grouping specify the manner in which data can be altered or used to create additional data. Data manipulation consists of sorting, classification, selection, calculation, summarization and updating as follows:

- **Sorting**. Sorting is the act of arranging data in ascending or descending sequence. You can arrange your documents such as students and staff lists in any order.
- **Classification**. Classification is the separation of data with similar characteristics into unique categories. This separation into groups allows one to reduce the complexity of dealing with data.
- **Selection**. The data processing function which allows one to extract specific types of data from a file is called **selection**. Selection like classification makes it easier to use large volumes of data.
- **Calculation**. The calculation is the most familiar of the data manipulation functions.
- **Summarization**. Summarization involves reviewing large amounts of data and reducing that data to a relatively small quantity of representative facts or figures. Summarizing is usually accomplished by accumulating numeric values, and then displaying the accumulated sums.
- **Updating**. The last of the data manipulating functions in our list is updating. Updating is the process by which a body of data is changed to reflect current status. Data is collected and stored in order to provide information concerning a given physical reality.
- **Merging**. This operation of combining two or more ordered (stored) sets of data to form another single ordered set.

3.8 Approach to Data Processing

The approach to data processing involves the following steps:

a. **Editing** – To determine the relevance of data is a crucial step in a data processing. Once the data has been accumulated from the different sources, the relevance of the data is been tested-out then. All the inappropriate data is taken out and only the relevant information is been kept.
b. **Coding** – All the needed information would be in a random order. Therefore, it needs to be aligned into a particular system so that it is unproblematic to comprehend it. This method other than Coding, is also called as ‘netting' or ‘bucketing' which necessitates certain codes
c. **Data Entry** – Data is entered into the software that does the eventual cross tabulation. After the decision has been made on a code, edited data is than entered into the software.
d. **Validation** – Validation is the second phase of ‘cleaning' in which thorough quality-check is been done. Data is double-checked so as to ensure that the process has been done infallibly.
e. **Tabulation** – Final step is the production of the end product which is tabulated in a systematic format so that thorough analysis can be done.

3.9 Methods of Data Processing

The following are the three major methods that have been widely used for data processing over the years namely: (a) manual method (b) mechanical method (c) computer.

a. Manual Method. The manual method of data processing involves the use of chalk, wall, pen, pencil and the like. These devices, machines or tools facilitate human efforts in recording, classifying, manipulating, sorting and presenting data or information. The manual data processing operations entail considerable manual efforts. Thus, manual method is cumbersome, tiresome, boring, frustrating and time consuming. Furthermore, the processing of data by the manual method is likely to be affected by human errors. When there are errors, then the reliability, accuracy, neatness, tidiness, and validity of the data would be in doubt. The manual method does not allow for the processing of large volume of data on a regular and timely basis.

b. **Mechanical Method.** The mechanical method of data processing involves the use of machines such as typewriter, machines and adding machines. These machines facilitate human efforts in recording, classifying, manipulating, sorting and presenting data or information. The mechanical operations are basically routine in nature. There is virtually no creative thinking. The mechanical operations are noisy, hazardous, error prone and untidy. The mechanical method does not allow for the processing of large volume of data continuously and timely.

c. **Computer Method.** The computer method of carrying out data processing has the following major features:
   a. Data can be steadily and continuously processed
   b. The operations are practically not noisy
   c. There is a store where data and instructions can be stored temporarily and permanently.
   d. Errors can be corrected easily and neatly instantly using built-in thesaurus, spelling and grammar software.
   e. Output reports are usually very neat, decent and can be produced in various forms such as adding charts, graphs, diagrams, pictures, video etc.
   f. Accuracy and reliability of data are highly enhanced.
   g. The speed of processing is usually high
   h. Data and information can be imported and exported

i. You can use the shortcut keyboard to make your tasks easier, faster and more productive
j. You can use the Find and Replace and selection menu to search for information quickly
k. You can use the sorting menu to sort your data and information in ascending and descending order

3.10 Advantages of computers

Base on the characteristics of computer mentioned above, computer has made a very vital impact on society. It has changed the way of life. The use of computer technology has affected every field of life. People are using computers to perform different tasks quickly and easily. The use of computers makes different task easier. It also saves time and effort and reduces the overall cost to complete a particular task. Many organizations are using computers for keeping the records of their customers. Banks are using computers for maintaining accounts and managing financial transactions. The banks are also providing the facility of online banking. The customers can check their account balance from the Internet. They can also make financial transaction online without necessarily going to the bank. The transactions are handled easily and quickly with computerized systems. People are using computers for paying their bills, managing their home budgets or simply having some break and watching a movie, listening to songs or playing computer games. Online services like skype or social media websites are used for communication and information sharing purposes. Computer can be used as a great educational tool. Students can have access to all sort of information on the Internet for their assignments and projects. Some great websites like Wikipedia, Khan's Academy, Code Academy, Byte-Notes provides free resources for students & professionals. Moreover, the computer is being used in every field of life such as medical, business, industry, airline, education, agriculture and weather forecasting, yet it has its challenges.

3.11 Disadvantages of computer

Every advantage has its challenges. The use of computer has also created some problems in society as follows:

a. **Unemployment.** Different tasks are performed automatically by using computers. It reduces the need of people and increases unemployment in society.
b. **Wastage of time and energy.** Many people use computers without positive purpose. They play games and chat for a long period of time. It causes wastage of time and energy. Young generation is now spending more time on the social media websites like Facebook, Twitter etc or texting their friends all night through smart phones which is bad for both studies and their health. And it also has adverse effects on the social life.
c. **Data Security.** The data stored on a computer can be accessed by unauthorized persons through networks. It has created serious problems for the data security.
d. **Computer Crimes.** People use the computer for negative activities. They hack the credit card numbers of the people and misuse them or they can steal important data from big organizations. Fraudsters crack people bank accounts numbers and make away with millions of monies such as: Naira, Dollars, Pounds, Euros and other national and international currency.
e. **Privacy violation.** The computers are used for storing personal data of the people. The privacy of a person can be violated if the personal and confidential records are not protected properly.

f. **Health risks.** The improper and prolonged use of computer can results in injuries or disorders of hands, wrists, elbows, eyes, necks and back. The users can avoid health risks by using the computer in proper position. Parts of the solution are for computer users to take regular breaks while using the computer for longer period of time. It is also recommended for computers users to take a couple of minutes break after 30 minutes of computer usage.

g. **Impact on Environment.** The computer manufacturing processes and computer waste are polluting the environment. The wasted parts of computer can release dangerous toxic materials. Green computer is a method to reduce the electricity consumed and environmental waste generated when using a computer. It includes recycling and regulating manufacturing processes. The used computers must be donated or disposed off properly.

Self-Assessment Exercise

a. What is a computer?
b. What are the advantages of computer method over manual and mechanical methods?
c. What are the disadvantages of computer?

3.12 Characteristics of a Computer.

The following are some of the characteristics of computer

1. **Speed:** The computer can manipulate large data at incredible speed and response time can be very fast.
2. **Accuracy:** Its accuracy is very high and its consistency can be relied upon. Errors committed in computing are mostly due to human rather than technological weakness. There are in-built errors detecting schemes in the computer.
3. **Storage:** It has both internal and external storage facilities for holding data and instructions. This capacity varies from one machine to the other. Memories are built up in K(Kilo) modules where K = 1024 memory locations.
4. **Automatic:** Once a program is in the computer's memory, it can run automatically each time it is opened. The individual has little or no instruction to give again.
6. **Reliability:** Being a machine, a computer does not suffer human traits of tiredness and lack of concentration. It will perform the last job with the same speed and accuracy as the first job every time even if ten million jobs are involved.
7. **Flexibility:** It can perform any type of task once it can be reduced to logical steps. Modern computers can be used to perform a variety of functions like on-line processing, multi-programming, real time processing etc.

3. 13 The Computer System

The computer system is made up of the computer system, the user and the environment in which the computer is operated.

The Computer System. The computer system is made up of the hardware and the software.

The Hardware. The computer hardware comprises the input unit, the processing unit and the output unit. The input unit comprises those media through which data is fed into the computer. Examples include the keyboard, mouse, joystick, trackball, scanner etc. The processing unit is made up of the Arithmetic and Logic Unit (ALU), the control unit and the main memory. The main memory also known as the primary memory is made up of the Read Only Memory (ROM) and the Random Access Memory (RAM).The output unit is made up of those media through which data, instructions for processing the data (program), and the result of the processing operation are displayed for the user to see. Examples of output unit are the monitor (Visual Display Unit) and the printer.

Software. Computer software is the series of instructions that enable the computer to perform a task or group of tasks. A program is made up of group of instructions to perform a task. Series of programs linked together make up software. Computer programs could be categorized into system software, utility software, and application programs.

Computer Users. Computer users are the different categories of personnel that operates the computer. We have expert users and casual users. The expert users could be further categorized into computer engineers, computer programmers and computer operators.

The Computer Environment. The computing environment ranges from the building housing the other elements of the computing system namely; the computer and the users, the furniture, auxiliary devices such as the voltage, stabilizer, the Uninterruptible Power Supply System (UPS), the fans, the air conditioners etc. The schematic diagram of the computer system is presented as follows in Fig 2.

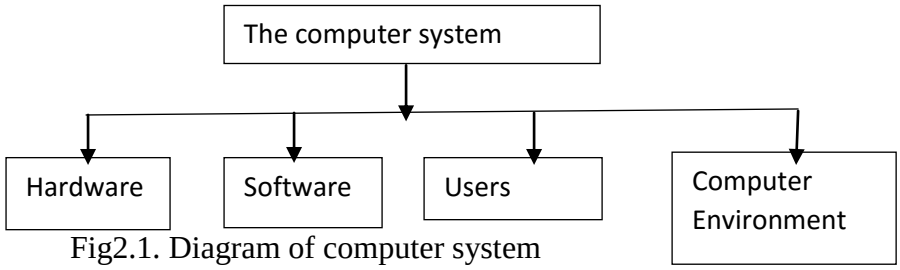

Fig2.1. Diagram of computer system

The Computer Hardware. The following are the component of the computer hardware, namely: hardware, input, CPU and the output as indicated in Fig2.2below:

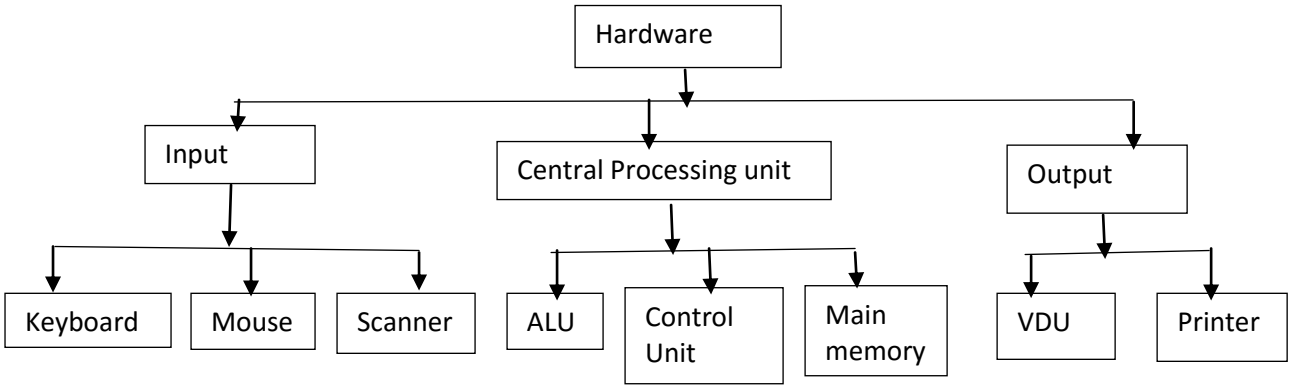

Fig2.2 Diagram of computer hardware

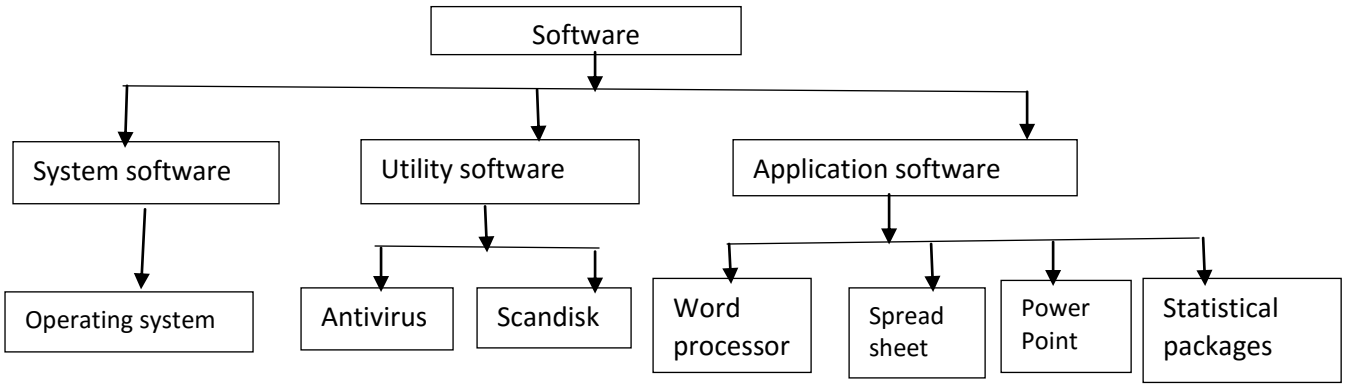

Fig2.3 Diagram of computer software

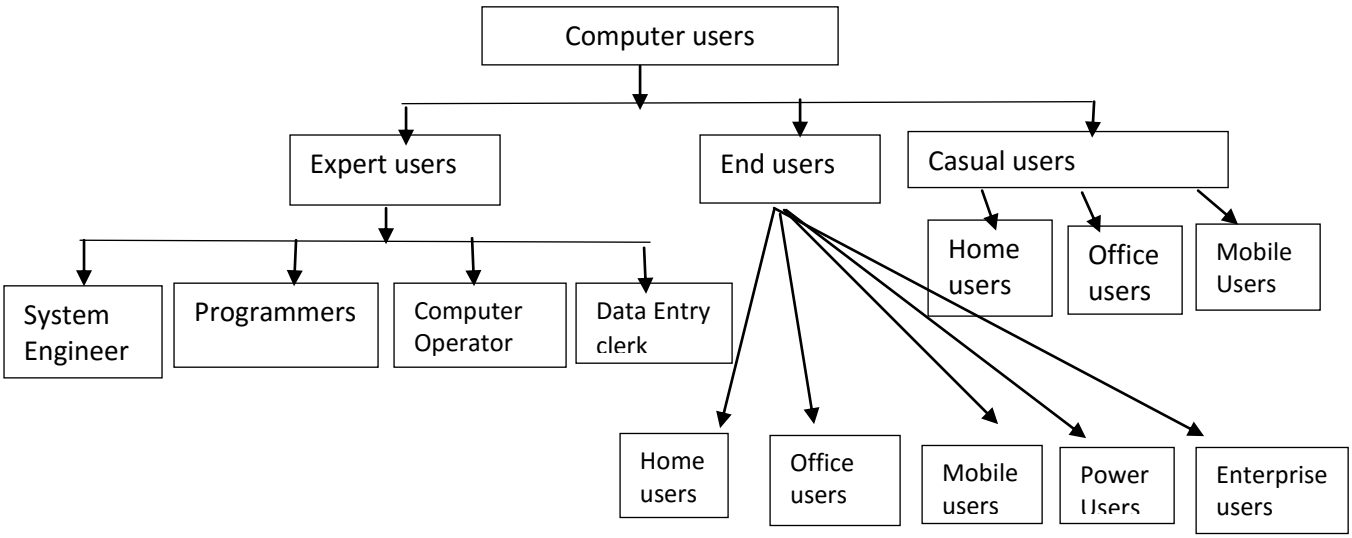

Fig2.4 Diagram of computer users

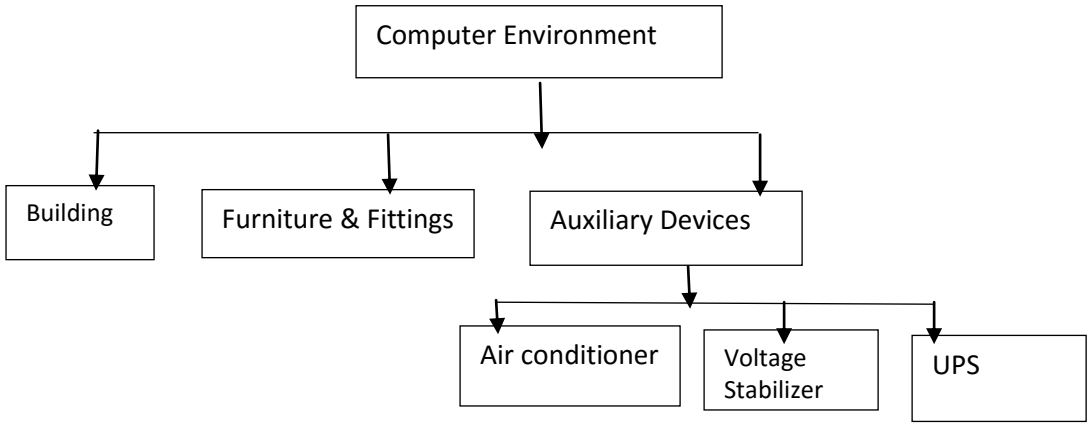

Fig2.5 Diagram of Computer Environment

4.0 CONCLUSION

The computer is a machine used for a variety of purposes. Its uses transcend all areas of human endeavor. This is due to the advantages of computer in solving problems over the use of manual and mechanical methods.

5.0 SUMMARY

In this unit, we have learnt the following:

a. Computer is any electronic device that can process, accept data, and communicate the output.
b. The computer method is superior to the manual and mechanical methods.
c. The computer system is made up of the computer system, the users and the computer environment.

6.0 Tutor-Marked Assignment

Explain any five advantages of a computer

With the aid of a diagram, describe the function of a software

7.0 REFERENCES AND FURTHER READINGS.

Gusen, J.N. Computer Made Easy. Jos. University Press.

Gusen, J.N. Ramson, E.N. and Ugwuanyi, F.O.(2009). Introduction to Computer Studies. In Gusen, J.N. et al (Eds.). Introduction to Computer Studies. Pankshin: Aureka Academic Foundation, FCE Pankshin

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UNIT 2: HISTORY OF THE COMPUTER

Content

1.0 Introduction

The computer as we know it today has evolved over the ages. An attempt is made in this unit to present in chronological order the various landmarks and milestones in the development of the computer. Based on the milestone achievement of each era, the computer evolution is categorized into generations. The generational classification however, is not rigid as we may find one generation eating into the next generation.

2.0 Objectives

The objective of this unit is to enable the students to know the processes leading to the emergence of the modern computer. There can be no present without the past just as the future depends on the present. By the end of this unit, students should be able to appreciate and visualize the direction of research in computer technology in the nearby future.

3.0 The main content

3.1 Brief History of the Computer

A complete history of computing would include a multitude of diverse devices such as the ancient Chinese abacus, the Jacquard loom (1805) and Charles Babbage's "analytical engine" (1834). It would also include discussion of mechanical, analog and digital computing architectures. As late as the 1960s, mechanical devices, such as the Merchant calculator, still found widespread application in science and engineering.

3.1.1 The Beginning of Calculating Devices.

The chronology of the events in the history of computing and computer is by no means exhaustive and complete. However, the history of the computer started when a Stone Age man first made use of his body parts as a medium of communication. As he progresses, the Stone Age man used stones for counting his wealth. Later the stones were replaced with sticks, marks on the earth, scratches and symbols on the stones and knots on the ropes. He found these computing aids very difficult to use because they require some physical efforts from him. Another difficulty was the computing speed which was very slow and cumbersome. These difficulties necessitated the development of a new number system which laid the foundation for the modern computer called Abacus. Be aware that the computer is basically a product of the late 1940s development. However, there were many important developments that preceded this. This is an important development that enrooted to the invention of modern day computers beginning with the Ancient Chinese Abacus.

3.1.1.1 Abacus.

The development of Abacus appeared in about 3000 BC. This development was championed by the Chinese, the Greese, Japan and the ancient eastern part of the world. The contribution of Abacus to mankind was to solve mathematical problems associated with addition, subtraction, multiplication and division etc.

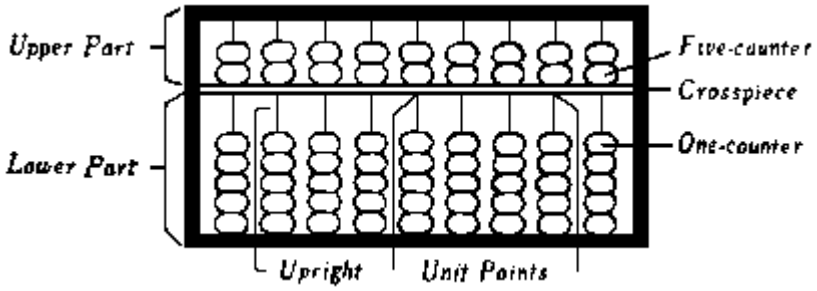

Figure 3.1: Chinese type of Abacus with two beats on top and four beats at the bottom

An easy to make and use Abacus

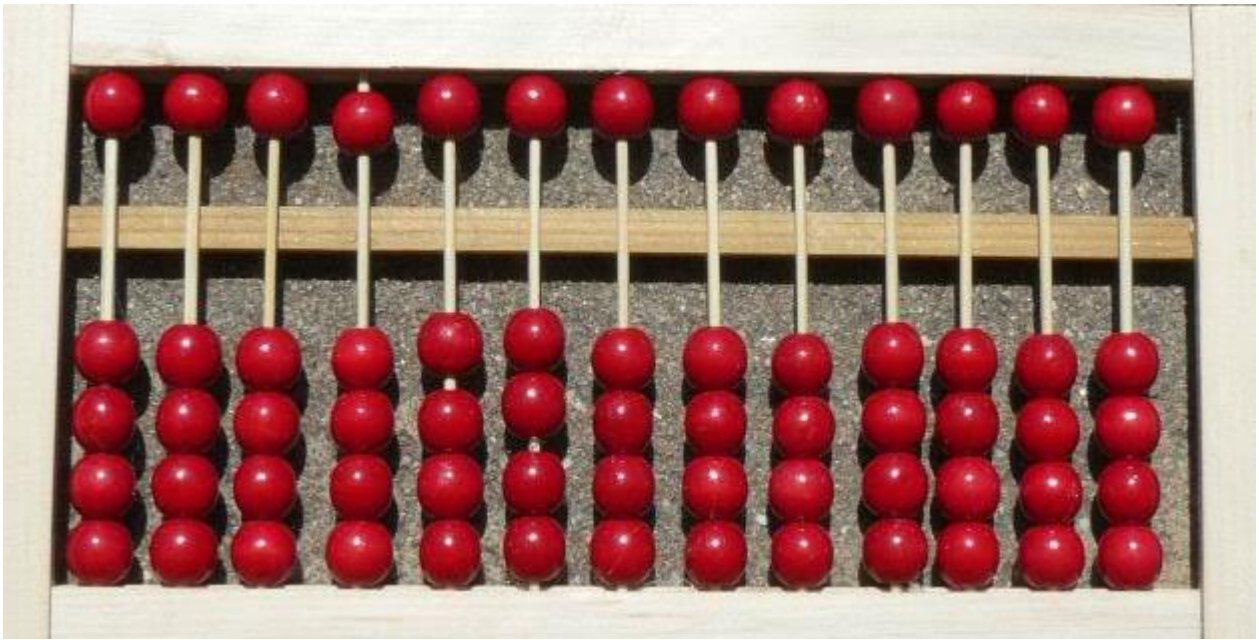

Figure 3.2: A modern Abacus with single beats on top and four beats at the bottom

3.2 The Mechanical Period of Calculating Devices

The following are pioneers who championed the development of mechanical technologies as from the 16th Century:

3.2.1 **John Napier.**

John Napier was born in 1614AD as a Scottish Mathematician, physicist, astronomer, and inventor of "Napier's bones." He invented Logarithms in 1617 using wooden rods for calculating. His calculation method was named after him, known as Napier's bones.

3.2.2 **William Oughted.**

In 1622, William Oughted developed a Slide Rule which was used for solving mathematics.

3.2.3 **Blaise Pascal.**

Blaise Pascal was a French Mathematician. He designed and constructed the first working mechanical calculator into the world which was also known as the digital addition machine referred to as the Pascaline Digital adding machine in 1642. Pascal invention was perhaps the beginning of input, processing and output.

3.2.4 Gottfried Von Leibniz (1646-1716).

Gottfried Leibniz was a German mathematician, a philosopher and a prolific inventor of the mechanical calculators in 1671. He invented his addition machine with gear wheels. Pascal machine could only add and subtract, but Leibnitz machine could also perform multiplication, division and square roots. Leibnitz machine design is closely related to Pascal calculator. In 1780, early public schools adopted the teacher/manager model with the teacher as the primary manger of instruction and assessment in a single classroom using this device.

3.2.5 Joseph Marie Jacquard.

Joseph Marie Jacquard was a French Textile Manufacturer. He developed his punched card which was controlled by looms to carry out instruction on weaving cloth as the beginning of the use of a binary automation in 1801. He was the developer of the earliest programmable loom, known as the Jacquard Loom.

3.2.6 Charles Thomas

Charles Thomas in 1820 was the designer of the Arithmometer. His invention was regarded as the first successful mechanical calculator which was commercially used.

3.2.7 Charles Babbage

Charles Babbage, a British Mathematician was born in 1791. In 1823 he became a British Professor of Mathematics at Cambridge University who conceived the programmable computer. He conceived the 1st programmable computer named "Analytical Engine". But he did not complete his work because at that time the standard of Engineering Technology was unsuccessful to make such parts. However, his contributions to science include the following:

a. He developed the Different Engines in 1822
b. He developed the Analytical Engines in 1833
c. He was considered the Father of computer

3.2.8 Herman Hollerith (Data Processing Machine)

In 1890 Dr. Herman Hollerith was born on the 29th February 1860. He developed the 1st electromechanical data processing machine which was used for the 1890 US Census, in which program were stored though a punch card. Today, this card is also use in some computers for input. The card used in telephone boot is the modern stage of this card. Hollerith works in American Bureau of census and used this machine to help in the computation of the result of 1890 census. The US Census Bureau announced the Census results using Herman Hollerith's machine. Herman was regarded as a programmer, an inventor and a founder of IBM. In 1896, Hollerith later left the bureau and forms a company of tabulating machine which later known as International Business Machine (IBM).

3.2.9 Ada Lovelace

Lady Ada Lovelace was born in 1815 in London. She was also known as Augusta Ada King and the Countess of Lovelace. Her development started in 1852. However, her contributions to science and humanity are as follows:

a. She was credited as the world's first computer programmer.
b. She developed the first algorithm to be processed by a machine.

c. She helped Charles Babbage with his analytical engine by translating his work

3.2.10 George Boole

George Boole was an English Logician, a mathematician, logician, and inventor of what is now known as Boolean logic. His logic operations involve Boolean logic: AND, OR, XOR and NOT. His invention can be useful for creating complicated conditional statements and processing Boolean logic. The idea of What If analysis comes from the Boole development. He used vacuum tubes and paper tape and could perform a number of Boolean (e.g. true/false, yes/no) logical operations.

3.3 The Period of Electromechanical devices

The following are the pioneers who championed the development of electromechanical calculators and computers.

3.3.1 Harvard Mark 1(1937-1944)

The 19th century witnessed a new era of effort towards the development of electromechanical machines. In 1937 Haward Aiken at Haward University began a project with IBM and completed in 1944. He developed a 1st Digital Computer of the world named "MARK-I". His development was electromechanical machine that advance computer technology by using relays instead of gears. It was a decimal machine which was about 8 feet high and 55 feet long. A data was entered to this machine by using card. Later it had proceeded to MARK-II, MARK-III and MARK-IV. The drawbacks of these electromechanical machines include:

a. Friction/inertia of moving components had limited the speed
b. The data movement using gears and linear was quite difficult and unreliable
c. The change was done with switching and storing mechanism with no moving parts and then the electronic switching technique triode tubes were used and hence born the first electronic computer

3.4 The Period of Computers

As the need for rapid calculations increased, commercial organizations introduced the electronic calculator to the market. Then the computer appeared. The price of computers decreased, and they started appearing in more businesses, in schools, libraries, and wealthier governments. The Internet connected computers together and provided more information to users, but there were also problems such as fraudulent websites, overabundant commercial e-mails, copyright violations, server outages, and lack of connectivity to poorer countries. The dawn of the computer age brought about other disadvantages, such as incompatible of file formats, fears about privacy, and error messages such as the Blue Screen of Death.

3.4.1 Konrad Zuse

Konrad Zusu was Born on June 22, 1990 at Berlin, German Empire. He is the developer of the Z1, the first programmable computer in 1938.His contributions to science and humanity include:

a. He developed the Z1, Z3, and Z4 the first programmable (modern) computer, making him the Father of computer.
b. He wrote the first algorithmic programming language called 'Plankalkül' in 1946.
c. He became one of the first people to create a commercial computer and computer company.

3.4.2 Leonard Kleinrock

Leonard Kleinrock was born in 1934 in New York City. He was the developer of Packet Switching that helps create the Internet we know today. He is a programmer. His contributions to science and humanity include:

a. The creation of the initial idea of the ARPANET the precursor to the Internet in his first paper entitled "Information Flow in Large Communication Nets" on May 31, 1961.
b. The development of Packet Switching.

3.3.3 George Stibitz

George Stibiz was a computer pioneer who was recognized as the Fathers of the Modern First Digital Computer. When Stibitz worked at Bell Labs in November 1937, he invented and built a relay-based calculator he dubbed the "Model K" (for "kitchen table", on which he had assembled it), which was the first to use binary circuits to perform an arithmetic operation. His later models added greater sophistication including complex arithmetic and programmability. These early electro-mechanical computers were either analog or were digital—such as the Model K and the Complex Number Calculator, both produced by George Stibitz. Stibitz was also responsible for the first remote access computing, done at a conference at Dartmouth College in New Hampshire. He took a tele printer to the conference venue, leaving his computer in New York City, and then proceeded to solve problems posed by the audience. He then entered the problems on the keypad of his tele printer, which outputted the answers afterward. He created electrical circuit to apply the Boolean algebra.

3.4.4 John Vincent Atanasoff

John Vincent Atanasoff was born in 1903 at Hamilton, New York. He is the inventor of the First Digital Computer. In 1937, Atanasoff created what is considered to be the official first electronic computer. His invention was known as the Atanasoff Berry Computer or simply ABC. In 1942, the Atanasoff-Berry computer was first conceived and it was the same year that the ABC was completed. Some early electronic computers such as ENIAC and the Harvard Mark 1 used decimal numeric systems, while others like the Atanasoff-Berry Computer and the Colossus Mark 2 used binary systems. With the exception of the Atanasoff-Berry Computer, all the major models were programmable, either using punch cards, patch cables and switches, or through stored programs in memory. This development was the foundation for the development of Electronic Digital Computer.

3.4.5. Howard Aiken

Howard Aike was born on 9 March 1900 in Hoboken, New Jersey, USA. He is the designer behind the IBM Harvard Mark I Computer. Howard H. Aiken, a Harvard engineer working with IBM, succeeded in producing an all-electronic calculator by 1944.

Howard Aiken was an electrical engineer and physicist who first conceived of an electro-mechanical device like the Mark I in 1937. After completing his doctorate at Harvard in 1939, Aiken stayed on to continue the computer's development. IBM funded his research. Aiken headed a team of three engineers including Grace Hopper and developed the following:

a. The Mark I reached completion in 1944.
b. In 1947, Howard Aiken completed the Mark II, an electronic computer. The same year he founded the Harvard Computation Laboratory.
c. He later published numerous articles on electronics and switching theory and started Aiken Industries.

d. Howard Aiken loved computers, but even he had no idea of their eventual widespread appeal. "Only six electronic digital computers would be required to satisfy the computing needs of the entire United States," he said in 1947.

The purpose of the computer according to him was to create ballistic charts for the U.S. Navy. It was about half as long as a football field and contained about 500 miles of wiring. The Harvard-IBM Automatic Sequence Controlled Calculator, or Mark I for short, was an electronic relay computer. It used electromagnetic signals to move mechanical parts. The machine was slow (taking 3-5 seconds per calculation) and inflexible (in that sequences of calculations could not change); but it could perform basic arithmetic as well as more complex equations (Stern 47). Among those who developed the Harvard Mark 1 were Howard Aiken & Grace Hopper. Howard Aiken and Grace Hopper designed the MARK series of computers at Harvard University. The MARK series of computers began with the Mark I in 1944. Imagine a giant roomful of noisy, clicking metal parts, 55 feet long and 8 feet high. The 5-ton device contained almost 760,000 separate pieces. Used by the US Navy for gunnery and ballistic calculations, the Mark I was in operation until 1959. The computer, controlled by pre-punched paper tape, could carry out addition, subtraction, multiplication, division and reference to previous results. It had special subroutines for logarithms and trigonometric functions and used 23 decimal place numbers. Data was stored and counted mechanically using 3000 decimal storage wheels, 1400 rotary dial switches, and 500 miles of wire. Its electromagnetic relays classified the machine as a relay computer. All output was displayed on an electric typewriter. By today's standards, the Mark I was slow, requiring 3-5 seconds for a multiplication operation.

3.4.6 Grace Hopper (1906-1992)

Grace Hopper was born on 9th December 1906 in New York, USA. She studied at Vassar College and Yale and then joined the Naval Reserve in 1943. In 1944, she started working with Aiken on the Harvard Mark I computer. She was responsible for the term ‘bug’ for a computer fault. The original ‘bug’ was a moth, which caused a hardware fault in the Mark 1. She was the first person to ‘debug’ a computer. In 1949, Grace Hopper started her research for the Eckert-Mauchly Computer Corporation where she designed an improved compiler and was part of the team which developed Flow-Matic being the first English-language data processing compiler. She invented the language APT and verified the language COBOL. She was the first computer Science woman of the year in 1969. In 1991, she received the National Medal of Technology for the development of Common Business Oriented Language (COBOL). She also developed a compiler that enables COBOL to run on many types of computers.

3.4.7 Alan Mathison Turing

Alan Turing was born in 1912 in Maida Vale, London, England. He developed the COBOL in 1943. His contributions to science and humanity include:

- English mathematician, logician, cryptanalyst, and computer scientist
- Developed the Turing Machine in 1936.
- Developed the Turing Test
- He was credited as the founder of computer science
- Since 1966, the Turing Award has been given annually by the Association for Computing Machinery to a person for technical contributions to the computing community.
- It is widely considered to be the computing world's highest honour, equivalent to the Nobel Prize
- Turing’s Colossus computer was used to break the German Enigma Code

- He was also known as the father of information theory

3.4.8 John Presper Eckert (UNIVAC)

He was born on 9th April, 1919. He and John Mauchly designed and built the ENIAC Designer in 1946. Electrical engineer and computer pioneer who help invent the ENIAC and UNIVAC. The development of Electronic Numerical Integrator and Calculator (ENIAC) used machine binary numbers and storage program instead of decimal system and possess no memory. Professor John Presper Eckert and John Mauchly are of the Moore School of Engineering, University of Pennsylvania, USA in 1946.In 1946, John Mauchly and John Presper Eckert developed the ENIAC I (Electrical Numerical Integrator And Calculator). The American military sponsored their research; the army needed a computer for calculating artillery-firing tables, the settings used for different weapons under varied conditions for target accuracy. The Ballistics Research Laboratory, or BRL, the branch of the military responsible for calculating the tables, heard about John Mauchly's research at the University of Pennsylvania's Moore School of Electrical Engineering. John Mauchly had previously created several calculating machines, some with small electric motors inside. He had begun designing (1942) a better calculating machine based on the work of John Atanaoff that would use vacuum tubes to speed up calculations.

On May 31, 1943, the military commission on the new computer began; John Mauchly was the chief consultant and John Presper Eckert was the chief engineer. Eckert was a graduate student studying at the Moore School when he met John Mauchly in 1943. It took the team about one year to design the ENIAC and 18 months and 500,000 tax dollars to build it. By that time, the war was over. The ENIAC was still put to work by the military doing calculations for the design of a hydrogen bomb, weather prediction, cosmic-ray studies, thermal ignition, random-number studies and wind-tunnel design.

In 1946, J Presper Eckert and John Mauchly started the Eckert-Mauchly Computer Corporation. In 1949, their company launched the BINAC (Binary Automatic) computer that used magnetic tape to store data. In 1950, the Remington Rand Corporation bought the Eckert-Mauchly Computer Corporation and changed the name to the Univac Division of Remington Rand. Their research resulted in the UNIVAL (Universal Automatic Computer), an important forerunner of today's computers. In 1955, Remington Rand merged with the Sperry Corporation and formed Sperry-Rand. Eckert remained with the company as an executive and continued with the company as it later merged with the Burroughs Corporation to become Unisys. The speed with which UNIVAC's magnetic tape could input data was faster than IBM's punch card technology, but it was not until the presidential election of 1952 that the public accepted the UNIVAC's abilities.

In a publicity stunt, the UNIVAC computer was used to predict the results of the Eisenhower-Stevenson presidential race. The computer had correctly predicted that Eisenhower would win, but the news media decided to blackout the computer's prediction and declared that the UNIVAC had been stumped. When the truth was revealed, it was considered amazing that a computer could do what political forecasters could not, and the UNIVAC quickly became a household name. The original UNIVAC now sits in the Smithsonian Institution

3.4.9 John Von Newmann

In 1945, John von Neumann outlines the architecture of the modern stored program computer system. In the mid-1940's John von Neumann joined the University of Pennsylvania team, initiating concepts in computer design that remained central to computer engineering for the next 40 years. Von Neumann designed the Electronic Discrete Variable Automatic Computer (EDVAC) in 1945 with a memory to hold both a stored program as well as data. This stored memory technique as well as the conditional control transfer that allowed the computer to be

stopped at any point and then resumed, allowed for greater versatility in computer programming. Through the use of a memory that was large enough to hold both instructions and data, and using the program stored in memory to control the order of arithmetic operations, EDVAC was able to run orders of magnitude faster than ENIAC. By storing instructions in the same medium as data, designers could concentrate on improving the internal structure of the machine without worrying about matching it to the speed of an external control. The key element to the von Neumann architecture was the central processing unit, which allowed all computer functions to be coordinated through a single source (Goldstine 171, 181 -183). Von contribution to science and humanity includes the following:

In 1948, Doctor John Von Neumann made several modifications to the ENIAC. The ENIAC had performed arithmetic and transfer operations concurrently, which caused programming difficulties. Von Neumann suggested that switches control code selection so pluggable cable connections could remain fixed. He added a converter code to enable serial operation. Modern computers based on the von Neumann architecture often have machine code in the form of an imperative programming language. The von Neumann architecture is a design model for a stored-program digital computer that uses a central processing unit (CPU) and a single separate storage structure ("memory") to hold both instructions and data. Such computers implement a universal Turing machine and have a sequential architecture

3.4.10 Murice V. Wilkes

Is a Professor of Mathematical Laboratory of Cambridge University in UK? The development of Electronic Delay Storage Automatic Computer Calculator (EDSAC) was made by him. He equally developed Universal Automated Computer (UNIVAC1) after the US Bureau of Census. This was the first generation computer dedicated to non-military work (business applications as it stored input and output data on magnetic tape). This development predicted the outcome of the 1951 Presidential election by the Columbia Broadcasting Service. In 1949 At Cambridge University Maurice Wilkes assembles the first practical stored program computer called the EDSAC. He is a programmer British computer scientist credited with several important developments in computing specifically micro computing. In 1951, little technology was used in schools, primarily TV; baby boom begins with resulting increases in class size; first-generation Univac computer delivered to the US census bureau.

3.4.11 Tim Berners-Lee

Tim was born in 1955 in London England. In 1989, Tim Berners-Lee toyed with the idea of web pages and hyperlinks. In1990, The World Wide Web (WWW) is born after the researcher Tim Berners-Lee develops HTML, the Hypertext Markup Language.

Tim Berners-Lee invented the World Wide Web in 1989. He founded and Directs the World Wide Consortium (W3C) the forum for technical development of the Web. He founded the Web Foundation whose mission is that the WWW serves Humanity, and co-founded the Open Data Institute in London. His research group at MIT's Computer Science and AI Lab ("CSAIL") plans to re-decentralize the Web. Tim spends a lot of time fighting for rights such as privacy, freedom and openness of the Web.

A graduate of Oxford University, Tim Berners-Lee invented the Web while at CERN, the European Particle Physics Laboratory, in 1989. He wrote the first web client and server in 1990. His specifications of URIs, HTTP and HTML were refined as Web technology spread.

He is the 3Com Founders Professor of Engineering in the School of Engineering with a joint appointment in the Department of Electrical Engineering and Computer Science at the Laboratory for Computer Science and Artificial Intelligence (CSAIL) at the Massachusetts Institute of Technology (MIT) where he also heads the Decentralized Information Group

(DIG). He is also a Professor in the Electronics and Computer Science Department at the University of Southampton, UK.
Tim is the Director of the World Wide Web Consortium (W3C), a Web standards organization founded in 1994 which develops interoperable technologies (specifications, guidelines, software, and tools) to lead the Web to its full potential. He is a Director of the World Wide Web Foundation which was launched in 2009 to coordinate efforts to further the potential of the Web to benefit humanity.
In 2011 he was named to the Board of Trustees of the Ford Foundation, a globally oriented private foundation with the mission of advancing human welfare. He has promoted open government data globally and is a member of the UK's Transparency Board. He is President of London's Open Data Institute.
In 2001 he became a Fellow of the Royal Society. He has been the recipient of several international awards including the Japan Prize, the Prince of Asturias Foundation Prize, the Millennium Technology Prize and Germany's Die Quadriga award. In 2004 he was knighted by H.M. Queen Elizabeth and in 2007 he was awarded the Order of Merit. In 2009 he was elected a foreign associate of the National Academy of Sciences. He is the author of "Weaving the Web".
On March 18 2013, Tim, along with Vinton Cerf, Robert Kahn, Louis Pouzin and Marc Andreesen, was awarded the Queen Elizabeth Prize for Engineering for "ground-breaking innovation in engineering that has been of global benefit to humanity."In 1990, the following are the contributions of Tim to science and humanity as he invented the WWW:

a. Invented the World Wide Web (WWW)
b. Proposed hypertext
c. Created the first website
d. Founded the World Wide Web Consortium
e. Father of World Wide Web

3.4.12 Jack S. Kilby

Jack Kilby was born on the 9th November 1923. In 1958 Kilby and Robert Noyce developed the first Integrated Circuit, which consisted of transistors, resistors and capacitors on silicon chip which is today known as the Chip. Jack Kilby recorded his initial ideas concerning the integrated circuit in July 1958 and successfully demonstrated the first working integrated circuit on September 12, 1958. In his patent application of February 6, 1959, Kilby described his new device as “a body of semiconductor material ... wherein all the components of the electronic circuit are completely integrated.” Kilby won the 2000 Nobel Prize in Physics for his part of the invention of the integrated circuit. Along with Robert Noyce (who independently made a similar circuit a few months later), Kilby is generally credited as co-inventor of the integrated circuit which became the first Integrated circuit. Jack Kilby, an engineer with Texas Instruments, developed the integrated circuit (IC) in 1958. The IC combined three electronic components onto a small silicon disc, which was made from quartz. Scientists later managed to fit even more components on a single chip, called a semiconductor. As a result, computers became ever smaller as more components were squeezed onto the chip. Another third-generation development included the use of an operating system that allowed machines to run many different programs at once with a central program that monitored and coordinated the computer's memory (Gersting 35 - 39). Jack Kilby, an engineer with a background in ceramic-based silk screen circuit boards and transistor-based hearing aids, started working for Texas Instruments in 1958. A year earlier, research engineer Robert Noyce had co-founded the Fairchild Semiconductor Corporation. From 1958 to 1959, both electrical engineers were working on an answer to the same dilemma: how to make more or less.

Self Assessment Exercise

a. Outline the major development of computer devices during the calculating devices
b. Describe the contributions of three prominent persons during the mechanical period

Why was Integrated Circuit Needed?

In designing a complex electronic machine like a computer it was always necessary to increase the number of components involved in order to make technical advances. The monolithic (formed from a single crystal) integrated circuit placed the previously separated transistors, resistors, capacitors and all the connecting wiring onto a single crystal (or 'chip') made of semiconductor material. Kilby used germanium and Noyce used silicon for the semiconductor material

3.4.13 Paul Baron

Paul Baron of RAND in 1960s was a Polish American engineer who was a pioneer in the development of computer networks. He was involved in production of smaller computers(minicomputers); The use of Integrated circuit technology and silicon chip; the development of batch processing system; the development of the first commercial integrated circuit with mouse; the development of timesharing and the development of the idea of distributed, packet switching networks. In 1963, Vocational Education Act in US was passed with new money supporting the use of technology in schools. However, the mainframe and minicomputers were in use at this time were using batch processing methods that did not fit well with the single teacher-as-manager-of-learning methods in use in most schools. BASIC, a simple high-level programming language was developed, mostly for use in universities to train programmers; IBM 360 family of computers is developed; most computers still using host methods with punched cards as the primary input device; line printers are still the primary output device

3.4.14 Thomas Kutz

Thomas Kutz and John Kemeny were involved in the development of BASIC programming language (Beginner's All Purpose Symbolic Instruction Code) in 1964. It allows non-mathematician to program a computer (time sharing system). Third generation computer developed. Thomas and Kemeny were the earlier programmers while at Dartmouth, in 1963, John Kemeny and Thomas Kurtz transformed the role of computers in education from primarily a research activity to an academic one. They did not like the idea that students had to stand in long lines with punch cards for batch processing. So they adopted the recently demonstrated concept of time-sharing that allowed many students to interact directly with the computer. The university developed the time-shared system and expanded it into a regional computing center for colleges and schools. At the time, most programs were written in machine language or FORTRAN. Kemeny and Kurtz developed a new, easy-to-use language, called BASIC. It spread rapidly and was used for the creation of computer-based instructional materials for a wide variety of subjects and for all levels of education.

3.4.15 Douglas C. Engelbart

In 1964, Douglas Engelbart developed the Computer Mouse, the Windows. He demonstrated the use of keyboard, keypad, mouse, Word processor, hypertext system. In 193 Douglas working at Stanford Research Institute (SRI) in Menlo Park he developed the first prototype mouse in 1963, and applied for a patent in 1967 and received it in 1970, for the wooden shell with two metal wheels. In the patent application it is described as an "X-Y position indicator for a display system". Engelbart later revealed that it was nicknamed the "mouse" because the tail came out the end. The Mother of All Demos is a name given retrospectively to Douglas Engelbart's December 9, 1968, demonstration at the Fall Joint Computer Conference (FJCC)

at the Convention Center in San Francisco, in which a number of experimental technologies that have since become commonplace were presented. The demo featured the first computer mouse the public had ever seen, as well as introducing interactive text, video conferencing, teleconferencing, email, hypertext and a collaborative real-time editor. Douglas Engelbart changed the way computers worked, from specialized machinery that only a trained scientist could use, to a user-friendly tool that almost anyone can use. He invented or contributed to several interactive, user-friendly devices: the computer mouse, windows, computer video teleconferencing, hypermedia, groupware, email, the Internet and more.
In 1965, Elementary and Secondary Education Act in US brought new money into schools for technology. Mainframes and minicomputers were put into place in some schools, but most were used for administration or for school counseling (databases for information about and for students). In 1967, High-level programming languages such as Fortran were being taught in universities. School vocational training programs began to include computer maintenance. In 1968, some programs were designed to bring money for technology into schools were canceled; host computers were not widely adopted in schools because they were seen as appropriate for use with the teacher/manager model of learning (they don't fit into the single classroom, but instead were accessed remotely by sending batches of data).< BR>. In 1970, Mainframes and minicomputers continued in use in some schools, but very little were used in the delivery of instruction.

3.4.16 Gary Kildall (1972)

The development of 8-bit microprocessor is the first Large Scale Integration (LSI). Internet developed in 1973 by Bob Kahn and Vint. The C programming developed by Brain Kernighan and Dennis Ritchie in 1974. The CP/M operating system was developed by Gary Kildall, founder of Digital Research, copy written in 1976 and released in 1977. Gary was born on 28thDecember, 1903 in Budapest, Austria Hungary. A mathematician who made major contributions to set theory, functional analysis, quantum mechanics, ergodic theory, continuous geometry, economics and game theory, computer science, numerical analysis, hydrodynamics and statistics. In 1973, Gary Kildall wrote the CP/M. American computer scientist and microcomputer entrepreneur who invented the CP/M operating system and gave Bill Gates the world.

3.4.17 Ray Tomlinson

Ray Tomlinson was born on 27th May 1971.He sends the first e-mail using @ in address. He was an American programmer who implemented an email system on the ARPANET first.

3.4.18 Bill Gates (Developer of Microsoft Office)

Bill Gates who is also known as William H. Gates was born on October 28, 1955 in Seattle, Washington, USA. On November 10, 1983, at the Plaza Hotel in New York City, happened a modest event, which will have a very important impact on the software industry in the next decades—the little known company Microsoft Corporation formally announced a graphical user interface (GUI) for its own operating system (MS-DOS), which had shipped for IBM PC and compatible computers since 1981. Initially the new product was developed under the name *Interface Manager*, but before the official introducing in 1985, the marketing gurus convinced Bill Gates, that *Windows* is a more suitable name. The main partner of Microsoft since 1981 was IBM, when MS-DOS became the highly successful operating system that came bundled with an IBM computer. That's why in that same November of 1983, the owner of Microsoft Bill Gates decided to show a beta version of Windows to IBM's management. Their response was negative though, probably because IBM was working on their own operating system, called *Top View*. IBM Top View was released in February of 1985 as a

DOS-based multitasking program manager without any GUI features. IBM promised that future versions of Top View would have a GUI. That promise was never kept, and the program was discontinued barely two years later. It seems Bill Gates realized how profitable a successful GUI for IBM computers would be, while he had seen Apple's Lisa computer and later the more successful Macintosh computer. Both Apple computers came with a stunning graphical user interface. In 1975, Bill Gate and Paul Allen Developed the first commercial microcomputer known as BASIC. They developed the Microsoft Operating software and Microsoft Office, the most influential software company in the world. Bill Gate contributions to science and humanity are as follows:

a. Co-Founder and early CEO of the Microsoft company.
b. Developed Altair BASIC for the MITS Altair.
c. Helped in the development of Microsoft's earlier programs such as MS-DOS
d. Youngest self-made billionaire.
e. Honored as the 12th Distinguished Fellow of the British Computer Society.

3.4.19 Steven Paul Job

Steven Paul Job was born in 1955, at Los Altos, California, USA. His contributions to science and humanity include:

a. Co-Founder and former CEO of the Apple company.
b. Founder of NeXT Computer.
c. Owner of Pixar.
d. Member of the board of directors of the Walt Disney Company in 2006.
e. Inventor or co-inventor of 342 US Patents relating to computers and portable devices.
f. Spearheaded the advent of the iPod, iTunes, iPhone, and iPad while CEO of Apple

3.4.19.1 The Contributions of Bill Gate and Steve Paul Job

According to Microsoft Office - Wikipedia, the free encyclopedia (2010) Microsoft Office is a proprietary commercial office suite of inter-related desktop applications, servers and services for the Microsoft Windows and Mac OS X operating systems, introduced by Microsoft in August 1, 1989 as indicated in Table 2.

Windows Version	Microsoft Office Year Released	Contents
	1990	Windows 3.0, Word for Windows 1.1, Excel for Windows 2.0 Power Point for Windows 2.0, Office for Windows 1.5, Excel 3.0, Windows 1.6 with Mail for PC Networks 2.1
	1992	Word 2.0, Excel 4.0, PowerPoint 3.0, Mail 3.0
	1993 Windows 3.0	Word 2.0, Excel 4.0, PowerPoint 3.0, Mail 3.0, Microsoft Access 1.1
	1994 Windows 4.0	Word 6.0, Excel 4.0, PowerPoint 3.0, Mail 3.0,
	Office 4.2 for Windows NT 3.51 1994 for i386 with Service Pack 5	Word 6.0, Excel 5.0, PowerPoint 4.0, Office Manager 4.2 with Office Shortcut Bar
	Office 4.3	Word 6.0, Excel 5.0, PowerPoint 4.0, Access 2.0 to support Windows 3.x, Windows NT3.1,3.5

	Office 95, August 1995	Office 95 Standard, Office 95 Professional, Word 7.0, Excel 7.0, PowerPoint 7.0, Shedule+7.0, Access 7.0 and Bookshelf
Windows NT 3.51 with Service Pack 5	Office 97	Use of menus, Use of toolbars, Use of Natural Language Systems, Use of Grammar checking, Word 7.0, Excel 7.0 PowerPoint 7.0, Shedule+7.0, Access 7.0, Bookshelf and Office Assistant
Windows 95	Office 2000 with Service Pack 2	Use of menus, Use of toolbars, Use of Natural Language Systems, Use of Grammar checking, Word 7.0, Excel 7.0, PowerPoint 7.0, Shedule+7.0, Access 7.0, Bookshelf Office Assistant, Digital signatures
Windows NT 4.0	Office XP or Office 2002	Use of Safe Mode, Handwritten recognition, Use of menus, Use of toolbars, Use of Natural Language Systems, Use of Grammar checking, Word 7.0, Excel 7.0, PowerPoint 7.0, Shedule+7.0, Access 7.0, Bookshelf, Office Assistant, Digital signatures and supported, Windows 98, ME and NT 4.0
Windows 2000 with Service Pack 3 or later	Office 2003 in 2003	Use of Safe Mode, Handwritten recognition, Use of menus, Use of toolbars, Use of Natural Language Systems, Use of Grammar checking, Word 7.0, Excel 7.0, PowerPoint 7.0, Shedule+7.0, Access 7.0, Bookshelf, Office Assistant, Digital signatures and supported, Windows 98, ME and NT 4.0, Use of New Logo, InfoPath, OneNote
Windows XP with Service Pack 2	Office 2007 in 2007	Use of Safe Mode, Handwritten recognition, Use of menus, Use of toolbars, use of Natural Language Systems, Use of Grammar checking, Word 7.0, Excel 7.0 PowerPoint 7.0, Shedule+7.0, Access 7.0, Bookshelf Office Assistant, Digital signatures and supported Windows 98, ME and NT 4.0, Graphic User Interface replacing Menus and Toolbars, Use of Ribbon, Use of Office Open XML, Use of Groove
Windows Vista with Service Pack 1, Windows 7	Office 2010, April 15, 2010	Use of Safe Mode, Handwritten recognition, Use of menus, Use of toolbars, Use of Natural Language Systems, Use of Grammar checking, Word 7.0, Excel 7.0 PowerPoint 7.0, Shedule+7.0, Access 7.0, Bookshelf, Office Assistant, Digital signatures and supported, Windows 98, ME and NT 4.0, Use of Service Pack 1
Windows 8	Office 2013	Word, Excel, PowerPoint, Outlook, Access, InfoPath Designer, InfoPath Filler, Lync, One Note, Publisher, Sky Drive Pro
Windows 8.1	Office 2013	Word, Excel, PowerPoint, Outlook, Access, InfoPath Designer, InfoPath Filler, Lync, One Note, Publisher, Sky Drive Pro

Windows 10	Office 2016	Word, Excel, PowerPoint, Outlook, Access, InfoPath Designer, InfoPath Filler, Lync, One Note, Publisher, Sky Drive Pro

3.4.20 Steve Wozniak

On August 11, 1950, Steve Wozniak was born at Sunnyvale, California, USA. On First April, 1976, Steve Wozniak, Steve Jobs and Ronald Wayne Found Apple Computer Inc. Steve Wozniak is a Co-founder of Apple. In 1972, Intel's 8008 microprocessor makes its debut, Hewlett-Packard announces the HP-35, Steve Wozniak built his blue box which is a tone generator to make free phone calls.

3.4.21 Mitchell Kapor

Mitchell is a programmer and a Founder of Lotus Development Corporation and designer of Lotus 1-2-3. Dan Bricklin and Bob Frankston were responsible for the development of spreadsheet program (VisiCalc) and the development of Compaq Computer Corporation. They were also responsible for the development of American Telegram and Telephone (AT&T). Mitchell champtioned the development of CD-ROM by Philips and Sony in 1983 and the development of Microsoft Windows and Database in 1988. He was also involved in the development of Interactive, compatible, knowledge base and multimedia systems in 1980s.

4.0 Conclusion

The development of what is today known as computer has passed through many stages of development, from the calculating devices to the present day ICT.

5.0 Summary

In this unit, we have learnt that the development of computer started from the calculative devices, mechanical period, and electromechanical devices to the era of Information age/ICT.

6.0 Tutor Marked Assignment

Explain the contributions made by Tim Berners-Lee to the world of ICT.
Describe the contribution of Bill Gates to the development of science and humanity.

7.0 REFERENCES AND FURTHER READING

More recent editions of these books are recommended for further reading.

Bradley, R. (1995). Understanding Computer Science for Advanced Level. 3rd Ed. London: Stanley Thornes.

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UNIT 3. GENERATION OF COMPUTER

Content

1.0. Introduction

The evolution of digital computing is often divided into generations. Each generation is characterized by dramatic improvements over the previous generation in the technology used to build computers, the internal organization of computer systems, and programming languages. Although not usually associated with computer generations, there has been a steady improvement in algorithms, including algorithms used in computational science. The following history has been organized using these widely recognized generations as mile posts. The six generations of computer in terms of technological development over time; computers have been broadly classified into six generations. The lines of distinction between each generation are not exact, and some overlap in technologies exists. Although these designations are open to some controversy, as a general description of types of technology in use, the terms first, second, third, fourth, fifth, sixth and seventh generation are sometimes useful in providing a general perspective of some of the advancements in computing technology.

1. First Generation: Approximately 1946-1958
2. Characteristics: vacuum tubes
3. Second Generation: Approximately 1959-1964
4. Characteristics: transistors
5. Third Generation: Approximately 1965-1970
6. Characteristics: integrated circuits
7. Fourth Generation: Approx. 1971-1989
8. Characteristics: large scale integration
9. Fifth Generation: 1990-1994
10. Characteristics: very large integration
11. Sixth Generation: 1995-present
12. Characteristics: Super large integration
13. Seventh Generation: 1996-date
14. Characteristics: dual processor

2.0 Objectives

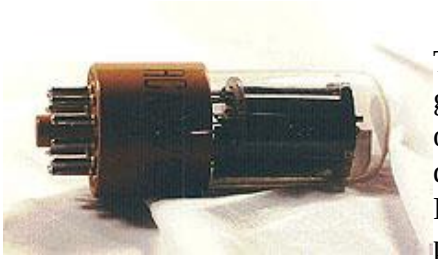
The objective of this unit is to enable students to examine the processes leading to the development of present generations of computer. There is no present without the past just as

the future depends on the current generation of the computers. By the end of this unit, students should be able to appreciate the direction of the development of computers based on their generations.

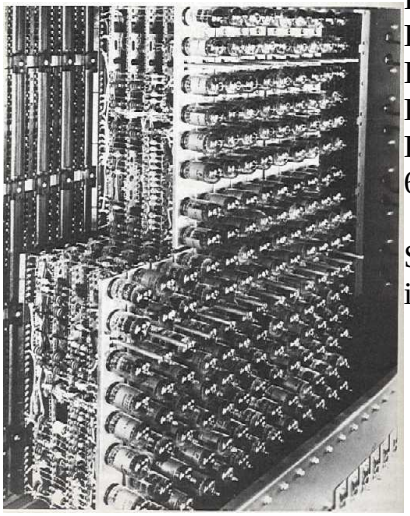
3.0 The generation of computers.

3.1. First Generation Computer (1946-1958, Vacuum Tube).

The introduction of the UNIVAC-1 in 1951 marked the beginning of the first generation (Nagpal, 2010). This is called a machine language or low-level language because the programs were written in machine code. They use binary numbers (1s and 0s) representing 0n and 0ff as their instructions. The computers that fall into the group of the first generation computers are Electronic Numerical Integrator Automatic Computer (ENIAC), Electronic Discrete Variable Automatic Computer (EDVAC), Electronic Delay Storage Automatic Computer Calculator (EDSAC), Mark1, Datamatics etc. These computers used vacuum tubes or valves which worked on the principle of thermionic emission. An example of the vacuum tube is as indicated in Figure.4



The computers that used vacuum tubes are known as first generation computers. The major software development that occurred with the first generation computers was the development of high-level programming language like FORTRAN (Formula TRANslation). The system of processing information was of batch processing type. That is batch of data was processed together. Example of the first generation computer as obtained from[www.techiwarehouse.com/engine/.../**Generations-of-Compute** **(2004)** is as indicated in Figure 5:



Harvard Mark I (electromechanical); Whirlwind; ENIAC; EDSAC; UNIVAC I, UNIVAC II, UNIVAC 1101; RCA BIZMAC; NCR CRC 102A, NCR CRC 102D; Honeywell Datamatic 1000; Burroughs E101, Burroughs 220; IBM models 604, 650 (drum memory), 701, 702, 704, 705, 709.

Some of the general features/characteristics of this generation include:

- Electronic circuitry used vacuum tubes
- Punched cards were used for feeding of information
- Punched cards and paper were used for getting results
- Vacuum tubes were used as the software.
- Magnetic tapes were used for external storage
- They were oriented towards batch processing
- Human operators had to set switches
- They were using machine language and assembly languages
- They were extremely slow and cumbersome compared to the present computers.
- They consume a lot of electricity.
- They were huge in size and not portable.
- They were restricted to computing capacity.
- They were expensive.
- They use Magnetic drum as their primary internal-storage medium.
- They use limited main-storage capacity.
- They have slow input/output, punched-card.
- They have low level symbolic-language programming.

- They have limited programming capacity.
- They have short life span.
- They contain a lot of heat generation and radiation just like Light bulbs do.
- They were unreliable as filaments frequently burnt out.
- They needed a large amount of power to run the machine.
- They needed heavy air-conditioning system.
- They needed an initialization time to start operations.
- The typical computers at that time were UNIVAC and IBM

Advantages of the First Generation Computers

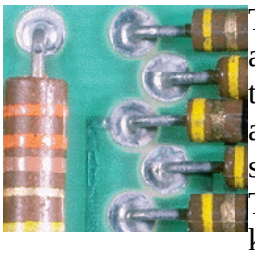
- Vacuum tubes were the only electronic components available during those days.
- Vacuum tube technology made possible the advent of electronic digital computers.
- These computers were the fastest calculating devices of their time. They could perform computations in milliseconds.

Disadvantages of the First Generation Computers

- They were too bulky in size.
- They were unreliable.
- The thousands of vacuum tubes that were used emitted large amount of heat and burnt out frequently
- Air conditioning required.
- They were prone to frequent hardware failures.
- They require constant maintenance.
- They were not portable.
- The manual assembly of individual components into functioning units was required.
- The commercial production was difficult and costly.
- There were limited commercial uses.

3.2 Second Generation Computers (1959-1964, Transistors).

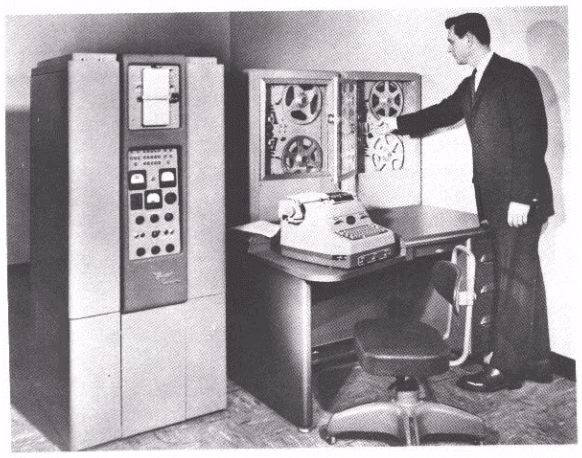
This second generation computer started from 1959 to 1964. This period saw several important developments at all levels of computer system design with transistor introduced in 1959 which replaced the vacuum tube. The transistors as indicated in Figure 6. was invented by Bell Telephone Laboratories in 1948, formed the basis for this generation of computers.



The use of Transistors makes the computers much faster, more reliable and more versatile than the first generation computers. They range from the basic circuits to the programming language used to write scientific applications. This generation computer used transistors, magnetic-core storage, magnetic tapes and magnetic disks instead of the vacuum tube. The transistors used solid material like silicon. This system is also known as Assembly language which used symbols as abbreviations. During this period, many new computer systems were developed: Input/output control systems; Early programming languages; FORTRAN compiler; COBOL compiler, BASIC, ALGOL compiler, PL (Programming Language). Significant computer development during this period include: IBM-1401, Honey well-800, IBM 1620 IBM 1620, CDC 3600. Example of the second generation computer as obtained from www.techiwarehouse.com/engine/.../**Generations-of-Compute** **(2004)** is as indicated in Figure 6.

UNIVAC 1107, UNIVAC III; RCA 501; Philco Transact S-2000; NCR 300 series; IBM 7030 Stretch; IBM 7070, 7080, 7090, 1400 series, 1600 series; Honeywell 800, 400 series; General

Electric GE 635, 645, GE 200; Control Data Corp. CDC 1604, 3600, 160A; LARC; Burroughs B5000, 200 series.



Some of the major characteristics of the second generation computers include as indicated in Fig. 7:

- The use of Electronic circuitry characterized by the use of transistors
- They made use of transistors for internal storage medium as its software.
- Punched cards and magnetic tapes were used for input of data
- Punched cards and paper were used for output
- Magnetic core storage were used for external storage
- They were oriented towards far more versatile types of applications used concurrently by users
- They used magnetic tape for external storage
- Human operators handled the punched cards
- They were cheaper to build than the vacuum tube.
- They were faster
- They consume less power.
- They were more reliable.
- They were smaller.
- They produce less heat.
- They have more storage capacity.
- They were less prone to failure.
- They use high level programs languages (COBOL, FORTRAN, BASIC, PL/I).
- They were also low-level language but more reliable and with high speed.
- The size was small.
- The speed of operation was relatively high.
- Less heat was generated.
- They were Portable and robust.
- They were more reliable and less prone to faults.
- They had no initialization time required.
- They cost less.
- They require less power
- The computers used were IBM 1400 series and 7000 series. Control Data 3600. General Electric 635 and Honeywell 200.

Advantages of the Second Generation Computers

- They were smaller in size as compared to first generation computers.
- They were more reliable.
- They were less heat generated.
- They were able to reduce computational times from milliseconds to microseconds.
- They were less prone to hardware failures.
- They were better portability.
- They were wider commercial use.

Disadvantages of the Second Generation Computers

- They require Air-conditioning.
- They require frequent maintenance.
- They require manual assembly of individual components into a functioning unit.
- The commercial production was difficult and costly.

3.3 Third Generation Computers (1965-1970, Integrated Circuits).

The third Generation Computers started in 1965 and used Integrated Circuits(IC) instead of using Transistors as indicated in Figure 8. This generation of computers included significant advances in machine hardware and software, the computer programs designed to make the machine work. These included special operating systems which provided capabilities for automatic proceeding from one job to the next without human intervention and for multiprogramming, which made it possible for machine to perform several jobs simultaneously. In other words, these transistors are compacted in such a small space called Integrated Circuit (Semiconductor chip-a single wafer of silicon). The invention of IC reduced both the size and cost of computers and therefore enhances their power. The IC today is called Motherboard. Those systems introduced during this period include: Operating systems in 1960, integrated circuit in 1964, IBM 360 Series in 1964, ICL 1900 series in 1965, Show and Baker time sharing in 1964-66, Commercial Minicomputers appeared in 1966. Others include: Large-scale integrated circuits in 1969, Read-only memory in 1970, IBM 370 series in 1970, and Intel 4004 chip in 1971, Pocket calculators using chips in 1971. The major developments during this period are: Integrated circuit, Small scale Integration and medium size integration technologies. The significant milestone in the development of operating system or software are the Integrated circuit and Database Management (DBMS), use of semiconductor memories, punch cards, magnetic tapes, disk and cache memories were used as secondary storage devices. Some of the well known computers of this age are: IBM 360 system, System 370 series of 5700 of Burroughs and PDP-II Minicomputers of Digital Equipment Corporation (DEC). Some of the computer programming languages developed were Report Program Generation (RPG), Algorithm Language (ALGOL). Example of the third generation computer as obtained from www.techiwarehouse.com/engine/.../**Generations-of-Compute** **(2004)** is as indicated in Figure 9: Burroughs 6700; Control Data 3300, 6600, 7600; Honeywell 200; IBM System/360, System 3, System 7 ; NCR Century Series; RCA Spectra 70 series; UNIVAC 9000 series; General Electric GE 600 series, GE 235.

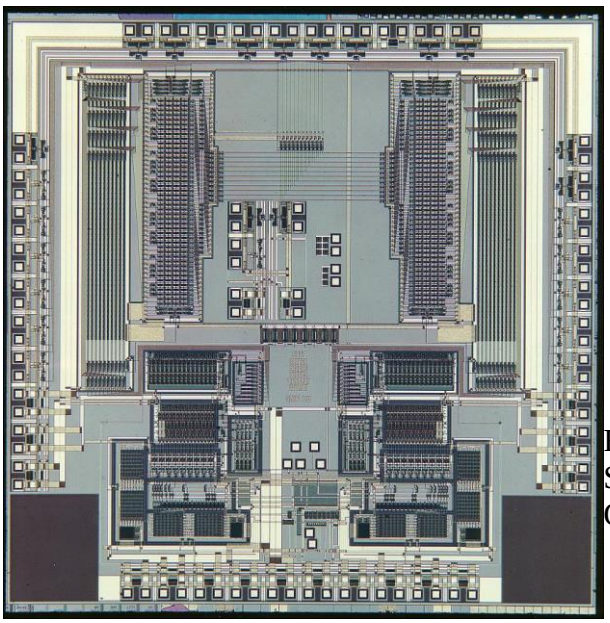


Fig. 9: 3rd Generation of computers

Some of the major characteristics of the 3rd Generation Computers include:

- They use electronic circuitry which contained the equivalence of many transistors
- They use monitors and keyboards which were introduced for data input and output
- They use punched cards which begun losing their promiences as the input or output devices
- They use of Integrated circuits as their software.
- They use magnetic disks for their external storage
- They use sophisticated operating system capable of handling several jobs simultaneously
- They introduced the concept of computer families
- They use more high-level languages such as Report Program Generator(RPG) and PASCAL, FORTRAN and COBOL
- They use magnetic core and solid state as the main storage device.
- They use smaller size and better performance and reliability.
- They use extensive high-level programming languages.
- They use minicomputers.
- They use remote processing and time-sharing through communication.
- They use availability of operating system programs software control I/O to perform many tasks.
- They use application software for airline reservation, market, forecasting, credit card billing.
- They use the computer for mathematics and scientific processing.
- The size of the computer was very small.
- They work at much higher speed.
- They were portable and handy.
- They were reliable and robust.
- The cost was less.
- They require less power.
- They were easy to learn.
- The typical computers used at this stage were: IBM System/360

Advantages of the Third Generation Computers

- They were smaller in size as compared to previous generation computers.
- They were more reliable than second-generation computers.
- They had lower heat generated than second generation computers.
- They were able to reduce computational times from microseconds to nanoseconds.
- The maintenance cost was low because hardware failures were rare.
- They were easily portable.
- They were totally general purposes which were widely used for various commercial applications all over the world.
- They were less power requirement than previous generation computers.
- They required manual assembly of individual components into a functioning unit was not required. So human labour and cost involved at assembly stage was drastically reduced.
- The commercial production was easier and cheaper.

Disadvantages of the Third Generation Computers

- Air-conditioning required in many cases.
- Highly sophisticated technology required for the manufacture of IC chips.

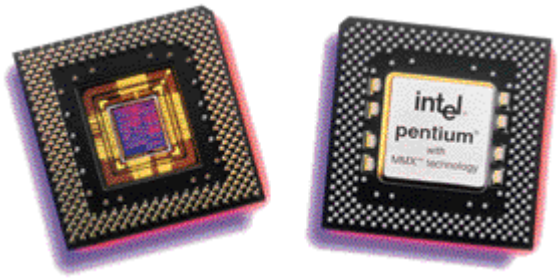
Self-Assessment Exercise

distinguish between the 1st and 2nd generation computers

Describe the characteristics of the third generation computer

3.4. Fourth Generation Computers (1972-1989, Microprocessors).

This generation of computers started in 1972 to 1989. The significant distinction for this generation is the development of Large Integrated Circuit(LSI) and Large Scale Integrated Circuit (LSIC) and the invention of microprocessor as indicated in Figure 10. Large System Intergration placed transistors into a single chip that could do all processing of a full-scale computer. Various developments emerged as a result of millions of transistors put into one integrated circuit chip and a single chip could do all the processing of a full-scale computer. Major developments during this period include: Kilby, J.S. and Noyce, R. who developed the LSI in 1972. Real-time input/output control systems were developed in 1972. Microcomputers were introduced in 1973. Bill Gates developed the first high-level language for a microprocessor in 1974. Computerized games emerged using TV screen in 1976. Large-scale databases were introduced in 1978. TV broadcasting network emerged in 1978; VisiCalc for microcomputer emerged in 1978; First Apple computers were built in 1978; View data system was introduced in 1979; IBM and ICL introduced Word processors in 1979. This is also known as 4GL as well as very high-level languages. Apple II computer desktop were developed; IBM Pcs were released in 1981 making computers accessible to many schools and homes. The Bill Gates version of BASIC became the standard programming for personal computer. Gates and Allen founded the Microsoft Corporation. They are one of the richest people in the world of computer specialists because of their development of computer operation system(different versions of Windows) and different Office application software and hardware systems. The major computers at this stage are:



- Medium Scale Integration (MSI).
- Large Scale Integration (LSI).
- Very Large Scale Integration (VLSI).

The major software developed during this period are the high-level programming languages: Query languages, Report writers, Spreadsheet, Graphics, Computer Aided Design, ADA, C, PASCAL, Word processing packages, Microsoft Office, Microsoft Windows, Database packages which incorporate structured Query Languages (SQL) like ORACLE, SYBASE, INFORMIX.

Three basic characteristics that differentiate microprocessors in this generation include:

- **Instruction Set**: The set of instructions that the microprocessor can execute.
- **Bandwidth**: The number of bits processed in a single instruction.
- **Clock Speed**: Given in megahertz (MHz), the clock speed determines how many instructions per second the processor can execute.

One of the earliest personal computers was the Altair 8800 computer kit as indicated in the two Figures 11. In 1975 you could purchase this kit and put it together to make your own personal computer. In 1977 the **Apple II** was sold to the public and in **1981IBM** entered the Personal Computer (PC).

In 1981 IBM introduced its first computer for the home user, and schools and in 1984 Apple introduced the

Macintosh. Microprocessors also moved out of the realm of desktop computers and into many areas of school curriculum and of life as more and more everyday products and schools began to use microprocessors for the teaching and learning. As these small computers became more powerful and available, they could be linked together to form networks, which eventually led to the development of the Internet. Fourth generation computers also saw the development of Graphic **User Interface (GUIs), the mouse and handheld devices.**

- The major characteristics of this fourth generation computers include:
- They use miniaturization which complete circuits are reduced virtually into microscopic sizes
- They use large-scale integrated circuit as their software.
- Further refinement of input and output devices were developed
- They introduced microcomputers
- Magnetic disks became the primary source of external storage
- They started to use sophisticated broad special software for managing large databases
- They increased storage capacity and speed.
- They use modular design and compatibility between equipment provided by various manufacturers.
- They use greater versatility of input/output device.
- They use increased minicomputers.
- They use microprocessors and microcomputers.
- They use application software for mathematical modeling and simulation, electronic fund transfer (EFT), Computer Aided Instruction (CAI), Computer Aided Management (CAM) and home computers.
- They use result oriented programming languages.
- They use improve productivity tools and real time sharing and control systems such as games.
- They use application software to copy and present data in different form.
- They were more reliable.
- They were powerful in mathematical calculations and data processing abilities.
- They were very fast.
- They require little power to operate.
- They were very small in size and light weight.
- They were multi-purpose capable of multi-tasking.
- They were robust and rarely prone to hardware problems.
- They were reliable in true sense.
- They were the cheapest among all generations of computers.
- They were user-friendly.
- Typical computers used at this generation were: IBM System/370, and HP3000

Advantages of the fourth Generation Computers

- They were the smallest in size because of high component density.
- They were very reliable.
- The heat generated was negligible.
- They require no air conditioning in most cases.
- They were much faster in computation than previous generations.
- The Hardware failure was negligible and hence minimal maintenance was required.
- They were easily portable because of their small size.
- They were totally for general purpose.

- There were minimal labour and cost involved at assembly stage.
- They were the cheapest among all generations.

Disadvantage of the Fourth Generation Computers

- Highly sophisticated technology required for the manufacture of LSI chips.

3.5. Fifth Generation Computers (1990, Artificial Intelligence).

This computer generation started in 1990. Supercomputers advanced in artificial Intelligence which could perform billions of calculations per second. The computer that think and reason caused further miniaturization of computer hardware. Artificial Intelligence (AI) is described as a branch of Computer Science that is involved with using computers to solve problems. The public first became aware of this disciple in 1956 when the term was coined as the theme for a conference held at Dartmouth College. Since then, researchers have been using the concepts from disciplines such as Linguistics, Psychology and Computer Science in an attempt to learn how to prepare programs or construct systems that do perform task which no machine has ever automatically done before. Figure 12 shows that the computers at this generation are smaller in sizes.

Source: museum.ipsj.or.jp › ...›Historical Computers in Japan› Other Computers

An example of AI is the use of Expert system as indicated in Figure 13 below. An expert system is software that attempts to encode the knowledge and decision rules established by human specialists so that package users can call on this expertise in making their own decisions. Computers will continue to be intelligence amplifiers in an alliance with humanity. This alliance would combine the current superiority of the human brain in matters involving creativity, judgment and intuition with the computer's superiority in matters requiring processing, speed, accuracy and tireless attention to detail. It started with major innovations in computer architecture which is the era of interaction between computer and human beings, like Parallel Processing, Intelligent Programming, application of Artificial Intelligent, Natural language, artificial language, knowledge-based languages and Object oriented languages. The firth generation computer makes it possible for hundreds of processors working on different parts of a single program. They work on parallel processing. The fifth generation computer combines both hardware and software to produce human intelligence with voice recognition, natural language processing, language translation, speech processing, other multimedia application, video databases and optical discs. Example of the fifth Generation computer as obtained from www.techiwarehouse.com/engine/.../**Generations-of-Compute** (2004) is as indicated in Figure 10.

Some of the major characteristics include:

- They use very large scale integration (VLSI) of circuits on smaller chips as their software.
- They use artificial intelligence system that deals with knowledge base and reasoning ability- known as knowledge information processing.
- They use expert system which is a product of artificial intelligent used in medical diagnosis, audit reviews, insurance policy risk assessments and personal financial planning.
- They use talking and voice recognition computer to capture input verbally, speech and natural language understanding.
- They use faster operating speeds synthesis, greater processing capacity, and virtually unlimited memory.
- They use relational databases and image processing.
- The development and use of personal computers.
- The development of personal computers has replaced typewriters.
- Electronic currency is developed and is replacing paper currency.
- The development of personal computers as part of our daily life in offices and homes.
- They use ATM to access money from banks in any part of the world

Advantages of the Fifth Generation Computers

- They are reliable,
- They work faster.
- They were portable and are available in different sizes with different features and different affordable prices
- A noninvasive probe that provides painless probing to the patient
- There is no question of probe passing beyond the junctional epithelium, as ultrasound waves detect, image, and map the upper boundary of periodontal ligament
- Computer storage of data and printout or visuals can be used for patient education
- Guidance path is predetermined
- Provides information regarding condition of the gingival tissues

Disadvantages of the Fifth Generation Computers

- Expensive
- Operator needs to understand the images provided by the computer
- Requires a learning curve

3.6 The sixth Generation Computer (1990s,Wide Area Networking)

According to the Sixth Generation (1990s-) the sixth generation will be the explosive growth of Wide Area Networking. The sixth-generation computing is the name used in the Japanese during their Promotion of Research and Development on Electronics and Information Systems in Tokyo (Lawrenceville, 2007). The Council set by the Japans Government was asked by their Ministry of Science and Technology in January 1983 to report on artificial intelligence in these terms (Chapman, 2009). Four objectives were specified for promoting knowledge science: innovations in frontier high technologies; economic and cultural advancements; contributions to the expansion of human potential; and establishing a foundation for creative science. The most interesting feature of the proposed research

program is based on inter-disciplinary interaction with physiology, psychology, linguistics and logic as indicated in Figure 1. The report analysed the state of the art in four relevant sciences and proposes the development of eight technologies based on their application in four major areas as expert system, machine translation system, Intelligent/CAD/CAM systems, and Intelligent Robot systems as illustrated in Figure14. Figure 14: The Japanese sixth generation program

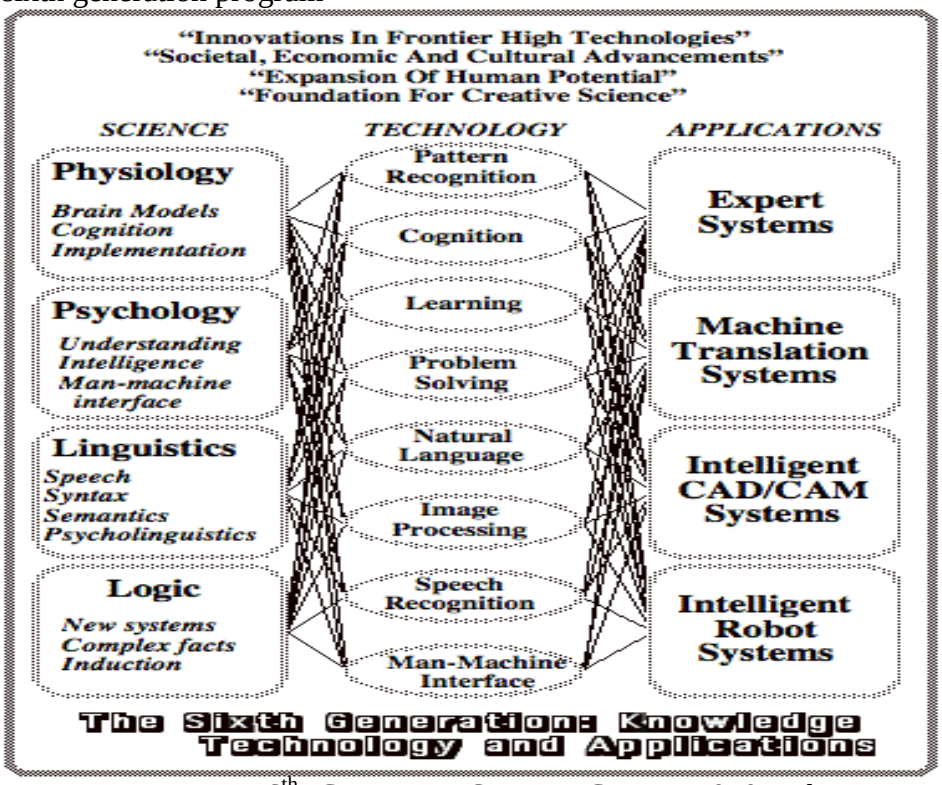


Fig. 14: Japanese 6th Generation:Source: Gaines 2010: The Japanese sixth generation program

This sixth generation computers paused a lot of issues and challenges to European and Americans. This Japans development of the sixth generation computers scared a lot of European and American decision makers. Fortunately they were not scared completely but instead decided to "counter-attack" by funding a lot of new research in different computer fields. Some of the projects which were started as a result of this development are the European Esprit, the British Alvey, and the American MCC. Representatives from these three initiatives were invited to the conference to report on their own progress which has been fairly substantial. Timothy Walker from the U.K. Information Engineering Directorate told of the varying British information technology projects which had succeeded in getting a number of key scientists to return to the U.K. from overseas. Several changes had been made in the projects over the years, including some name changes, such as changing "AI" to "knowledge based systems" because of lowered expectations. On the other hand, the area of human-computer interaction was receiving more emphasis now: At the start of the Alvey project 5 years ago, HCI might have been seen as important but not so much was done about it, whereas now they realized that they had to make a serious effort to ensure usability. Walker said that HCI could either be done as an independent field of study or integrated with other topics and that they had chosen to base their projects mostly on the latter view.

Transitions between generations in computer technology are hard to define, especially as they are taking place. Some changes, such as the switch from vacuum tubes to transistors, are immediately apparent as fundamental changes, but others are clear only in retrospect. Many

of the developments in computer systems since 1990 reflect gradual improvements over established systems, and thus it is hard to claim they represent a transition to a new "generation", but other developments will prove to be significant changes. In this section, we offer some assessments about recent developments and current trends that we think will have a significant impact on computational science. This generation is beginning with many gains in parallel computing, both in the hardware area and in improved understanding of how to develop algorithms to exploit diverse, massively parallel architectures. Parallel systems now compete with vector processors in terms of total computing power and most especially parallel systems to dominate the future. Combinations of parallel/vector architectures are well established, and one corporation (Fujitsu) has announced plans to build a system with over 200 of its high and vector processors. Manufacturers have set themselves the goal of achieving teraflops (1012arithmetic operations per second) performance by the middle of the decade, and it is clear this will be obtained only by a system with a thousand processors or more. Work station technology has continued to improve, with processor designs now using a combination of RISC, pipelining, and parallel processing. As a result it is now possible to procure a desktop workstation that has the same overall computing power (100megaflops) as fourth generation supercomputers. This development has sparked an interest in heterogeneous computing: a program started on one workstation can find idle workstations elsewhere in the local network to run parallel sub tasks. One of the most dramatic changes in the sixth generation is the explosive growth of wide area networking. Network bandwidth has expanded tremendously in the last few years and will continue to improve for the next several years. T1 transmission rates are now standard for regional networks, and the national "backbone" that interconnects regional networks uses T3. Networking technology is becoming more widespread than its original strong base in universities and government laboratories as it is rapidly finding application in K-12 education, community networks and private industry. A little over a decade after the warning voiced in the Lax report, the future of a strong computational science infrastructure is bright.

3.7 Seventh Generation of computer (1996-date)

The seventh generation of computer is still under development. However, it can be refer to:

a. Seven generation sustainability, the idea that decisions should be considered for their impact on the seventh generation to come, inspired by the laws of the Iroquois
b. Seventh Generation Amendment, a proposed amendment to the U.S. Constitution to put ecologically sensitive areas under government control
c. Seventh Generation Inc., a Vermont-based manufacturer of cleaning products
d. History of video game consoles (seventh generation), the previous generation of video games containing the Xbox 360, Nintendo DS, Wii, PlayStation Portable, and PlayStation
e. Dual Core processors generation.
f. The social media and social networking generation

The characteristics. The Seventh Generation replacing desktop PCs and personal printers with more energy-efficient laptops and all-in-one printers. Desktop PCs and personal printers are out. Energy-efficient laptops and all-in-one printers are in. Therefore with more energy-efficient availability and accessibility of laptops, Internet, e-prints, Ipad, GSM, e-mail, face-book, Whats App, modem, twitter, Podcasts, blogs, Wikis, Linkedin, YouTube, MySpace etc, one can achieve the following characteristics of social media and social networking:

a. **Web space.** The website should provide the users free web space to upload content.
b. **Web address.** The users are given a unique web address that becomes their web identity. They can post and share all their content on this web address.

c. **Build profiles.** Users are asked to enter personal details like name, address, date of birth, school/college education, professional details etc. The site then mines the personal data to connect individuals.
d. **Connect with friends.** Users are encouraged to post personal and professional updates about themselves. The site then becomes a platform to connect friends and relatives.
e. **Upload content in real time.** Users are provided the tools to post content in real time. This content can be text, images, audio, video or even symbolic likes and dislikes. The last post comes first, giving the site freshness.
f. **Enable conversations.** Members are given the rights to comment on posts made by friends and relatives. The conversations are a great social connect.
g. **Posts have time stamp.** All posts are time stamped, making it easy to follow posts.
h. **Interactive:** Another characteristic of modern social networks is the fact that they are so interactive
i. **Relationships:** Unlike the websites of the past, social networks thrive on relationships
j. **Emotion over content.** The social network actually provides users with emotional security and a sense that no matter what happens, their friends are within easy reach
k. **User-based**. Online social networks, are built and directed by users themselves

4.0 Conclusion

The development of computer span through seven generations with each generation Chronicling the landmark achievements of the period with their characteristics.

5.0 Summary

1. Computer is an electronic device which accepts data as input, performs processing on the data, and gives the desired output. A computer may be analog or digital computer.
2. Speed, accuracy, diligence, storage capability and versatility are the main characteristics of computer.
3. The computing devices have evolved from simple mechanical machines, like ABACUS, Napier's bones, Slide Rule, Pascal's Adding and Subtraction Machine, Leibniz's Multiplication and Dividing Machine, Jacquard Punched Card System, Babbage's Analytical Engine and Hollerith's Tabulating Machine, to the first electronic computer.
4. Charles Babbage is called the father of computer.
5. The evolution of computers to their present state is divided into five generations of computers, based on the hardware and software they use, their physical appearance and their computing characteristics.
6. First generation computers were vacuum tubes based machines. These were large in size, expensive to operate and instructions were written in machine language. Their computation time was in milliseconds.
7. Second generation computers were transistor based machines. They used the stored program concept. Programs were written in assembly language. They were smaller in size, less expensive and required less maintenance than the first generation computers. The computation time was in microseconds.
8. Third generation computers were characterized by the use of IC. They consumed less power and required low maintenance compared to their predecessors. High-level languages were used for programming. The computation time was in nanoseconds. These computers were produced commercially.
9. Fourth generation computers used microprocessors which were designed using the LSI and VLSI technology. The computers became small, portable, reliable and cheap.

The computation time is in picoseconds. They became available both to the home user and for commercial use.

10. Fifth generation computers are capable of learning and self organization. These computers use SLSI chips and have large memory requirements. They use parallel processing and are based on AI.
11. The sixth generation computers are still being developed as social media and social networking.

6.0 Tutor-Marked Assignment

Explain the major characteristics of the fifth generation computers

Compare the characteristics of 5^{th} generation and 6^{th} generation computers

7.0 References and Further Reading

More recent editions of these books are recommended for further reading.

Bradley, R. (1995). Understanding Computer Science for Advanced Level. 3^{rd} Ed. London: Stanley Thornes.

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Turban, E., Rainer, R., Potter, R.E., (2007). Introduction to Information Technology, 2^{nd} Ed. New Delhi. Wiley Indian Edition.

In addition to the above books, you can browse on the Internet to get additional materials on the topics covered in this course.

UNIT 4: CLASSIFICATION OF COMPUTERS

Contents

1.0 Introduction

The computer has passed through many stages of evolution from the days of the mainframe computers to the era of microcomputers. Computers have been classified based on different criteria. In this unit, we shall classify computers based on three popular methods.

2.0 Objectives

The objectives of this unit are to:

a. Classify computers based on their size, type of data they represent and by purpose.
b. Study the features that differentiate one class of the computer from the others.
c. Describe any five types of microcomputers

3.0 Main Content

3.1 Classification Based on types of data they represent

Even though there are no standardized methods of categorizing computers, different types of computer systems are available in the market to cater to the variety of computing needs. Broadly, computers may be classified on the basis of:

a. The type of input they accept and the way they perform the processing operations, and
b. Size, in terms of capacities and speed of processing, namely: Digital, Analog and Hybrid computers.

3.1.1 Digital Computer

Digital computer represents its variable in the form of digits. It counts the data it deals with, whether representing numbers, letters or other symbols are converted into binary form on input to the computer. The data undergoes a processing after which the binary digits are converted back to alpha numeric form for output for human use. Because of the fact that business applications like inventory control, invoicing and payroll deal with discrete values (separate, disunited, discontinuous); they are beset processed with digital computers. As a result of this, digital computers are mostly used in commercial and business places today. They work with quantities represented as digitals. They operate on discrete quantities. They contain both numeric and non-numeric information which are represented as strings of digits. They use binary codes such as 0s (off) and 1s (on), to represent the information. The basic operation performed by a digital computer is addition, multiplication, division, subtraction and exponentiation before computed. The digital computers are useful for evaluating arithmetic expressions and manipulation of data such as payroll preparation, billing. Examples of digital computers are as indicated in Fig 15:

- Calculators.
- Adding machines.

- Computers such as Desktop, laptop, Tablet laptop etc.
- A digital clock that display whole seconds but not the time in between the seconds.

Fig. 15: Digital computer

Digital Clock. It does not represent time continuously, but rather discretely, in distinct steps. A digital clock might display whole seconds but not the time in between the seconds.

The characteristics of Digital Computer.

a. Speed. The speed of operation is very high. This is why they can carry out trillions of operations in a second. Digital computers are discrete systems and operate in discontinuous steps and so operate by counting.
b. Automatic. These machines are automatic. Once properly started, they can perform task without any human intervention. This makes these devices immensely helpful in carrying out tedious tasks which may tire normal human brain
c. The calculations are converted into binary numbers (1s and 0s). This is why numbers, words and symbols can easily and quickly represented and processed.
d. The output is represented in the form of discrete values.
e. Its accuracy is good. A Digital computer stores the information in encoded form which guarantees its longevity and accurate retrieval
f. It has large memory space. It can store and recall any amount of information because of its secondary storage facility. The information can be stored and retrieved as long as a user desires
g. Flexibility. It is versatile in nature in the sense that they carry out different type of jobs at a time without any interference. They are also suitable for a number of applications. They modify their behaviour based on the information they process

2. Classification by purpose
    a. Special purpose
    b. General purpose

3.1.2 Analog Computer

Analogue is a Greek word, meaning similar. The similarities between two quantities are measured by electrical voltages or current. These are special-purpose computers dedicated to a single task. They are computers that operate on continuous electrical signals or data usually by measuring of weigh, speed, lengths, voltage waveform, current waveform, temperature instead of counting. This type of computer sets up a model of a system. Common type represents it variables in terms of electrical voltage and sets up circuit analog to the equation connecting the variables. The answer can be either by using a voltmeter to read the value of the variable required, or by feeding the voltage into a plotting device. They hold data in the form of physical variables rather than numerical quantities. In theory, analog computers give an exact answer because the answer has not been approximated to the nearest digit. Whereas, when we try to obtain the answers using a digital voltmeter, we often find that the accuracy is less than that which could have been obtained from an analog computer.
It is almost never used in business systems. It is used by the scientist and engineer to solve systems of partial differential equations. It is also used in controlling and monitoring of systems in such areas as hydrodynamics and rocketry; in production.
There are two useful properties of this computer once it is programmed:

a. It is simple to change the value of a constant or coefficient and study the effect of such changes.
b. It is possible to link certain variables to a time pulse to study changes with time as a variable, and chart the result on an X-Y plotter.

The output of an analogue computer is in the form of graphs. Examples of the analogue computers include: (a) Thermometer, (b) Measuring scales, (c) Barometer (d) Speedometer,(e) Antikythera mechanism, (f) astrolabe,(g) differential analyzer,(h) Deltar,(i) Kerrison Predictor,(j) mechanical integrator,(k) MONIAC Computer (hydraulic model of UK economy), (l) nomogram, (m) Norden bombsight, (n) operational amplifier, (o)planimeter,(p) Range keeper,(q) slide rule,(r) thermostat, (s) tide predictor, (t) Torpedo Data Computer, (u)Torquetum, (v) Water integrator, (w)Mechanical computer, (x) a dial clock, (y) Analog Clock, the hands move continuously. This clock is an example of analogue computer showing only the hours and the munities as indicated in Fig 16.

Fig. 16: Analogue computer

The characteristics of Analogue computer.

The following are some of the characteristics of analogue computers:

- It operates by measuring.
- It requires physical analogue.
- It functions on continuously varying quantities.
- The output is usually represented in the form of graph.
- They are first converted in equations and later converted into electrical signals.
- The accuracy of the output is poor.
- Its speed is usually low.
- It has limited memory space.
- It is not versatile (It has limited applications).
- It is not suitable for business and industry.
- It has infinite voltage gain.
- It has infinite input resistance (or zero input current).
- It has zero output resistance (infinite output current capability).
- It excel in solving differential equations and is faster than digital computers

3.1.3 Hybrid Computer

Hybrid computers combine the features of analogue and digital computers, i.e. they count and measure things as they can process both continuous and discrete data. They have many of the same kinds of parts of an analogue computer. But like digital computers, they process data by manipulating numbers. In some cases, the user may wish to obtain the output from an analog computer as processed by a digital computer or vice versa. To achieve this, he set up a hybrid machine where the two are connected and the analog computer may be regarded as a peripheral of the digital computer. In such a situation, a hybrid system attempts to gain the advantage of both the digital and the analog elements in the same machine. This kind of

machine is usually a special-purpose device which is built for a specific task. It needs a conversion element which accepts analog inputs, and output digital value. Such converters are called digitizers. There is need for a converter from analog to digital also. It has the advantage of giving real-time response on a continuous basis. Complex calculations can be dealt with by the digital elements, thereby requiring a large memory, and giving accurate results after programming. They are mainly used in aerospace and process control applications. Examples of Hybrid computers include:

- Microcomputer.
- Minicomputer.
- Thermometer and Speedometer.

3.1.3.1 Differences between Digital and Analogue Computers.

The differences between digital and analogue computers can be distinguished in Table 3

S/N	Digital computer	Analogue computer
1	It operates by counting	It operates by measuring
2	It functions on discrete numbers	It functions on continuous variables
3	The calculations are converted into binary numbers(1s and 0s)	The calculations are first converted to equations and later into electrical signals
4	The output is in the form of discrete values	Its output are in the form of graph
5	It is more accurate	It is less accurate
6	It has high speed	It has less speed
7	It has more memory space	It has less memory space
8	It has high flexibility	It is rigid
9	It can process alphanumeric information	It cannot process alphanumeric information
10	It has more applications	It has limited application
11	It is highly suitable for business application	It is not suitable for business applications
12	The circuits are always the same when we want to solve a problem	When we switch to a new problem, we must rewrite the entire computer
13	It redress problems as a series of numerical stop	It used to create the analogue to a problem
14	It can store numerical data in form which is not obviously related to the system it represented	It can simulate the actual system as problems are usually carried out in real-time system
15	Data is transmitted inside a digital computer as a train of square waves	Information is represented by quantities such as smoothly varying voltages
16	Data storage is concentrated in the core in digital, disk or magnetic type	Data is stored in the form of electronic potential as is dispersed persists only for a limited period
17	The cost of digital computer is higher than its parallel analogue	It has a small volume of devices such as integrators and multipliers and cheater to program and to buy
18	It handles alphanumeric data and other symbols	It represents measurable quantities and simulate the responses of physical systems by mathematical analogies
19	It works in scientific, business and statistical areas	It has no suitable applications in an electronic data processing (EDP)

		department
20	It is automatic	It is no longer automatic

What are the characteristics of digital analog and hybrid computers?
The following are the characteristics of digital, analog and hybrid computers:

a. digital computers work on discrete data representing quantities by encoding (e.g. integers, coded alphanumeric characters, coded floating point numbers).
b. analog computers work on continuous data representing quantities by analogy (e.g. voltages, currents, shaft rotation rate, shaft position).
c. hybrid computers are a combination of digital & analog computers connected together to work as one machine.

Why digital computers are more popular than analog computers?
This circuit is used in almost every electronic digital computer ever built & was invented in 1918 (patent GB148582). Well it is kind of simple really but digital has better graphics and says to run faster. The reason is simple: **ease of programming:**

a. Digital computers can be programmed by writing code, which can be reloaded at any time.
b. Analog computers usually have to be "taken apart and rewired" to be programmed.

In fact, when built with the same technology, Analog computers are always **faster** than Digital computers at solving the same problem. However Analog computers have not been built since the 1980s (and then only for special purposes) so Analog computing technology now lags Digital computing technology by several decades

Self-Assessment Exercise

a. Justify the basis in which computers are classified into three?
b. What is the difference between digital, analog and hybrid computers?

3.2 Classification of computer based on purpose.

Depending on their flexibility in operation, computers are classified as either special purpose or general purpose/ degree of versatility

a. Special purpose
b. General purpose

3.2.1 Special Purpose Computers

Computers can be classified according to the principles of operation, purpose and on the basis of their size, speed and generation. Classes of computer on the principles of Operations include: the Digital computer, Analogue computer and Hybrid computer as mentioned above. Those on the basis of purpose or application include special purpose and general purpose computers. Those computers that are classified on the basis of size and speed are five namely: Super computer, Mainframe computer, workstations, Minicomputers/Microcomputer and microcontrollers. Likewise, those computers classified on the basis of generations include: 1st generation, 2nd generation, third generation, fourth generation, fifth generation and sixth generation. The classification of computer on the basis of degree of versatility (purpose and application) is:

- **Special Purpose.** As the name suggest, these are computers designed to perform a particular job or task because of its limited memory and speed. For example, the computers that are designed for air traffic control, or measuring temperature cannot be used in word processing of documents. A special purpose computer is one that is designed to solve a restricted class of problems. Such computers may even be designed

and built to handle only one job. In such machines, the steps or operations that the computer follows may be built into the hardware. Most of the computers used for military purposes fall into this class. Other example of special purpose computers include:

a. Computers designed specifically to solve navigational problems.
b. Computers designed for tracking airplane or missiles.
c. Computers used for process control applications in industries such as oil refinery, chemical manufacture, steel processing and power generation.
d. Computers used as robots in factories like vehicles assembly plants and glass industries.

Attributes of Special Purpose Computers

Special purpose computer are usually very efficient for the tasks for which they are specially designed. However, they are very much less complex than the General-Purpose Computers. The simplicity of the circuiting stems from the fact that provision is made only for limited facilities. They are very much cheaper than the General-Purpose type since they involve less components and are less complex.

- **General Purpose.** These are computers designed to solve a wide variety of tasks in the fields of engineering, science, commerce, education, industry etc. With general or generic purpose computers, the emphasis is on flexibility in preparing store reports, sales reports, students' exams reports, payroll etc. For example, a computer is designed to solve the problem of word processing with graphics embedded at the same time performing calculation using Excel software. They are designed to handle wide range of problems. Theoretically, a general-purpose computer can be adequate by means of some easily alterable instructions to handle any problems that can be solved by computation. In practice however, there are limitations imposed by memory size, speed and the type of input/output devices. Examples of areas where the general purpose are employed include the following:
    a. Payroll
    b. Banking
    c. Billing
    d. Sales analysis
    e. Cost accounting
    f. Manufacturing scheduling
    g. Inventory control

Some of the attributes of General-Purpose Computers include the following:

a. General-Purpose computers are more flexible than special purpose computers.
b. They can handle a wide spectrum of problems.
c. They are less efficient than the special-purpose computers due to such problems as;
    - Inadequate storage;
    - Low operating speed;
    - Coordination of the various tasks and subsection may take time.
    - General Purpose Computers are more complex than the special purpose ones.

3.3 Classification of Computers According to Capacity/Size

In the past, the capacity of computers was measured in terms of physical size. Today however, the physical size is not a good measure of capacity because the modern technology has made it possible to achieve compactness. A better measure of capacity today is the volume of work that computer can handle. The volume of work that a given computer handles is closely tied to the cost and to the memory size of computer. Therefore, most authorities today accept the price of rental price as the standard for ranking computers. Here,

both memory size and cost shall be used to rank (classify) computer into four main categories as follows:

(a) Supercomputer
(b) Main frame computer/large computer
(c) Mini/medium/small computer
(d) Microcomputers/very small computers

These are computers designed according to large size and small size computers. The Large size computer systems have been traditionally divided into super computers, mainframe computers and minicomputers.

3.3.1 Supercomputer.

It is the fastest, powerful and most expensive type of computer. Super computer has large memories and high speeds. Its capacity is extremely high which can process up to billion instructions. Its speed, function and language, accuracy etc are very high. It is used by very large organizations. It is used for processing very large files and performing large scale mathematical calculations. It has operations done in parallel, rather than sequential. Its main memory ranges from 8 to 64 megabytes. Super computer is widely used in scientific applications such as aerodynamic design and simulation, processing of geological data, genetic coding, collecting and processing of weather data and worldwide forecasting. It is used for tracking and controlling space explorations, oil exploration and simulations as indicated in Fig. 17.

Characteristics of supercomputers

a. They have ability to recover automatically from failures
b. They have multiple processors that process instruction at a time(parallel) such as resource optimization, image processing, graphics and financial analysis
c. They use several processors working simultaneously.
d. They process at a rapid speed.
e. The main memory ranges from 8 to 64 megabytes.
f. They have operations done in parallel, rather than sequentially.
g. They are used in weather forecasting, supersonic aircrafts design.

3.3.2 Mainframe computer.

Mainframe computers or central host computer occupy a very large air-conditioned rooms. They are usually slower, less powerful and less expensive than super computers. They process data at several million instructions per second (MIPS).They are used by large organizations such as businesses, banks, universities and government agencies to up-date inventory and handle millions of transactions. These computers keep their records on magnetic files as indicated in Fig. 18.

Advantages.
They are capable of handling all tasks.
The storage capacity is about 10 Mega words.
They have great processing speed and data storage capabilities.
The word lengths are with 24,32,48,64 or 128 bits.
They are able to accept any high level language.
They can support around 500 terminals.
Fig. 18: Mainframe computer

Disadvantages

a. Only few individuals had access to mainframe computers.
b. They are very expensive to purchase.
c. Maintenance cost is very expensive.
d. Programming in mainframe computer was difficult.
e. These computers are non-interactive.
f. They require large rooms.
g. Their consumption of electricity is very high.

3.3.3 Minicomputer.

Minicomputers are smaller than mainframe computers and general purpose computers. They are desk-sized machines which enable them to move easily than mainframe computers. They combine the characteristics of the mainframe and microcomputers. They are bigger than microcomputer. Medium-size companies or departments of large companies used them for research and monitoring of a particular manufacturing process and for processing of accounting and educational needs. They are well adapted for functions such as accounting, word processing, database management, Statistical Packages for Social Sciences (SPSS), Computer Aided Design (CAD) and Numerical Analysis. They form the basis for a network system. They are relatively expensive but available to a wider organization as indicated in Fig. 19.

Characteristics

a. It is a general purpose machine with a smaller CPU than a mainframe.
b. Its storage capacity is about 2 mega words.
c. It word lengths are usually 12, 16, 24 or 32 bits.
d. Its rate of acceptance and transfer of data is a maximum of 4 million bytes/second.
e. It can support all high level languages.
f. It can support many terminals.

Advantages

a. It performs almost all the tasks that a mainframe computer does.
b. It is relatively inexpensive and is within the purchasing power of the small and medium sized business firms.

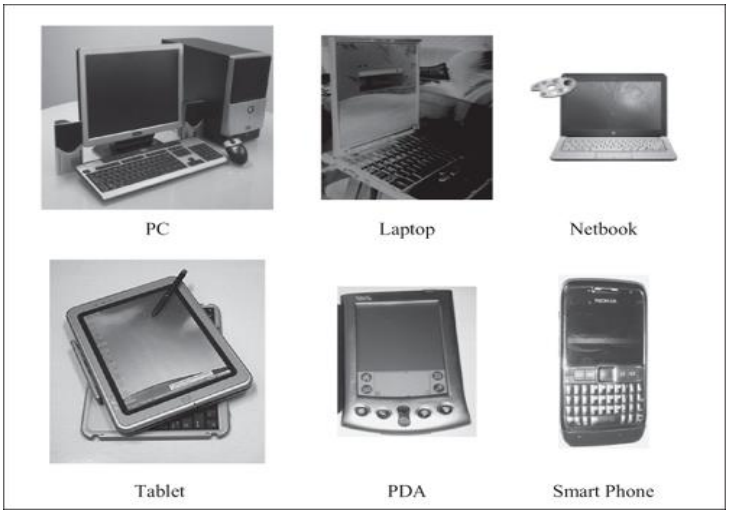
Disadvantages

a. It is slower when comparing with mainframe computers.
b. Its memory is smaller than mainframe computers

Workstations. They are expensive, powerful personal computers usually used for complex scientific, mathematical, and engineering calculations and for computer-aided design and computer-aided manufacturing.

Server. The server is also considered. The term server actually refers to a computer's function rather than to a specific kind of computer. With the rise of the Internet and web, it is a central computer that holds collections of data (databases) and programs for connecting or supplying services to PCs, workstations, and other devices which are clients. A server runs a network of computers. It handles the sharing of equipment like printers, transmitting e-mail and the communication between computers on the network. A server should therefore have the following advantages over other computers:

a. More power.
b. Larger memory.
c. Larger storage capacity, and
d. Higher speed communications.



Microcontrollers. This is also called embedded computers. They are the tiny, specialized microprocessors installed in smart appliances and automobiles. They enable microwave ovens to store data about how long to cook your potatoes, yams and at what power setting. Examples of microcontrollers are digital cameras, MP3 players and organizers for storing photos, videos and music.

Smaller Computer Systems. Smaller computer systems have been divided into four categories ad indicated in Figure 20.

Fig: 20: Smaller Computer systems

3.3.4 Microcomputers A microcomputer is smaller. It is the smallest and least expensive of all the computers. They have smallest memory and less power. They are physically smaller and permit fewer peripherals to be attached. They are also called personal computers (PC). The small size and the use of this computer make them to be called Microcomputer. They are also called Personal Computer (PC). The physical size is smaller than Minicomputer. They are widely used with other computers to provide the best performance you need. They are inexpensive and more accessible. They are extremely flexible and general-purpose machines. All the computers have three units namely Input, Output and Central Processing Unit. Its storage capacity is low when compared to mini and mainframe computers. It is able to accept most of the high level languages. It uses an interpreter or compiler for running high level languages. The programming systems are highly interactive and so non-technical users can comfortably develop and use them. They are usually placed on a desk. They consist of a processor on a single silicon chip.

Features

a. Its storage capacity is low.
b. Its rate of acceptance and transfer of data is limited.
c. It is able to accept most high level languages.

Advantages

a. They are small and portable.
b. They are relatively inexpensive.
c. They work as soon as they are switched on.

d. They have excellent graphic capacities.
e. They do not occupy much space.
f. They do not consume much power.

Disadvantages
a. Micros have a limited storage capacity.
b. They are relatively slow.

3.3.4.1 Desktop or Tower systems.
This is intended for office use and supports the day-to-day activities of an organization's employees. **Tower PCs** are microcomputers whose case sits are as a tower often on the floor beside a desk.
Portable Computers. These are microcomputers that are small and light enough to move easily from one place to another. They are self-contained. They are Microcomputers with their own keyboards, mouse. The categories of portable computers include the following:

1. **Laptops.** Laptops provide mobile computing technology. They are battery-operated and can be used anytime and anywhere. They are smaller enough to fit into a lap of a user. They are weighing between 10-16 pounds. They are either AC-powered, battery-powered or both. They can be carried on a shoulder strap and mostly used by business and educational top managers. They are equipped with powerful microprocessors, graphic capabilities, adequate memory size and mouse-driven input. They have face capabilities, CD-ROM drives, and optical storage devices and can be linked to various input and output devices.

Uses of Personal Computers. Personal computers can perform the following functions:
a. Can be used to produce documents like memos, reports, letters and briefs.
b. Can be used to calculate budget and accounting tasks
c. It can analyze numeric function
d. It can create illustrations
e. Can be used for electronic mails
f. Can help in making schedule and plan projects.
g. It can assist in schedules and plan projects.
h. It can assist in searching for specific information from lists or from reports.

Advantages of Personal Computers
a. Computer is versatile; it can be used in any establishment.
b. Has faster speed for processing data.
c. Can deal with several data at a time
d. Can attend to several users at the same time, thereby able to process several jobs at a time.
e. Capable of storing several data.
f. Operating of Computer is less fatigue
g. Network possible, that is linking of two or more computers together.

Disadvantages of Personal Computers
a. Computer is costly to maintain.
b. It is very fragile and complex to handle
c. It requires special skill to operate
d. With the invention and innovation everyday, computer suffers from being obsolete.
e. It can lead to unemployment when used mostly in less Developed Countries.

f. Some computers cannot function properly without the aid of cooling system e.g. air-condition or fan in some locations.

2. **Notebooks.** Notebooks are even smaller than laptops. They are smaller than laptop. They weight less. They can fit into most briefcases. They are mostly used for note-taking by students, salespersons, journalists. They are the most popular portable computers today. They are equipped with powerful microprocessors, graphic capabilities, adequate memory size and mouse-driven input. They have face capabilities, CD-ROM drives, and optical storage devices and can be linked to various input and output devices.
3. **Sub-Notebooks.** They fit easily into a briefcase and mostly used by flyers and life-on-the –road types. They weigh between 2-6 pounds.
4. **Hand-Held Computers.** Hand-Held computers are even smaller than notebooks and sub-notebooks. They are primarily used to collect field data. Police use these types of computer to apprehend criminals, when a suspect is apprehended; a police officer uses a hand-held computer to do back ground check on the individual. Each hand-held computer holds more than 1.200 records and provide an investigator with timely and life-saving information.
5. **Personal Digital Assistants.** Personal Digital Assistants (PDA) are much smaller than sub-notebooks. They combine pen input, writing recognition, personal organizational tools, and communications capabilities. They are mostly used by workers at a warehouse for recording of changes in inventory and handling daily communications by business executives. They have different names such as: Senator Notebook, Canon Notebook, Palmtop, and Palm Pilot, Hewlett Notebook. Most of the portable computers have built-in rechargeable battery as a source of power. One big advantage of the PCs is the small size that enables you to carry about, enter phone numbers, link into Internet anywhere, anytime provided there is network service.
6. **Network Computer.** Network Computer (NC) is the type of computer that provides access to a network system. It has limited disk storage, less powerful processor and less memory.
7. **Pen-Based Computer.** Pen-Based computer refers to portable computers that use an electronic writing pad and a light-sensitive electronic pen. This type of computers frees users from the constraints of a keyboard. They are becoming increasingly popular because most people nowadays are comfortable using a pen. It is particularly useful for sales and service representatives, insurance agents, retail suppliers, delivery people, inventory clerks, health care providers who are on the move all the times.
8. Tablet PC. It is a Notebook running Windows XP Tablet Edition, Windows 7, 8, 8.1 and Windows 10. Revival of pen-based computing idea. Built-in support for ink. They have the following characteristics:
   a. Draw with stylus, active digitizer.
   b. Handwriting recognition.
   c. Also support for speech recognition.
   d. Unlike a Personal Digital Assistant(PDA), the Tablet PC runs everything on a normal Windows XP machine
   e. Lecturing
   f. Collaboration
   g. Discipline-specific applications
   h. Note-taking
   i. Grading and reading documents
   j. Creating figures and diagrams

k. Brainstorming

With tablet personal computer, you can use electronic stylus to write on the screen, just like with a pen and paper, only your words in digital Ink. The Tablet PC edit, erase and saves your work. How Tablet PC's are being used in education.

The benefits of Tablet Pcs include:

a. **Use Microsoft's Most Advanced Operating System.** Tablet PC Edition has the full capabilities of Windows XP Professional, plus additional features to enable pen-based computing.
b. **Extend the Way You Work with Your PC.** Windows XP Tablet PC Edition lets you interact with your PC in a more natural way by incorporating the convenient and intuitive aspects of pen and paper into the PC experience.
c. **Work from Anywhere with the Most Mobile PC Ever.** The Tablet PC provides everything you expect in a mobile PC, in a form that allows you to be productive in more situations—at your desk, in the hallway, at a meeting, or on the go.
d. **Take All Your Notes Electronically.** Windows XP Tablet PC Edition comes with Microsoft® Windows® Journal, a note-taking utility that lets you create and organize your handwritten notes.
e. **Collaborate Easily and Effectively.** Windows XP Tablet PC Edition lets you integrate electronic "ink" into your everyday business applications.
f. **Personalize Your Experience.** Using Tablet and Pen Settings controls, you can customize your Tablet PC: Calibrate your pen, optimize your Tablet PC for left- or right-handed operation, and program your Tablet PC's hardware buttons to complete specific actions, such as opening an application or changing screen orientation from landscape to portrait.
g. **Extend Your Applications with Ink.** Windows XP Tablet PC Edition is a powerful platform and the foundation for a new generation of applications with pen and ink capabilities. For example, the Tablet PC's powerful but simple Ink Controls and Applications Programming Interfaces allow software developers to extend existing applications with pen and ink and to develop new applications using this technology.
h. **Deploy and Manage Easily.** Windows XP Tablet PC Edition includes the advanced deployment technologies and policies included in Windows XP Professional, making it easy to deploy and manage Tablet PCs in the corporate, environment.
i. **Provide a Global Business Solution.** Windows XP Tablet PC Edition is localized into English, German, French, Japanese, Chinese (Simplified & Traditional), and Korean. It also supports the Windows XP Multilingual User Interface (MUI), which lets you change dialog boxes, menus, help files, dictionaries, and proofing tools for each user's language.
j. **Get the Highest Level of Protection for Critical Data.** Windows XP Tablet PC Edition offers all of the protection features of Windows XP Professional, including the Encrypting File System security feature and the access control feature. Tablet PC also supports secure log on using a single CTRL+ALT+DEL hardware button.

Disadvantages of Tablet Technology. The following are the disadvantages of a Tablet PC:

a. Keyboards mostly small.
b. Screen resolution limited on most models to 1024x768.
c. Software applications limited, but growing.
d. Handwriting recognition average.
e. Clicking a little tricky.
f. More expensive.

g. Requires projector in classroom, may have difficulty using, setting up, smaller writing area than large black/whiteboard.
h. Learning curve, around four days.
i. Most require external CD-ROM.
j. Display viewing angles often poor.

9 IPad Laptops. The iPad is slim and fast. There are different purposes for both devices an Ipad is a device made by apple, launched in January 2010 which is all touch screen and without a keyboard. IPad 2 is a fun device that can also do some of the tasks of a laptop, but it certainly cannot replace a laptop. It lacks a physical keyboard, USB ports, and multitasking which are common things with any laptop. a laptop has a word processor, and can view flash video. An ipod can only view the Internet and run applications from the app store. You cannot type with it because you cannot touch type (this means type without looking at the keys). I would go with a laptop because it is faster and easier to take notes on because of the keyboard. An ipad lasts longer on a single battery charge, and comes integrated with certain Apple software frameworks that some people may find useful. A modern laptop is more powerful and more versatile than an ipad, but also more expensive. I would go with the laptop, on the basis that there are lots of things I want to do that are hard to do with an ipad. An Ipad is a device made by apple, which is all touch screen and without a keyboard, it can hold applications, and surf the web. A laptop has a keyboard, with a opening and closing top, to protect the screen. I personally would use a laptop, because it has a keyboard and is less fragile. The ipad is handy to carry around everywhere or search Internet or whatever. Well iPad is a Mac product which means, you will need to buy software for it and they're quite expensive. While Laptops mostly run Windows. An iPod has no keyboard, no optical drive, very limited storage space and is tied to ONE software and ap vendor. You can do a million more things on a laptop versus an ipad, Final cut pro, photoshop. The ipad can only run apps from apple's app store and you can't view flash video on the ipad. laptops can do anything that a regular computer can do. An iPod is smaller, can't do as much as a laptop can and can't get as many sites on the web on an ipad as you would do with a laptop.

4.0 Conclusion

Computers are classified based on three major criteria namely size, type of data they represent, and purpose. The classification adopted at any point in time depends on the issues involved. For instance, if our goal is to process different kinds of data or to accept one type of signal and convert to another form of signal, we should look in the realm of analog or digital or even the hybrid computers. This of course, calls for a converter such as Analog to Digital Converter in line with the Digital age.

5.0 Summary

In this unit we have been able to understand the following:

a. Computers could be classified based on three major criteria: size, type of data they represent and purpose.
b. Based on size computers are classified as supercomputer, mainframe, mini-computer and microcomputer.
c. Based on the type of data they represent, computers are classified as analog, digital and hybrid.
d. Based on purpose, computers are classified as general purpose and special purpose computers.

e. Microcomputers now come in different forms due to the continued reduction in size and advances in electronic technology. Microcomputers could be desktop, laptop, tablet laptop, palmtop and ipad.

6.0 Tutor-Marked Assignment

Describe any five microcomputers you know

Explain the characteristics of a Tablet Laptop over ordinary laptop

7.0 REFERENCES AND FURTHER READING

More recent editions of these books are recommended for further reading.

Bradley, R. (1995). Understanding Computer Science for Advanced Level. 3rd Ed. London: Stanley Thornes.

Capron, H.L. (1998). Computers: Tools for an Information Age. 5th Ed. Reading: Addison-Wesley.

Doyle, S.(2003). ICT for You. London: Edexcel.

French, C.S. (1998). Computer Science. 5th Ed. London. Letts Educational Aldine Place.

Gusen, J.N. Computer Made Easy. Jos. University Press.

Gusen, J.N. Ramson, E.N. and Ugwuanyi, F.O.(2009). Introduction to Computer Studies. In Gusen, J.N. et al (Eds.). Introduction to Computer Studies. Pankshin: Aureka Academic Foundation, FCE Pankshin

Gusen, J.N. (2014). 2523 questions and Answers on ICT. Jos: Deka Enterprises.

Heathcote, P.M. (2000). "AS" Level ICT. Great Britain. W.M West Midland.

Mangal, S.K. and Mangal, U.(2009). Essentials of Educational Technology. New Delhi. PHI Learning. International.

Parker, C.S. (1992). Understanding Computers and Information Processing Today and Tomorrow 4th Ed. New York. The Dryden Press.

Radlow, J. (1986). Computers and the Information Society. New York. McGraw-Hill Book.

Ram, B. (2008). Computer Fundamentals: Architecture and Organization, 4th Ed. New Delhi. New Age International Publishers.

Sharp, V. (1996). Computer Education for Teachers. Boston: McGraw Hill.

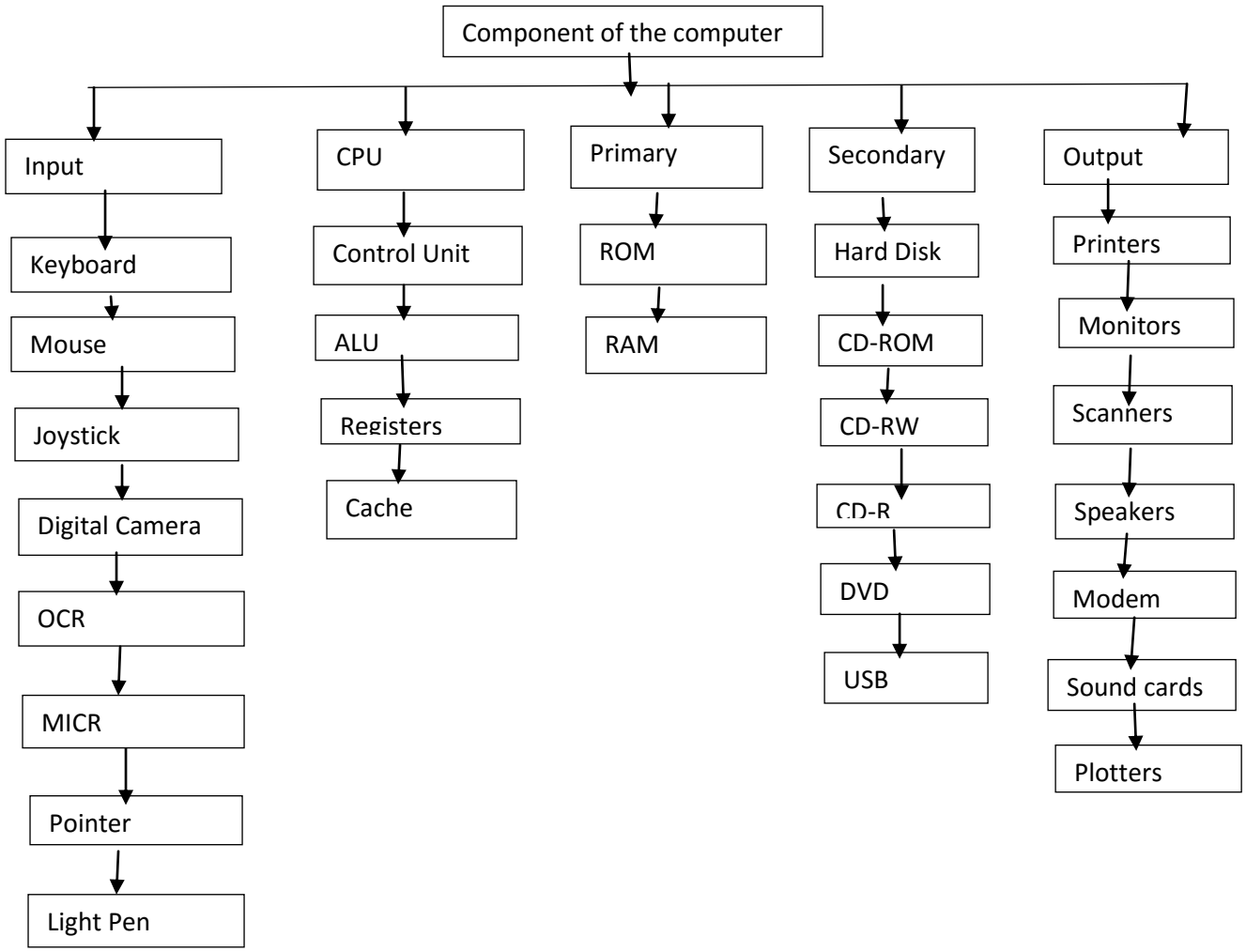
Turban, E., Rainer, R., Potter, R.E., (2007). Introduction to Information Technology, 2nd Ed. New Delhi. Wiley Indian Edition.

In addition to the above books, you can browse on the Internet to get additional materials on the topics covered in this course.

MODULE 2: COMPUTER HARDWARE
UNIT 1: HARDWARE COMPONENTS
Content

1.0 Introduction

Components of the computer are variously, called: parts of the computers, system unit, and anatomy of the computer that made up the computer. The five components of the computer consist of the input, CPU, primary, secondary and output units as indicated in Table4.



2.0 The objectives

At the end of this unit, you should be able to:

a. Make students aware of the five components of the computer
b. Enable students to appreciate the importance of each of the components to overall smooth operations of the computer
c. Familiarize students with the function of each of the components of the computer as illustrated in Fig…. below

3.0 The Input devices

3.1 Input devices and their functions

An input device is any device that provides input to a computer. Input devices such as cameras, scanners, keyboard and mouse are used to input information into a computer system. Obviously a **keyboard** and **mouse** are the main input devices used to control a computer system to type information and control the cursor on screen. There are many input devices, but the two most common ones are a keyboard and the mouse. Every key you press on the keyboard and every movement or click you make with the mouse sends a specific input signal to the computer. These input devices are also known as peripherals since they surround the CPU and memory of a computer system. The input devices are grouped into four, namely:

a. Text input devices
b. Pointing devices
c. Gaming devices
d. Image, video input devices
e. Audio input devices

Input Devices.

The following are devices that give instruction to compute or to enter data as indicated in Fig.21

Fig. 21: Keyboard for typing alphabets

Fig.22: Scanner for transfer of data from piece of paper

Microphone for recording io voice

Laptop for typing and editing documents

Digital camera use to take memory

Joystick for controlling game on the screen

Trackball use to enter motion data into computers

CD-ROM for writing and reading data

Fig. 23: Input Devices

3.1 Text Input devices

The text input devices include the keyboard. The Keyboard is a device to input text and characters by depressing buttons (referred to as keys), similar to a typewriter. Keyboard is the most common input device of a Computer System. Modern Keyboards have more than just the letter and numeric keys. They have multimedia keys for volume control, Play / Pause videos etc. Every single key on a keyboard is assigned a binary numbers to it which transmits that binary pattern to the computer. Now, have you ever wondered why the keys on a keyboard are not in alphabetic order? The keys are laid out in the QWERTY order so that those key that are often struck in succession were not next to each other. Therefore, the QWERTY layout is intended for slow typists. While for speed typing there is another keyboard available with "Dvorak" layout. Same is the case with the numeric keys layout. If you have noticed, the layout of a Phone is different from that of a numeric key on a Keyboard. This is because earlier phones cannot handle fast dialers. However, the layout of numeric keys on a keyboard is designed for speed typing. Keyboard is the most common and very popular input device which helps in inputting data to the computer. Each button on a concept keyboard relates to a particular item or function. Buttons can be labeled with text or a picture. Fast food restaurants often use concept keyboards because very little training is needed to operate them and they are efficient. A single button can order an entire meal. Keyboards are of two sizes 84 keys or 101/102 keys, but now keyboards with 104 keys or 108 keys are also available for Windows and Internet.

The below illustrated are the different types of keyboard namely: standard keyboard, Ergonomics Keyboard, Wireless Keyboard, Compact keyboards, Internet keyboard, multimedia keyboard, Virtual keyboards, gaming keyboard:

a. **Standard Keyboard.** The average number of keys on a regular keyboard is 105. Some older versions may have keys in the range of 95-103. QWERTY keyboards are the most common and have the six alphabets Q, W, E, R, T, and Y in the first row, while letters in AZERTY keyboards are replaced with A, Z, E, R, T, and Y in the first row(Different *Types* of *Keyboards* - Buzzle,2013)

Fig.24 Source: www.buzzle.com/articles/different-**types**-of-**keyboards**.html

b. Ergonomics refers to the study of methods that can reduce stress on muscles to avoid repetitive strain injury. Ergonomic computer keyboards are a computer keyboard

designed with ergonomic considerations to minimize muscle strain and a host of related problems. An ergonomic keyboard is designed to make typing easier and lessen the strain that your hands may suffer, such as *"Carpal Tunnel Syndrome(CTS)*

*Fig.25Source: www.buzzle.com/articles/different-**types**-of-**keyboards**.html*

c. Wireless Keyboards. As the name suggests, these keyboards do not need to be connected to the computer using wire. This makes it very convenient for the user to use the keyboard comfortably. Wireless keyboards use three basic types of connections: Bluetooth, Infrared (IR), and Radio Frequency to connect to the computer

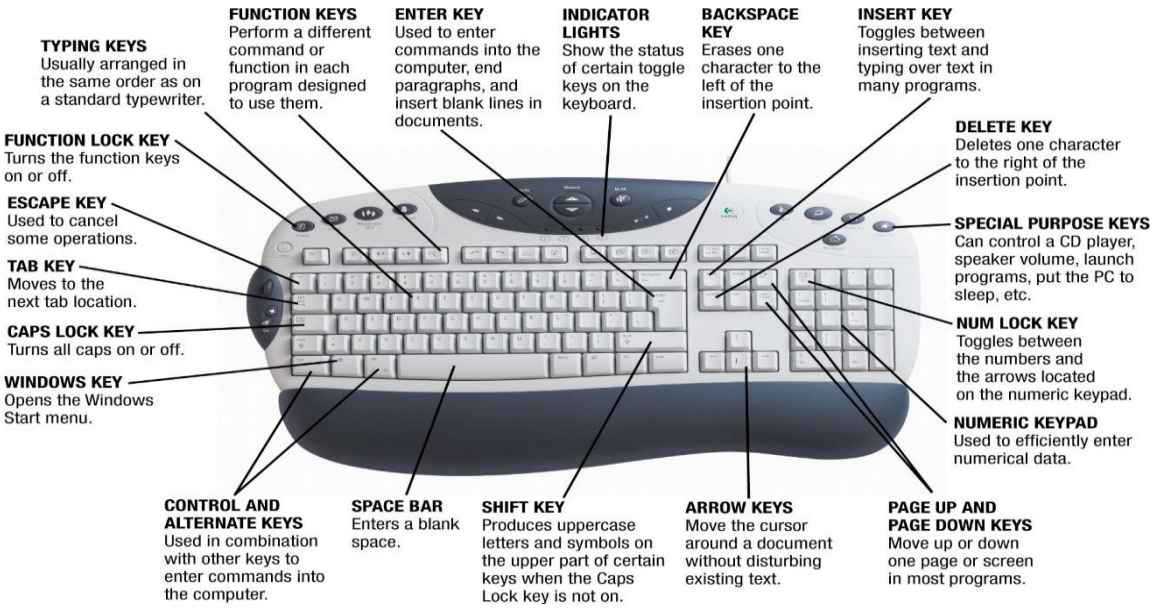


*Fig. 26Source: www.buzzle.com/articles/different-**types**-of-**keyboards**.html*

Compact keyboards are slim and usually do not have the numeric keypad that is present on the right side of other keyboards as indicated in Figure 5.5. These are typically used in

laptops, where sizing issues make it difficult to accommodate a standard keyboard. To make up for the small size, these keyboards rely on the use of multiple keys to carry out functions that would only use a single key on a standard-sized keyboard. Some models also include a touch-pad that can be used instead of the mouse. These types of keyboard offer portability during travel and storage. Another benefit of compact keyboards is that they can be used by people with certain disabilities that hinder them from effectively using hand and finger movements (Different *Types* of *Keyboards* - Buzzle,2013).

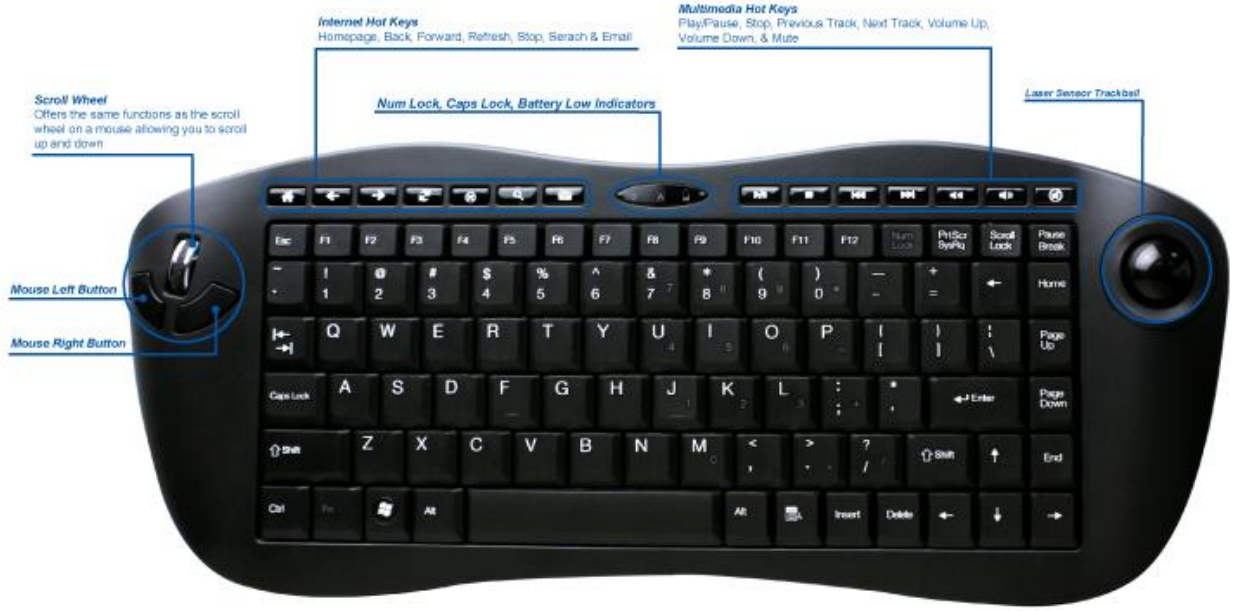


*Fig. 27Source: www.buzzle.com/articles/different-**types**-of-**keyboards**.html*

Internet Keyboards

The Internet is one of the main reasons why a majority of the people use computers these days. Internet keyboards have special keys, called hot keys, which perform functions related to Internet usage. Typical hot keys have functions like back, forward, bookmarks list, e-mail inbox, Google search, YouTube, shopping online, (Different *Types* of *Keyboards* - Buzzle,2013).

*Fig. 28Source: www.buzzle.com/articles/different-**types**-of-**keyboards**.html*

Multimedia Keyboard

The multimedia keyboard is specially designed for people who are much into multimedia designing. This keyboard is just like the standard key board, but composed of additional keys for the multimedia purposes such as multimedia application launch, volume control and mute button (Different *Types* of *Keyboards* - Buzzle (2013).

*Fig. 29Source: www.buzzle.com/articles/different-**types**-of-**keyboards**.html*

Virtual Keyboards

Virtual keyboards are software devices that let you input data just like a hardware keyboard. They open up as an application and can be controlled by a mouse or using a touch screen (Different *Types* of *Keyboards* - Buzzle (2013). They are mainly used in devices which do not necessarily require a keyboard, like a tablet or a smart-phone. They are useful as they aid in making the size of the device smaller. Virtual keyboards are also used in situations concerning security, as anything entered on an ordinary keyboard is recorded in a key log, leading to security risks associated with passwords or PIN numbers(Different *Types* of *Keyboards* - Buzzle2013).

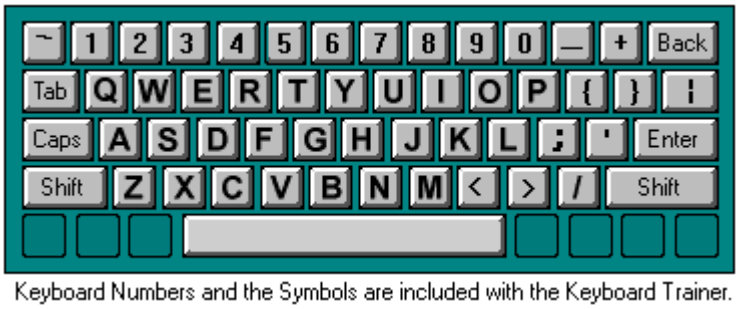


*Fig. 30Source: www.buzzle.com/articles/different-**types**-of-**keyboards**.html*

Gaming Keyboards

As the name suggests, gaming keyboards are designed specifically for gamers. They include features meant to enhance gaming experience, as well as provide convenient usage for gamers. They include features like volume control, key lighting, programmable keys, interchangeable keys, touch screens to customize the keyboard, in-built joysticks, fancy lighting, etc. Gaming keyboards come in all shapes and sizes, ranging from round keyboards to v-shaped ones, but this is mainly done as a marketing gimmick to attract gamers. Many gaming keyboards are designed for specific types of games.

*Fig. 31Source: www.buzzle.com/articles/different-**types**-of-**keyboards**.html*

Parts of a keyboard

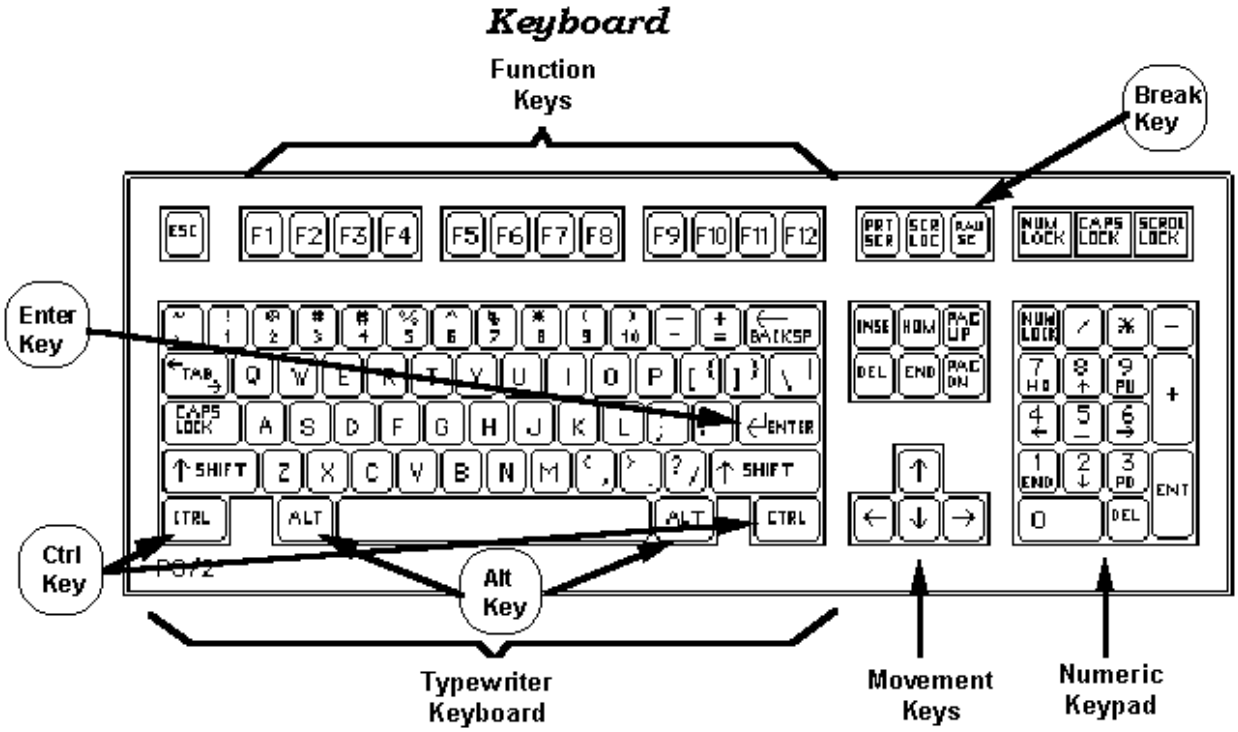


*Fig. 32Source: readanddigest.com/different-**types-of-computer-keyboards***

The intelligent computer keyboard has four major divisions, namely: Function keys, Alphanumeric keys, Numeric keys and Control keys.
In addition to the four types of keys, there are some special or important keys such as the following:
(a) Return or Enter key
(b) Escape key denoted by ESC
(c) Control key denoted by CTRL
(d) Alternate key denoted by ALT
(e) Delete key denoted by DEL
(f) Insert key denoted by INS
(g) Backspace key
(h) Shift key.

Self-Assessment Exercise

a. List and explain the use of five input unit of the computer
b. List and explain any three types of keyboard

Function Keys

1. How to use the Function Keyboard

Function Keyboard according to **What are the F1 through F12 keys? - Computer Hope (n.d.).** are keys which start with F1 through F12 which may have a variety of different uses or no use at all. This is depending on the installed operating system and the software program currently open will change how each of these keys operate. You may have even been afraid to touch them for fear of what they might do. Function keys can be programmed to perform special tasks. If you are using a Windows PC, they are probably pre-programmed for you. Learn how this special row of keys can make your life a little easier. A program is capable of not only using each of the function keys, but also combining the function keys with the ALT or CTRL key, for example, Microsoft Windows teachers can effectively press ALT + F4 to close the program currently active and other functions using the correction figure position as mentioned in Figure 33 below:

Fig. 33: Function Keyboard

1. **Use of F1**: It is almost always used as the help key, almost every program will open the help screen when this key is pressed. Teachers can use it for Enter CMOS Setup. You can use Windows Key + F1 to open the Microsoft Windows help and support center. They can equally use it to Open the Task Pane.
2. **Use of F2**: It is use in Windows to renames a highlighted icon, file, or folder in all versions of Windows. Teachers can use Alt + Ctrl + F2 to opens document window in Microsoft Word. Teachers can also use Ctrl + F2 to display the print preview window in Microsoft Word. They can well use it to quickly rename a selected file or folder. Teachers can as well use it to Enter CMOS Setup.
3. **Use of F3**: Often opens a search feature for many programs including Microsoft Windows when at the Windows Desktop. Teachers can use it MS-DOS or Windows command line F3 will repeat the last command. They can use Shift + F3 to change the text in Microsoft Word from upper to lower case or a capital letter at the beginning of every word. They can use Windows Key + F3 to open the Advanced find window in Microsoft Outlook. They can equally use it to Open Mission Control on an Apple computer running Mac OS X.
4. **Use of F4**: Open find window in Windows 95 to XP. Teachers can use it to Open the address bar in Windows Explorer and Internet Explorer. They can also use it to repeat the last action performed (Word 2000+).
5. **Use of Alt + F4**. Teachers use it to close the program window currently active in Microsoft Windows. Teachers can use Ctrl + F4 to close the open window within the current active window in Microsoft Windows.
6. **Use of F5**: In all modern Internet browsers pressing F5 will refresh or reload the page or document window. Teachers can use it to open the find, replace, and go to window in Microsoft Word. They can use it to starts a slideshow in PowerPoint.

7. **Use of F6**: Move the cursor to the Address bar in Internet Explorer, Mozilla Firefox, and most other Internet browsers. Teachers can use Ctrl + Shift + F6 to open to another open Microsoft Word document.
8. **Use of F7**: Commonly used to spell check and grammar check a document in Microsoft programs such as Microsoft Word, Outlook, etc. Teachers can use Shift + F7 to run a Thesaurus check on the word highlighted. They can use it to Turns on Caret browsing in Mozilla Firefox.
9. **Use of F8**: Function key is used to enter the Windows startup menu, as well as to access Windows Safe Mode.
10. **Use of F9**: Opens the Measurements toolbar in Quark 5.0.Teachers can use it with Mac OS 10.3 or later to show all open Windows. They can use the Fn key and F9 at the same time to open Mission Control on an Apple computer running Mac OS X.
11. **Use of F10**: In Microsoft Windows activates the menu bar of an open application. The use of Shift + F10 is the same as right-clicking on a highlighted icon, file, or Internet link. Teachers can use it to access the hidden recovery partition on HP and Sony computers. They can also use it to enter CMOS Setup. They can as well use it with Mac OS 10.3 or later to show all open Windows for active program.
12. **Use of F11**: Full-screen mode in all modern Internet browsers. Teachers can use the Ctrl + F11 as computer is starting to access the hidden recovery partition on many Dell computers. They can also use it to access the hidden recovery partition on eMachines, Gateway, and Lenovo computers. They can use it with Mac OS 10.4 or later hides all open windows and shows the Desktop.
13. **Use of F12**: Open the Save as window in Microsoft Word. Teachers can use it to Shift + F12 to save the Microsoft Word document. They can also use Ctrl + Shift + F12 to prints a document in Microsoft Word. They can equally use it to preview a page in Microsoft Expression Web. Teachers can use it to Open Firebug**.** Teachers may find it useful with an Apple running Mac OS 10.4 or later F12 to show or hides the Dashboard.
14. **Use of F13-F24**: Early IBM computers also had keyboards with F13 through F24 keys. However, because these keyboards are no longer used they are not listed on this page.

Steps in using a Computer Keyboard

How To Use A Computer Keyboard | Step-By-Step Guide

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How to use a computer keyboard

Whenever you use a computer, you'll probably use a keyboard. The most common kind is referred to as a 'QWERTY' keyboard after the keys on the top row of letters. It was invented by C L Scholes in the 1860s when he was working out the best place to put the keys on a manual typewriter.**Follow these step-by-step instructions to help you get to know what your keyboard can do, s**o that you can carry out the simple exercises below, you'll need a document open to type into the following steps.

Step 1: Have a good look at your keyboard. The most important keys are labeled on the diagram above: Some keyboards, especially those on laptops, will have a slightly different layout. For example, yours might not have a number pad or the delete key may be in a different place. But virtually all keyboards will have these important keys somewhere.

Step 2: The main keys are the letter keys. When you type just using these, you get lower-case print. However, if you hold down a 'shift key' (there are two to choose from) at the same time as you type, you'll get UPPER-CASE letters. Try typing your name, including capitals

(UPPER-CASE) and spaces. The 'space bar' (which you press briefly to make a space) is the wide key at the bottom of the keyboard.

Step 3: If you make a mistake in your typing, there's always a remedy. To delete a letter, place your cursor (mouse pointer) just after the letter and click. Then press **Backspace** briefly. (Always press briefly – otherwise, you'll get repeated deletions, spaces, letters or whatever.) Or place your cursor just before the letter, click and press **Delete**.

Step 4: Now type this sentence: The quick brown fox jumped over the lazy dog.

This is a good sentence to practice because it contains most of the letters of the alphabet.

Step 5: You can move the cursor along this sentence without deleting anything by using the arrow keys:

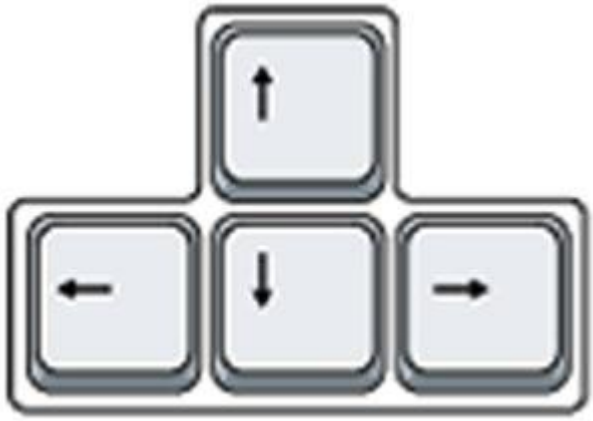


Fig. 34: Arrow key

Try moving the cursor backwards and forwards through your sentence.

Step 6: Now try using the number pad, if you have one. To use this to type numbers, you have to press the **Num Lock** key. There may be an indicator light at the top of the keyboard or on the 'Num Lock' key itself to show that it's on.

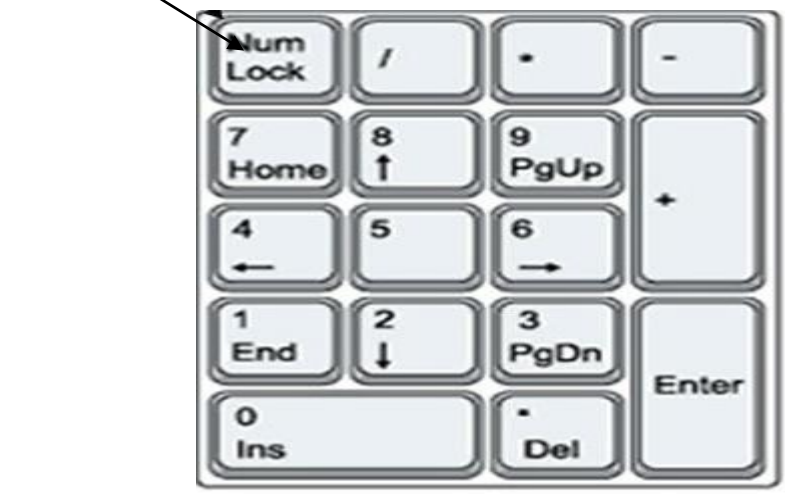


Fig. 35: Number Lock Key

Step 7: You can also type using the numbers on the main keyboard. You'll find them on the row of keys above the top line of letters. Above these numbers are various symbols, which include '£', '&', '!'. To use these, hold down the **Shift** key while you type. So if you press '7′ on its own, you get '7′, but if you press '7′ while you hold down the 'Shift' key, you get '&'.Try typing: Last night I won a laptop on life skills. You will find similar extra symbols elsewhere on the keyboard:

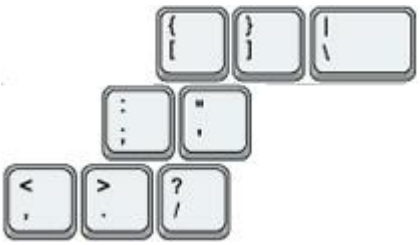


Fig.36: Caps Lock Key

They operate in exactly the same way as the ones above the numbers.

Step 8: If you want everything to appear in upper case, press the **Caps Lock** key and then type:

I CAN TYPE IN CAPITAL LETTERS

Again, an indicator light may come on to show that your capitals are 'locked'. Don't forget to press this key again when you're finished to turn 'Caps Lock' off.

Fig. 37: Windows Key

Step 9: The 'Windows' key comes in a number of different designs, such as the example to the right. It does exactly the same thing as the Windows button on the taskbar on your computer screen. You can choose to open the 'Start' menu by pressing this key or by clicking the button on the taskbar with your mouse.

Step 10: There are a number of ways that you can move round a web page. Try using the keys below to see where they take you:

Fig. 38: Taskbar/movement key

Step 10: You will be told to use the 'Control' (Ctrl) and 'Alternate' (Alt) keys for some operations. When you do so, keep holding down one or the other key or both keys while you press any other keys.

Fig. 39: Control+Alternate keys

For example, if you press **Ctrl**, **Alt** and **Delete** all at the same time, a menu will open. To make it disappear, press the 'Escape' (**Esc**) key in the top left-hand corner of the keyboard.

Fig. 40: Escape key

Step 11: Some of the things that you use the mouse for can be done with keyboard shortcuts. These require you to hold down one key while pressing another, and often involve using the 'Ctrl' and/or 'Alt' keys. Some people prefer using them to using the mouse. There are many shortcuts – check out the list provided by Microsoft Support.
The effects of the functions keys are software package dependent. That is, they mean different translations depending on which software package one is running on the computer. The function keys are traditionally labeled F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11 and F12. The function keys are often arranged to the left of the main keyboard in two columns or they are arranged in a row above the main keyboard. In most software packages, the function key F1 is used to run the HELP program. Word perfect, for example, uses F3 for HELP program and F1 to cancel the last command issued on the computer. The function keys F7 and F12 are used to save a text and block a section of a text respectively in word perfect. Function keys can be programmed to carry out the functions desired by a programmer. For example the function keys F10 may be programmed to display menus. Thus, the operations of the function keys can be determined by the user or programmed by the software package being used at any point in time.

Alphanumeric Keys
The Alphanumeric keys can be likened with the conventional typewriter keys. They contain alphabetic characters, numeric characters and special characters such as comma, full stop, open bracket, close bracket, asterisk, semicolon, colon, question mark, and so on. Usually, each key carries a character at the lower part and another character at the upper part. The SHIFT key is used to switch on or off the lower and upper characters by the programmer.

Cursor Control Keys
The cursor marks the active or current spot on the screen. It is an indicator that tells the user where in the midst of a document the system is pointing to. It may be a rectangular bar of light or a blinking underscore. When a text is being typed, the cursor moves as the carriage on a keyboard moves and character are typed in. The cursor control keys include four directional arrow keys.

Control Key Functions
The steps are as follows:

- Moves the cursor one line up.
- Moves the cursor one line down
- Moves the cursor one character to the right
- Move the cursor one character to the left.
- HOME Moves the cursor to the beginning of a line or page
- END

- Move the cursor to the bottom left of a page or to the end of the current line in most text editors
- PGDN. Moves the cursor to the top of the next page in the document or text. For example, pressing this key while on page 5 of the text will place the cursor at the top of the page 6 of the text.
- PGUP Moves the cursor to the top of the previous page. For example, if you are on page 3 of a document, pressing this key will place the cursor at the top of page 2 of the document. Other cursor control keys are HOME, PAGE UP, PAGE DOWN, and END. These keys may be part of the numeric keypad or separated from the numeric keypad. Moving the cursor around on the screen is one of the most common tasks in an application program. In fact, cursor movement is so important in an application such as word processing that it can usually be accomplished by additional key-driven commands. The control keys and their functions are documented in Table the above table.

Numeric Keypad
The numeric keypad contains a set of keys required for typing or entering number digits 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9 into the computer store. A numeric key is often activated by pressing the Num lock Key. The numeric keypad is also used in combination with Alternate (Alt) key to produced extended characters. Extended characters are characters not normally found on most keyboard. For example, to produced the character alpha data denoted '□', one holds down the Alt key and press 224; to produce character beta denoted by '□', one holds down the Alt key and press 255 and to produce pound sterling denoted by '£', one holds down the Alt key and press 156.

Shift Key
When the Shift key is pressed, the capital letters on the alphanumeric keys are activated. It also serves as the activator of characters that are at the upper part of each alphanumeric key. The Shift key has no effects on itself; its effect are realized when some other keys are pressed. Thus, if one presses the shift key and then 'equal' sign key, the 'plus' sign which is at the upper part of the 'equal' sign is activated and then it appears on the screen.

CapLock Key
The Cap Lock Shifts all alphabetic characters into upper case (capital letters). Thus all characters typed are in lower case (small letters) when not pressed.

Alternate Key (Alt)
The Alternate key can be used in combination with numeric keys to generate characters not shown on the keyboard, that is, extended characters. For example, holding the Alt key down and pressing 228 produces the summation (□) sign; holding the Alt key down and pressing 235 produce □□sign. To restart or reboot your computer, press Alt, Ctrl and Del keys simultaneously.

Num Lock Key
The Num lock key activates the numeric keypad. Neither Num Lock nor Cap Lock affects the function keys.

Control Key (Ctrl)
The Control key is often used in most text mode to perform block operations like mass deletion, insertion and so on. For example, CTRL + Y delete a line in most text documents. It

can also be used in combination with other keys to move the cursor to different locations in a text or document. In some application packages, the Alt, Ctrl and Shift key are used in combination with the function keys to perform several operations. For example, in Word Perfect word processing package, to centre a text; press Shift and F6; to print a text, press Shift and F7.

Escape Key (Esc)

The Escape key cancels an operation in progress. For example, when one is editing a file or issuing a command, ESC cancels any changes one might have made or terminates the command.

Return or Enter Key

The Return key serves as one of the most important keys on most keyboards. It is actually used to inform the computer the end of an input or command. It performs two functions depending on the program with which it is used. For example, suppose you are asked to respond to an operating system command at the prompt or other entries, the operating system will wait until the return key is pressed before continuing. Pressing the return key also positions the cursor at the beginning of the next line (in text mode), which is the equivalent of pressing the carriage return on a typewriter.

Insert Key (Ins)

Pressing the Insert key puts ones keyboard in insert mode, pressing it again returns to overstrike (type over) mode. In insert mode, the characters one types are inserted at the cursor position, the character at the cursor position and all characters to the right, shift to make room for them. In overstrike or type over mode, newly typed characters overwrite the characters at the current cursor position. In most application software insert mode is indicated by a symbol in the status line.

Delete Key (Del)

The delete key deletes the character at the cursor position when pressed and the remaining text moves to the left while the cursor remains at the same position.

Back Space Key

The Back Space Key deletes the characters to the left of the cursor when pressed and all other characters to the right of the cursor are shifted one space to the left.

Spacebar

The Spacebar is the longest key found on most keyboards. It erases characters at the cursor position or gives blank space when pressed.

Tab Key

The Tab Key moves the cursor by five spaces to the right when pressed. The number of positions moved depends on the software or the Tab Set by the operator. The Tab is normally pressed to insert paragraphs during typing. In some programs, when this key is pressed in combination with shift key, the same number of positions is moved backwards.

Print Screen Key (Prtsc)

When the Print Screen key is pressed in combination with the Shift Key, whatever in is the screen will be printed on a printer. The same effect can be achieved by pressing the key alone on some keyboards.

Keeping Your Keyboard Clean and Working

Never spill liquids on your keyboard. Coffee, soda, and other beverage spills can ruin your keyboard. Liquid spills on the keyboard have even been known to cause electrical damage to the PC itself. With that in mind, though you may not stop drinking coffee around your computer, you should at least get a spill-proof mug or keep the coffee on the other side of the desk. Another enemy of keyboards is static electricity. Static electricity can have the same damaging effect on your keyboard as does liquid. If your keyboard doesn't respond properly after a strong static charge, you may just need to turn off the PC and turn it back on to reset the keyboard. In some cases, however, the static discharge can zap the keyboard and even parts of the PC. If you shuffle your feet across carpet or your PC is in a room with dry air, avoid touching the PC or the keyboard until you have touched something metal to discharge any static. If you don't have a metal desk or bookcase in your work area, consider buying an anti-static mat and keeping it where you can touch it before touching the PC. Dust, dirt, food crumbs, and hair are other enemies of keyboards. Try to avoid eating over the keyboard and if your computer is in a dirty, dusty area, keep the keyboard covered when not in use. Some dirt and dust is unavoidable. To keep the keyboard working well, you should occasionally clean it.

The summary of the layout of the computer keyboard is as indicated in Table 5:

S/N	Keys	Description
1	Typing Keys	These keys include the letter keys (A-Z) and digit keys (0-9) which generally give same layout as that of typewriters also known as QWERTY key.
2	Numeric Keypad	It is used to enter numeric data or cursor movement. Generally, it consists of a set of 17 keys that are laid out in the same configuration used by most adding machines and calculators.
3	Function Keys	The twelve function keys are present on the keyboard which are arranged in a row at the top of the keyboard. Each function key has unique meaning and is used for some specific purpose
4	Control Keys	These keys provide cursor and screen control. It includes four directional arrow keys. Control keys also include Home, End, Insert, Delete, Page Up, Page Down, Control(Ctrl), Alternate(Alt), Escape(Esc).
5	Special Purpose Keys	Keyboard also contains some special purpose keys such as Enter, Shift, Caps Lock, Num Lock, Space bar, Tab, and Print Screen.

2013 Keyboard Shortcut as indicated in Table 6

BASIC SHORTCUT KEYS	
Alt + F	File menu options in current program
Alt + E	Edit options in current program
F1	Universal help (for all programs)
Ctrl + A	Select all text
Ctrl + X	Cut selected item
Shift + Del	Cut selected item
Ctrl + C	Copy selected item
Ctrl + Ins	Copy selected item
Ctrl + V	Paste
Shift + Ins	Paste
Home	Go to beginning of current line
Ctrl + Home	Go to beginning of document
End	Go to end of current line
Ctrl + End	Go to end of document
Shift + Home	Highlight from current position to beginning of line
Shift + End	Highlight from current position to end of line
Ctrl + ←	Move one word to the left at a time
Ctrl + →	Move one word to the right at a time

MICROSOFT® WINDOWS® SHORTCUT KEYS	
Alt + Tab	Switch between open applications
Alt + Shift + Tab	Switch backwards between open applications
Alt + Print Screen	Create screen shot for current program
Ctrl + Alt + Del	Reboot/Windows® task manager
Ctrl + Esc	Bring up start menu
Alt + Esc	Switch between applications on taskbar
F2	Rename selected icon
F3	Start find from desktop
F4	Open the drive selection when browsing
F5	Refresh contents
Alt + F4	Close current open program
Ctrl + F4	Close window in program
Ctrl + Plus Key	Automatically adjust widths of all columns in Windows Explorer
Alt + Enter	Open properties window of selected icon or program
Shift + F10	Simulate right-click on selected item
Shift + Del	Delete programs/files permanently
Holding Shift During Bootup	Boot safe mode or bypass system files
Holding Shift During Bootup	When putting in an audio CD, will prevent CD Player from playing

WINKEY SHORTCUTS	
WINKEY + D	Bring desktop to the top of other windows
WINKEY + M	Minimize all windows
WINKEY + SHIFT + M	Undo the minimize done by WINKEY + M and WINKEY + D
WINKEY + E	Open Microsoft Explorer
WINKEY + Tab	Cycle through open programs on taskbar
WINKEY + F	Display the Windows® Search/Find feature
WINKEY + CTRL + F	Display the search for computers window
WINKEY + F1	Display the Microsoft® Windows® help
WINKEY + R	Open the run window
WINKEY + Pause /Break	Open the system properties window
WINKEY + U	Open utility manager
WINKEY + L	Lock the computer (Windows XP® & later)

WORD® SHORTCUT KEYS	
Ctrl + A	Select all contents of the page
Ctrl + B	Bold highlighted selection
Ctrl + C	Copy selected text
Ctrl + X	Cut selected text
Ctrl + N	Open new/blank document
Ctrl + O	Open options
Ctrl + P	Open the print window
Ctrl + F	Open find box
Ctrl + I	Italicize highlighted selection
Ctrl + K	Insert link
Ctrl + U	Underline highlighted selection
Ctrl + V	Paste
Ctrl + Y	Redo the last action performed
Ctrl + Z	Undo last action
Ctrl + G	Find and replace options
Ctrl + H	Find and replace options
Ctrl + J	Justify paragraph alignment
Ctrl + L	Align selected text or line to the left
Ctrl + Q	Align selected paragraph to the left
Ctrl + E	Align selected text or line to the center
Ctrl + R	Align selected text or line to the right
Ctrl + M	Indent the paragraph
Ctrl + T	Hanging indent
Ctrl + D	Font options
Ctrl + Shift + F	Change the font
Ctrl + Shift + >	Increase selected font +1
Ctrl +]	Increase selected font +1
Ctrl + Shift + <	Decrease selected font -1
Ctrl + [	Decrease selected font -1
Ctrl + Shift + *	View or hide non printing characters
Ctrl + ←	Move one word to the left
Ctrl + →	Move one word to the right
Ctrl + ↑	Move to beginning of the line or paragraph
Ctrl + ↓	Move to the end of the paragraph
Ctrl + Del	Delete word to right of cursor
Ctrl + Backspace	Delete word to left of cursor
Ctrl + End	Move cursor to end of document
Ctrl + Home	Move cursor to beginning of document
Ctrl + Space	Reset highlighted text to default font
Ctrl + 1	Single-space lines
Ctrl + 2	Double-space lines
Ctrl + 5	1.5-line spacing
Ctrl + Alt + 1	Change text to heading 1
Ctrl + Alt + 2	Change text to heading 2
Ctrl + Alt + 3	Change text to heading 3
F1	Open help
Shift + F3	Change case of selected text
Shift + Insert	Paste
F4	Repeat last action performed (Word 2000+)
F7	Spell check selected text and/or document
Shift + F7	Activate the thesaurus
F12	Save as
Ctrl + S	Save
Shift + F12	Save
Alt + Shift + D	Insert the current date
Alt + Shift + T	Insert the current time
Ctrl + W	Close document

EXCEL® SHORTCUT KEYS	
F2	Edit the selected cell
F5	Go to a specific cell
F7	Spell check selected text and/or document
F11	Create chart
Ctrl + Shift + ;	Enter the current time
Ctrl + ;	Enter the current date
Alt + Shift + F1	Insert new worksheet
Shift + F3	Open the Excel® formula window
Shift + F5	Bring up search box
Ctrl + A	Select all contents of worksheet
Ctrl + B	Bold highlighted selection
Ctrl + I	Italicize highlighted selection
Ctrl + C	Copy selected text
Ctrl + V	Paste
Ctrl + D	Fill
Ctrl + K	Insert link
Ctrl + F	Open find and replace options
Ctrl + G	Open go-to options
Ctrl + H	Open find and replace options
Ctrl + U	Underline highlighted selection
Ctrl + Y	Underline selected text
Ctrl + 5	Strikethrough highlighted selection
Ctrl + O	Open options
Ctrl + N	Open new document
Ctrl + P	Open print dialog box
Ctrl + S	Save
Ctrl + Z	Undo last action
Ctrl + F9	Minimize current window
Ctrl + F10	Maximize currently selected window
Ctrl + F6	Switch between open workbooks/windows
Ctrl + Page up & Page Down	Move between Excel® worksheets in the same document
Ctrl + Tab	Move between two or more open Excel® files
Alt + =	Create formula to sum all of above cells
Ctrl + '	Insert value of above cell into current cell
Ctrl + Shift + !	Format number in comma format
Ctrl + Shift + $	Format number in currency format
Ctrl + Shift + #	Format number in date format
Ctrl + Shift + %	Format number in percentage format
Ctrl + Shift + ^	Format number in scientific format
Ctrl + Shift + @	Format number in time format
Ctrl + →	Move to next section of text
Ctrl + Space	Select entire column
Shift + Space	Select entire row
Ctrl + W	Close document

OUTLOOK® SHORTCUT KEYS	
Alt + S	Send the email
Ctrl + C	Copy selected text
Ctrl + X	Cut selected text
Ctrl + P	Open print dialog box
Ctrl + K	Complete name/email typed in address bar
Ctrl + B	Bold highlighted selection
Ctrl + I	Italicize highlighted selection
Ctrl + U	Underline highlighted selection
Ctrl + R	Reply to an email
Ctrl + F	Forward an email
Ctrl + N	Create a new email
Ctrl + Shift + A	Create a new appointment to your calendar
Ctrl + Shift + O	Open the outbox
Ctrl + Shift + I	Open the inbox
Ctrl + Shift + K	Add a new task
Ctrl + Shift + C	Create a new contact
Ctrl + Shift+ J	Create a new journal entry

Pointing devices.

The point devices include the mouse and the trackball. The Mouse is one of the devices that detect two dimensional motions relative to its supporting surface. The mouse cursor seen on the screen of the computer moves along with the mouse. The cursor can be used to select menu commands and areas, as well as activating different objects by clicking the mouse keys. The mouse is an input device used as a means of access and navigation around the operating system of a computer. The recent type of mouse used is the optical mouse, which unlike the previous mouse models uses a laser to track where the user wants to go. The mouse is mainly used as a means to point and click icons, menus, and command buttons on a graphical interface. It is also used (as mentioned above), as a means of navigating through the operating system on a computer. Most mouse, if not all are compatible with every computer system, it all depends on the drivers that need to be installed, as this helps the computer to recognize the Mouse. This goes for all input devices. Mouse is most popular pointing device. It is a very famous cursor-control device having a small palm size box with a round ball at its base which senses the movement of mouse and sends corresponding signals to CPU when the mouse buttons are pressed. Generally it has two buttons called left and right button and a wheel is present between the buttons. Mouse can be used to control the position of cursor on screen, but it cannot be used to enter text into the computer. A mouse is a device that rolled about on a desktop to direct a pointer on the computer screen. It controls a pointer that is displayed on the monitor. It usually appears in the shape of an arrow. The most common basic design types of mouse are:

The Mouse can fall into the following:

a. **Mechanical mouse**. It has a ball on the bottom and is attached with a cord to the system unit. It is usually referred to as the traditional type, but currently widely used. As you move the mouse across a smooth surface, the roller rotates and controls the pointer on the screen.
b. **Optical mouse**. This type of mouse has no moving parts. It emits and senses light to detect mouse movement. It can be used on any surface, more precise and does not require periodic cleaning.
c. **Cordless or wireless mouse**. It is a battery-powered device that typically uses radio waves or infrared light waves to communicate with the system unit. It frees up desk space and eliminates the mouse cord.
d. **Palm mouse** – held in the palm and operated with only two buttons; the movements across the screen correspond to a feather touch, and pressure increases the speed of movement
e. Foot mouse – sometimes called a mole – a mouse variant for those who do not wish to or cannot use the hands or the head; instead, it provides foot clicks. Similar to a mouse is a puck, which, rather than tracking the speed of the device, tracks the absolute position of a point on the device (typically a set of crosshairs painted on a transparent plastic tab sticking out from the top of the puck). Pucks are typically used for tracing in CAD/CAM/CAE work, and are often accessories for larger graphics tablets.
f. Eye tracking devices – a mouse controlled by the user's retinal movements, allowing cursor-manipulation without touch.
g. **Finger-mouse** – An extremely small mouse controlled by two fingers only; the user can hold it in any position
h. **Gyroscopic mouse** – a gyroscope senses the movement of the mouse as it moves through the air. Users can operate a gyroscopic mouse when they have no room for a regular mouse or must give commands while standing up. This input device needs no cleaning and can have many extra buttons, in fact, some laptops doubling as TVs come with gyroscopic mice that resemble, and double as, remotes with LCD screens built in
i. Soap mouse – a handheld, position-based pointing device based on existing wireless optical mouse technology

Trackballs.

A trackball is a pointing input device. It performs functions like a mouse but it is a stationary device. It has move-able ball on its top. The ball is rotated or rolled with fingers (or palm of the hand) to move the pointer on the screen. Like mouse, a trackball also has buttons used to send the commands to computer. The trackball is usually available laptop computer. It is fixed on its keyboard. It is also available as separate input device as indicated above. A trackball device consisting of an exposed protruding ball housed in a socket that detects rotation about two axes. The trackballs can be used to control the pointer by rotating a ball with your thumb. Joystick is also a pointing device even though it is a gaming device. Track ball is an input device that is mostly used in notebook or laptop computer, instead of a mouse. This is a ball which is half inserted and by moving fingers on ball, pointer can be moved. Since the whole device is not moved, a track ball requires less space than a mouse. A track ball comes in various shapes like a ball, a button and a square.

Touch surfaces. It is also called touch pad and can be used to control the pointer by moving and tapping your finger as indicated in Fig 32.

Fig. 41: Touch Pad

ouch Pad is a pressure-sensitive pointing device. Touch pad is also known as track pad. It is also stationary device like trackball but it has no moving arts. It is a small, flat surface (or sensitive pad) over which a user slides fingertip to move the pointer on the screen. Touch Pad also has one or two buttons. These buttons are located near the pad. These buttons work like mouse buttons. Touch Pad is normally used with laptops. Nowadays, it is also available as separate input device. It is fixed on separate keyboard.

Light Pen. Light pen is a pointing device which is similar to a pen. It is used to select a displayed menu item or draw pictures on the monitor screen. It consists of a photocell and an optical system placed in a small tube. When the tip of a light pen is moved over the monitor screen and pen button is pressed, its photocell sensing element detects the screen location and sends the corresponding signal to the CPU.


Fig.42: Light Pen

A light pen as indicated in Fig. 42is a device similar to a touch screen, but uses a special light-sensitive pen instead of the finger, which allows for more accurate screen input. As the tip of the light pen makes contact with the screen, it sends a signal back to the computer containing the coordinates of the pixels at that point. It can be used to draw on the computer screen or make menu selections, and does not require a special touch screen because it can work with any CRT display.
Laser pen – can be used in presentations as a pointing device.

The language of the Mouse or trackball are as indicated in Table7.

S/N	Terms	Definitions
1	Point	This means you have to move the pointer to the desired spot on the screen over a particular word or object
2	Click	This means you have to press and quickly release the left hand button. Clicking also select an item on the screen.
3	Double-click	This means you have to press and quickly release the left hand button twice as quickly as possible. This also means opening a document or starts a program
4	Drag	This means you have to press and hold the left mouse button while moving the pointer to another location
5	Drop	This means release the mouse button after dragging. So drag and drop makes it easier to move an item on the screen
6	Right-click	This means you have to select an item by using the button on the right side of the mouse

The advantages and disadvantages of the three pointing devices Table 8

S/N	Name	Advantages	Disadvantages
1	Mouse	(a).Relatively inexpensive. (b).Very little finger movement is needed to reach the bottoms (c).Moves the cursor faster than the arrow keys of keyboard	(a).When gripped too tightly can cause muscle strain. (b).Uses more desk space than other printing devices. (c).Must be cleaned regularly
2	Trackball	(a).It uses less desk space than mouse. (b).It requires less arm and hand movement than the mouse.	(a).Wrist is bent during use. (b).More finger movement needed to reach buttons than with other pointing devices
3	Touchpad	(a).Small footprint. (b).Least prone to dust	(a).Places more stress on index finger than other pointing devices do. (b).Small active area makes precise cursor control difficult
4	Light pen	(a).Small pen (b).Less prone to dust	(a). Places more stress on pointing devices (b).The pen can spoil the pad when getting old

Gaming devices

Gaming devices are devices used for playing of computer games. A pointing stick is a pressure-sensitive pointing device. It looks like a pencil eraser. It exists between keys of keyboard. It is used to control the movement of a pointer on the screen. The pointer in the screen moves in the direction in which the pointing stick is pushed. Pointing stick input device is normally used with laptop computers. A pointing stick is a pressure-sensitive small nub used like a joystick. It is usually found on laptops embedded between the *G*, *H*, and *B* keys. It operates by sensing the force applied by the user. The corresponding "mouse" buttons are commonly placed just below the space bar. It is also found on mice and some desktop keyboards. The following are the most common gaming devices as indicated in Fig 43:

(a) Joystick.

Fig. 43: Joystick

It is a general control device that consists of a handheld stick that pivots around one end, to detect angles in two or three dimensions. Joystick is also a pointing device which is used to move cursor position on a monitor screen. It is a stick having a spherical ball at its both lower and upper ends. The lower spherical ball moves in a socket. The joystick can be moved in all four directions. The function of joystick is similar to that of a mouse. It is mainly used in Computer Aided Designing (CAD) and playing computer games.

- **Isotonic joysticks** are handle sticks where the user can freely change the position of the stick, with more or less constant force:
  - Joystick
  - Analog stick
- **Isometric joysticks**. This is where the user controls the stick by varying the amount of force they push with, and the position of the stick remains more or less constant. Isometric joysticks are often cited as more difficult to use due to the lack of tactile feedback provided by an actual moving joystick.

- **Gamepad**. This is a general handheld game controller that relies on the digits (especially thumbs) to provide input. Gamepad, joystick and steering wheel have similar function.
- **Game controller.** This is a specific type of controller specialized for certain gaming purposes, Steering wheel on the other hand can be thought of as a 1D pointing device.

Image, Video input devices

These are devices such as image scanner and webcam that provide input by analyzing images and sound that can be transferred over the Internet as indicated in Fig.44

a. Scanner/Image scanner.

Fig. 44:Silver scanner with lid open

Scanner is the third important input device of a computer system. A scanner converts printed documents in to images. Some types of scanners scan documents and produce the results in black & white images. The scanner operates in the same manner as a Photocopier. A colored scanner works somewhat in a complicated manner as compared to a simple scanner. It is therefore a device that provides input by analyzing images, printed text, handwriting, or an object. It is therefore an input device which works more like a photocopy machine. It is used when some information is available on a paper and it is to be transferred to the hard disc of the computer for further manipulation. Scanner captures images from the source which are then converted into the digital form that can be stored on the disc. These images can be edited before they are printed. A scanner can be used to digitise images. They're similar to a photocopier but they make a digital copy instead of a physical copy. They can also be used with optical character recognition (OCR) software to scan in text that is then editable as in Fig.45

b. **Webcam**.

Fig. 45: Webcam

This is a low resolution video camera used to provide visual input that can be easily transferred over the internet as indicated in Fig 45. This is a small video camera that takes video and inputs it into the computer. These allow you to record and send small videos or have a video chat with someone over the Internet. Webcams commonly have microphones built-in too. As seen above, it is a camera connected to a **computer** or **server** that allows anyone connected to the **Internet** to view still pictures or motion **video** of a user. The majority of webcam **web** sites are still pictures that are frequently refreshed every few seconds, minutes, hours, or days. The image to the right-diagram 5.8 is a picture of the **Logitech** QuickCam Express and an example of what a webcam may look like. Today, most webcams are connected to the **USB** or **Fire wire** port on a computer.

There are millions of webcams around the world that allow you to view other people, places and events

Audio input devices. Audio input devices include microphone.

Microphone. This is an acoustic sensor that provides input by converting sound into electrical signals. It is a device used to input voice data and sound. You hold the microphone up to a source, most likely a person's mouth, and it registers the sounds and inputs them into audio recording applications. This will let you do many things, from recording a song to talking to someone on Skype. Mix bus uses an internal audio routing system to make audio connections between Mix bus, your sound I/O, and other parts of Mix bus. With a new session, Mix bus makes these connections:

a. The master bus is connected to the first two physical output ports.
b. Track/Bus inputs are assigned sequentially from the physical inputs whenever a new track/bus is created.

The Auditioner and the Click are connected to the first two physical output ports. However it is possible to change any or all of these connections using The Audio Connections Manager window via Window->Audio Connections

Audio Connections Manager. The Audio Connections Manager window allows you to connect any output port to the track/bus input.

The Fig46 are collection of various audio input devices

Digital Camera

Digital Cameras are used to capture images and pictures and can usually record video too. Those images are then transferred to a computer when the Camera is connected to the computer.

Fig. 47: Digital Camera

The pictures in Fig.47it takes and the videos it records are stored in files. These files can be copied to a computer and later edited. Mostly the Digital Camera images are in JPEG format

Gamepad
A computer can serve many purposes. Besides work, a user can also play games on a Computer. You can use a keyboard and mouse for gaming but a specialized Hardware device, i-e a Gamepad can also be used. A gamepad is used for controlling games, with few buttons that controls the movements of character in a Computer Game.

Automatic input devices
Sensors
Sensors are often used as part of a feedback cycle. They collect data continuously and are typically linked to a control program that specifies acceptable levels, eg the minimum and maximum temperature in a green house. The control program decides what to do next based on the data it's fed by the sensors.

Magnetic strip (or stripe) reader as in Fig 48

Fig. 48: Debit card.
Magnetic stripes are built into many plastic cards such as debit or credit cards and personal identity cards. The magnetic strip on the back of the card can hold the personal details of the card owner and, with the necessary PIN, will allow access to secure information, eg bank account details. Data stored on the strip is scanned and input into a computer system by a magnetic stripe reader.

Digitizer. Digitizer is an input device which converts analog information into digital form. Digitizer can convert a signal from the television or camera into a series of numbers that could be stored in a computer. They can be used by the computer to create a picture of whatever the camera had been pointed at. Digitizer is also known as Tablet or Graphics Tablet because it converts graphics and pictorial data into binary inputs. A graphic tablet as digitizer is used for doing fine works of drawing and image manipulation applications as in Fig.49.

Fig. 49: Digitizer

Magnetic Ink Card Reader (MICR). MICR input device is generally used in banks because of a large number of cheques to be processed every day. The bank's code number and cheque number are printed on the cheques with a special type of ink that contains particles of magnetic material that are machine readable. This reading process is called Magnetic Ink Character Recognition (MICR). The main advantages of MICR is that it is fast and less error prone as in Fig. 50

Fig. 50: Magnetic Ink Card Reader (MICR)

Optical Character Reader (OCR).OCR is an input device used to read a printed text. OCR scans text optically character by character, converts them into a machine readable code and stores the text on the system memory as in Fig. 42.

Fig. 51: Bar Code Reader (BCR)

Bar Code Readers (BCR). Bar Code Reader is a device used for reading bar coded data (data in form of light and dark lines). Bar coded data is generally used in labeling goods, numbering the books etc. It may be a hand held scanner or may be embedded in a stationary scanner. Bar Code Reader scans a bar code image, converts it into an alphanumeric value which is then fed to the computer to which bar code reader is connected.

Optical Mark Reader (OMR). OMR is a special type of optical scanner used to recognize the type of mark made by pen or pencil. It is used where one out of a few alternatives is to be selected and marked. It is specially used for checking the answer sheets of examinations having multiple choice questions.

Microphone. Microphone is an input device to input sound that is then stored in digital form. The microphone is used for various applications like adding sound to a multimedia presentation or for mixing music. In computing they can be used with voice recognition software and a word processing application to enter text. Webcams commonly have microphones built-in too as in Fig. 52.

Fig. 52: Microphone

Touch screen
A touch sensitive visual display unit (VDU) or screen has a grid of light beams or fine wires criss-crossing the screens that are used to detect touch. Many mobile phones use touch

screens and do away with the keypad entirely. They're often used on cash machines and in shopping centres too. Touch screens are robust, easy to operate and easy to reprogram. Touch screen computers use a touch screen which is an electronic visual display. Touch screen computers work by detecting the location of a touch within the display screen. Though touch screen computers are commonly made for touching the screen with a finger, an object such as a stylus can also be detected. Touch screen computers have many benefits and they allow the user to interact directly with what they see. There are three basic touch screen computers you can obtain. Desktop touch screen computers, which can be all-in-one, the tablet touch screen computer or the touch screen laptop. All are personal computers but both suitable in different ways.

There are three types of touch screen, namely: desktop touch screen which is built all-in-one, the tablet touch screen and the touch screen laptop.

a. A desktop touch screen computer has been created for regular use in one location. Due to this, the monitor has the capability of being large while a system unit may also required. System units can be avoided if the touch screen computer is all-in-one. This means the monitor is combined into the same case as the CPU. A separate mouse and keyboard is attached to the desktop touch screen computer and these can be upgraded. A desktop touch screen computer can easily be upgraded in terms of graphic cards (for those gamers) and memory. They will have many expansion slots, such as the Conventional PCI, which is not always present in a laptop. They can have greater availability if you obtain a system unit separately and then obtain a touch screen monitor for you perfect touch screen computer.
b. The tablet touch screen computer is the most popular of the three, especially with the release of the Apple's iPad. Tablet touch screen computers have been created at a good size, allowing them to be easy for transporting and not too heavy to hold. It uses the touch screen as the primary input device as it cannot be attached to a keyboard. Tablet touch screen computers do not have hardware components with high performance compared to the desktop computer. It is not perfect for those gamers out there due to this but good for individuals who need a touch screen computer for use of a planner, music and quick internet wherever wifi allows.
c. Lastly, the touch screen laptop. This is a portable touch screen computer, designed to carry around which makes it good for business work and for university students. As mentioned earlier, a laptop cannot contain many expansion slots and is also not as good when it comes to upgrading.

How the touch screen computers work.

a. **Surface Acoustic Wave System**. Firstly, the surface acoustic wave system in a touch screen computed uses transducers. A transducer transforms one type of energy to another. There is a receiving transducer used and one required for sending. They are placed across the glass on the touch screen computer monitor. On this same glass are reflectors. A reflector is used in co-operation with the transducer by reflecting the signals between the two. The receiver can locate a stimulus caused via touch. This does not require the use of metallic layers. Touch screen computers with this system are therefore with complete light output and this makes the image clearer to see. If graphics are necessary for your touch screen computer, this is the best system to use. It would therefore be best for games. Similar to the resistive system, the touch screen computers using the surface acoustic wave systems can use anything to cause a reaction.
b. **Surface Resistive System**. Secondly there is the resistive system. When the monitor in a touch screen computer is on, an electric current is passed through it. The monitor

itself is made of two main layers. Glass is covered by metallic layers, once being a conductor and one being resistive. These two layers are kept from touching by the use of spacers. Touch screen computers are easier to scratch due to their constant touch. In order to avoid this, they are usually covered by a scratch-proof layer. If you touch a touch screen computer using this system, these two layers will make contact and this leads to a change in the electrical field at that particular point. This can be recorded to a particular co-ordinate on the monitor and then calculated by the touch screen computer. This system links with the operating system by recognising the stimulus, and leading to a movement. Seeing as the message is only recorded when the two layers touch, you could touch the screen or a pen could and it would still react.

c. **Capacitive System**. Lastly there is the capacitive system. A metallic layer is above the glass on the monitor of the touch screen computer. This layer holds the electrical charge, but it is released when a person touches the monitor. It is moved to the user. This causes the capacitive layer to decrease in electrical charge, and this can be measured at all four corners of the touch screen computer monitor. By calculating how far from each corner the touch was via the decrease in circuits, the location of touch can be calculated. This is then related back to the touch screen computer driver software. A large amount of light is transmitted from touch screen computers using this capacitive system. Though it is 10% less than the surface acoustic wave system, it is almost 15% more than the resistive system. This means that the capacitive system have very clear images, making it suitable for high graphical images. Touch screen computers using this system can only work with a conductive stimulus, such as a finger. In price range, a resistive touch screen computer is the cheapest, and a surface acoustic wave touch screen computer is the most expensive. This is more likely due to the clarity of the image quality due to the light output Fig.53

Fig.53:Images of touch screen computers

Video digitiser
A video digitiser takes an image from a video camera or television and digitises it so it can be read by, and stored on, a computer. Video sequences captured using a video digitiser is often used in multimedia presentations.
Graphics tablet
A graphics tablet consists of a flat pad (the tablet) on which the user draws with a special pen. As the user draws on the pad the image is created on the screen. Using a graphics tablet a designer can produce very accurate on-screen drawings as if they were drawing on paper.

3.2. Central Processing Unit
The processing is mainly handled by the Central Processing Unit (CPU).

Fig54:Image of CPU

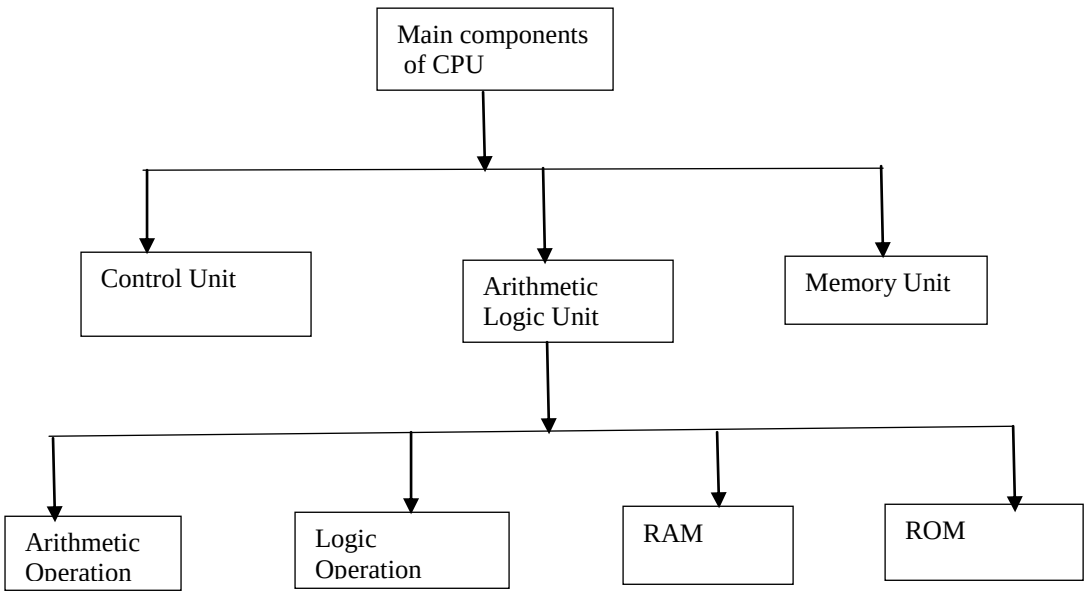


Fig. 55:The main component of CPU

3.2.1. Arithmetic Logic Unit (ALU)

The ALU is the part of a CPU that performs all arithmetic computations including addition, subtraction, multiplication, and division. The Arithmetic Logic Unit also performs all logical operations. The ALU is a literally the fundamental building block of the CPU, and even the simplest processors contain an ALU. Today's modern CPUs and graphics processing units (GPUs) in graphic cards have very complex ALUs, and some contain a number of ALUs. In some CPUs an individual ALU is further divided into two units called an arithmetic unit (AU) and a logic unit (LU). Some processors even contain more than one AU. Normally the ALU has direct input and output access to the processor controller, main system memory (RAM), and input/output devices. In a nutshell an ALU works by loading data from what is called input registers, then an external Control Unit tells the ALU what operation to perform on that data, and finally the ALU stores its result into an output register. At this point the data is moved between the registers and the memory via a data path called a bus.

3..2.2 Control Unit

The CPUs control unit is responsible for executing or storing the results coming out of the ALU. Within the CPU, the control unit performs the functions of fetch, decode, execute, and store. The control unit communicates with both the arithmetic logic unit (ALU) and memory, and literally directs the entire computer system to carry out, or execute, stored program instructions. In a nutshell here is how a control unit works. Basically a control unit fetches or retrieves an instruction from memory and then analyzes the instruction it fetched before deciding how it should be processed. Depending on the action required, the control unit will then send segments of the original instruction to the appropriate section of the processor.

3.2.3. Registers

Registers are the temporary storage areas for instructions or data within the processor. Registers are basically special storage locations somewhat similar to a computer's memory though contained within the processor and exceptionally faster. Registers work under the direction of the control unit to accept, hold and transfer instructions or data and perform arithmetic or logical comparisons at a high rate of speed. Metaphorically speaking, the control unit uses the CPUs data storage registers similar to the way a cashier at a local market would conveniently store money away in a cash register to be used temporarily for transactions.

What Does the CPU do?

a. Carries out instructions and tells the rest of computer system what to do.
b. Sends command signals to the other components of the system.
c. Perform arithmetic calculations and data manipulation.
d. Holds data and instructions, which are in current use.

Control Unit (CU)

a. Directs the entire computer system to carry out stored program instructions.
b. Instructs the arithmetic logic unit which arithmetic operations or logical operation is to be performed.

Arithmetic Logic Unit (ALU)

a. Executes arithmetic and logical operations.
b. Arithmetic operations include addition, subtraction, multiplication and division.
c. Logical operations compare numbers, letters and special characters.

Memory Unit

The memory unit holds data and instructions for processing.

a. RAM (Random Access Memory) used to store instructions and data needed while processing.
b. ROM (Read Only Memory) comes with instructions permanently stored inside and these instructions cannot be over-written by the computer's CPU.

RAM & ROM.

The term ROM stands for Read-Only Memory. A ROM chip is programmed with a permanent collection of pre-set bytes. The address bus tells the ROM chip which byte to get and place on the data bus. When the RD line changes state, the ROM chip presents the selected byte onto the data bus. Similarly, the term RAM stands for Random-Access Memory. RAM contains bytes of information, and the microprocessor can read or write to those bytes depending on whether the RD or WR line is signaled. One problem with today's RAM chips is that they forget everything once the power goes off. That is why the computer needs ROM. On a PC, the ROM is called the BIOS (Basic Input/Output System). When the microprocessor starts, it begins executing instructions it finds in the BIOS. The BIOS instructions do things like test the hardware in the machine, and then it goes to the hard disk to fetch the **boot sector**. This boot sector is another small program, and the BIOS store it in RAM after reading it off the disk. The microprocessor then begins executing the boot sector's instructions from RAM. The boot sector program will tell the microprocessor to fetch something else from the hard disk into RAM, which the microprocessor then executes, and so on. This is how the microprocessor loads and executes the entire operating system.

How the CPU Works

The CPU is centrally located on the motherboard. Since the CPU carries out a large share of the work in the computer, data pass continually through it. The data come from the RAM and the units keyboard, drivers, etc. After processing, the data is sent back to the RAM and the units. The CPU continually receives instructions to be executed. Each instruction is data processing order. The work itself consists mostly of calculations and data transport.

The Instruction-Execution Cycle

The CPU performs four steps in executing an instruction:

a. The control unit gets the instruction from memory.
b. The control unit decides what the instruction means and directs the necessary data to be moved from the memory to the arithmetic logic unit.
c. The arithmetic logic unit performs the actual operation on the data.
d. The result of the operation is stored in memory or a register.

Each CPU has an internal clock (or system clock), which produces pulses at a fixed rate to synchronies all computer operations. A single machine cycle instruction is made up of a number of sub instructions, each of which must take at least one clock cycle. Each type of CPU is designed to understand a specific group of instruction called the instruction set.

How the CPU finds instructions and data

a. An address, or a number that stands for location in the computer memory identifies the location in memory for each instruction and each piece of data.
b. An address may be compared to a mailbox in everyday life, except that the address can hold only one item-a fixed amount of data, a number or a word-at any time.

Overview of today's CPU's

Titanium. Intel unveiled new details about its upcoming line of IA-64 processors and announced the name of the first IA-64 processor, to be called the Intel Titanium processor. Previously known by the code name Merced, the Titanium processor employs a 64-bit architecture and enhanced instruction handling to greatly increase the performance of demanding e-Business, visualization, computation and multimedia operations. Today, five different 64-bit operating systems have booted on Intel Titanium processors, Servers and workstations based on the Titanium processor are scheduled for production in 2000.

Pentium III. This processor sets a new baseline for high-performance business desktop computing, and is also available for entry-level workstations and servers. The new mobile Pentium III processor enables greater productivity on the go, at speeds of up to 500MHz.

Pentium III Xeon. With the advent of the powerful Pentium III Xeon processor, Intel-based servers challenge RISC-based servers in price/performance and raw performance. This premium server engine from Intel will deliver speeds of up to 550MHz (up to 733MHz in 2-way platforms). Pentium III Xeon processor-based servers have the enhanced scalability, availability, reliability, and manageability you need for business in the Internet age.

Pentium. Intel introduced the 80586 Pentium processor in 1993. These Pentium chips contained more than 3 million transistors and could execute 112 million instructions per second. Pentium processors had clock speeds (how fast the system processes data) from 60 Megahertz to 200 Megahertz. The pins on the bottom of Pentium chips attach to motherboards via a Socket 7 (32 pin) connector. These systems used the older non-ATX case as well as the older Socket 7 for the chip as in Fig. 56.

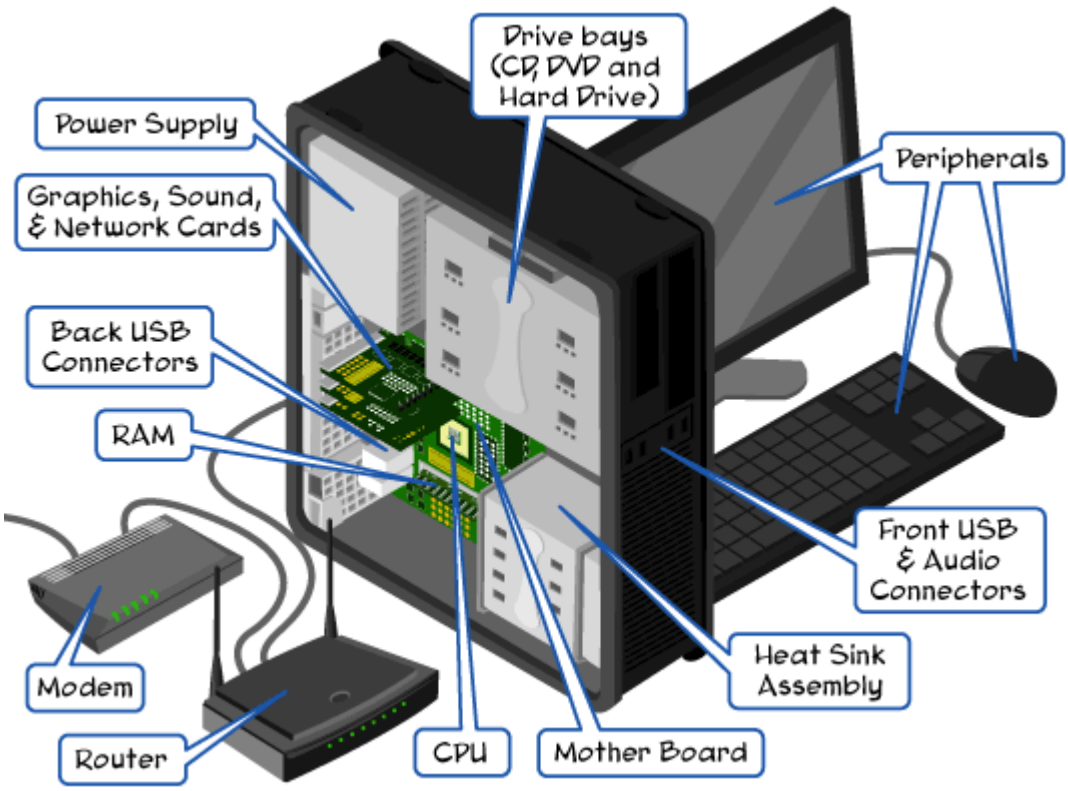


Fig. 56: Overview of CPU

Intel Core is Intel's brand name for various mid-range to high-end consumer and business microprocessors. These processors displaced the existing mid-to-high end Pentium processors of the time, moving the Pentium to the entry level, and bumping the Celeron series of

processors to low end.As of 2015 the current lineup of Core processors included the Intel Core i7, Intel Core i5, Intel Core i3, and Core M.

History of the development of the Intel Processors of the CPU

Be aware that the speed of the CPU is measured in megahertz (MHz). So a computer has central clock that keeps all the components in time with each other. As such one hertz is similar to a clock tick and megahertz is equal to one million ticks per second in in Table 9**.**

Year	**Name of Processor**	**Clock Speed**	**No. of Transistors Produced**
April, 1972	8008	200 kilohertz	3,500
December 1974	8080	2 MHz	6,000
August 1976	8085	5 MHz	6,500
September 1978	8086	10 MHz	29,000
February 1982	286	12 MHz	134,000
October 1985	386	16 MHz	275,000
February 1987	386	20 MHz	275,000
April 1989	486	25 MHz	1,200,000
June 1991	486	50 MHz	1,200,000
March 1993	Pentium	60 MHz	3.1 million
March 1994	Pentium	75 MHz	3.2 million
March 1995	Pentium	120 MHz	3.2 million
June 1995	Pentium	133 MHz	3.3 million
January 1996	Pentium	166 MHz	3.3 million
June 1996	Pentium	200 MHz	3.3 million
May 1997	Pentium II	300 MHz	3.3 million
April 1998	Pentium II	400 MHz	7.5 million
August 1998	Pentium II	450 MHz	7.5 million
August 1999	Pentium III	600 MHz	9.5 million
October 1999	Pentium III	733 MHz	28 million
January 2000	Pentium III	800 MHz	28 million
March 2000	Pentium III	1.0 GHz	28 million
November 2000	Pentium 4	1.5 GHz	42 million
April 2001	Pentium 4	1.7 GHz	42 million
Aug 2001	Pentium 4	2 GHz	42 million
Jan 2002	Pentium 4	2.2 GHz	42 million
Jun 2002	Pentium 4	2.53 GHz	55 million
Aug 2002	Pentium 4	2.8 GHz	55 million
Nov 2002	Pentium 4	3.0 GHz	55 million
Jun 2003	Pentium 4	3.2 GHz	55 million
Feb 2004	Pentium 4	3.4 GHz	55 million
July 2006	Core 2 Duo	4 MB	253 million
Nov 2006	Core 2 Extreme QX6700	8 MB	582 million
Nov 2008	Core i7	2.66–3.2 GHz	730 million
Jan 2011	Core i7 "Sandy Bridge"	1.66–3.4 GHz	995 million
Jun 2013	Core i7 "Haswell"	1.9–4.4 GHz	1400 million
3Q 2015	Core i7 "Skylake"	3.5–4.2 GHz	1350 million

Storage capacity of a computer

Based on the above analysis of the storage capacity of a computer which is measured in megahertz and gigabit (GB), they are used to measure both memory (such as RAM) and

storage space such as found on hard disks. The faster the clock ticks, the faster the computer runs.

- **Bits.** Personal computers are **digital** computers because they work with two digits: 0s and 1s. A zero or a one is a bit.
- **Bytes.** A combination of 8 bits is a byte (pronounced bite). A byte of memory space can hold one alphanumeric character (a letter or a number).
- **Kilobytes (KB)**. A kilobyte is 1,024 bytes (usually rounded off to simply 1,000). A kilobyte of space will hold about 128 alphanumeric characters – about the size of this whole sentence including the spaces.
- **Megabytes (MB)**. A megabyte is 1 thousand kilobytes. The now increasingly obsolete 3.5 inch floppy disks could hold about 1.5 megabytes of information. A megabyte of storage space will hold about 1,000 copies of the first two sentences of this paragraph.
- **Gigabytes (GB).** A gigabyte is 1 billion megabytes. It is the unit most often used when considering the memory and hard disk space of current personal computers, for example: 4GB of RAM and a 500 GB hard disk.
- **Terabytes.** A terabyte is 1,000 gigabytes – the equivalent of 1 trillion bytes. Hard disks of one terabyte are now available. In 2008 Cisco, the computer network hardware manufacturer, estimated that the Internet transferred about 160 terabytes per second.

Therefore the following are the file sizes of the secondary storage facilities: floppy dis, zip disk, CD and DVD can hold:

- a floppy disk holds about 1.5 Mb;
- a Zip disk holds 100 Mb or 250 Mb;
- a CD holds about 800 Mb;
- a DVD holds about 4,700 Mb.
- The capacity of a CD-ROM is 650MB to 700MB
- The capacity of CD-R is 650MB to 700MB
- The capacity of CD-RW is 650MB to 700MB
- The capacity of DVD-ROM is 4.7GB
- The capacity of DVD-R is 4.7GB
- The capacity of DVD-ROM range from 2.6 to 5.2GB
- Gmail.com can allow 25MB attachment and space
- Yahoo.com can allow 25MB attachment and space
- Livemail.com can allow 25MB attachment and space
- Hotmail.com can allow 10MB attachment and space
- Rediffmail.com can allow 10MB attachment and space

Factors Affecting the computer Processor Speed

There are many factors which affect how fast your computer can process data and instructions. They all depends on:

a. The amount of RAM memory
b. The speed and generation of your CPU (the system clock)
c. The size of the Register on your CPU
d. The Bus type and speed
e. The amount of Cache memory

Ways of speeding up Computer PC or Laptop are as follows:

a. Reduce the number of programs that “run-on-startup

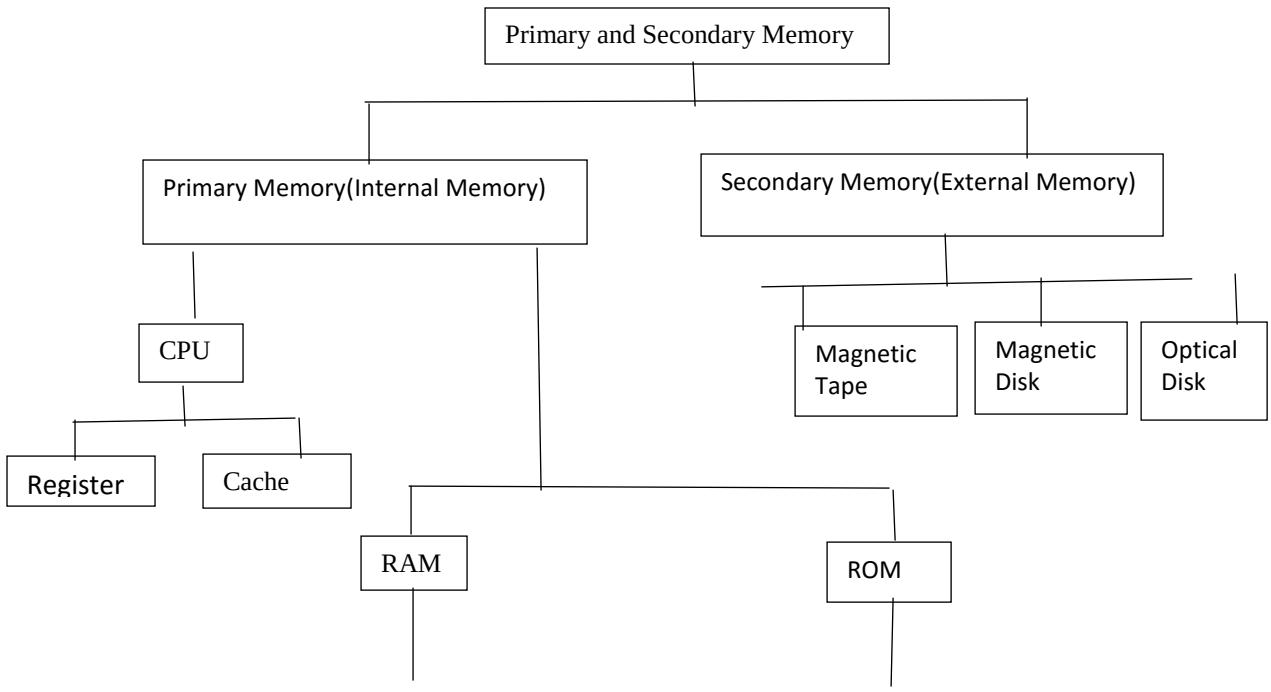
b. Add a bigger and faster disk drive
c. Clean up your computer
d. Scan your computer for Viruses
e. Remove unnecessary browser "Add-Ons"
f. Reinstall or Repair your Operating System (OS)
g. Upgrade your Operating System (OS)
h. Replace your modem
i. Contact your ISP ask for a "speed-test" and see if they can "boost" your internet speed
j. Buy a new PC or Laptop

Ten ways to make your computer run faster

a. Uninstall unused programs
b. Automatically delete temporary files
c. Install a solid state drive
d. More hard drive storage
e. Prevent unnecessary start ups
f. More RAM.RAM, which stands for Random Access Memory, is the temporary storage memory used by your computer and is in use when tasks are being executed by different programs
g. Run a disk defragment
h. Run disk clean up
i. Give your computer a static IP
j. Hovering out the dust

3.3 Primary and Secondary Memory

There are two types of physical memory: *primary* and *secondary* memory. Primary memory is volatile memory. Secondary memory (secondary storage) is non-volatile. Computer's memory can be classified into two types; primary memory and secondary memory (**RAM).** Memory is the best essential element of a computer because computer can't perform simple tasks. The performance of computer mainly based on memory and CPU. Memory is internal storage media of computer that has several names such as majorly categorized into two types, Main memory and Secondary memory as in Fig. 57 below.



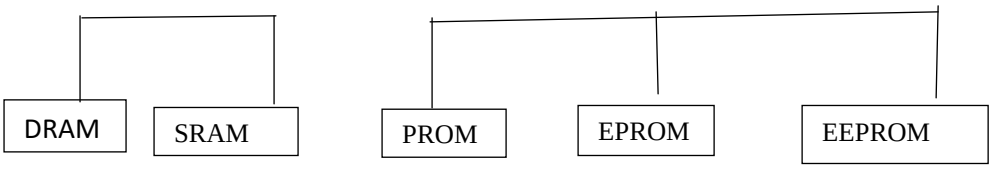


Fig. 57. Diagram of the CPU

3.3.1 Primary memory(Volatile Memory)

Primary Memory, also known as main storage, is the area in a computer in which data is stored for quick access by the computer's processor. It is a computer system's volatile storage mechanism. This includes several types of memory, such as the processor cache and system ROM. However, in most cases, primary memory refers to system RAM. Primary memory is considered faster than secondary memory. The main functions of primary memory (also called main memory or primary storage) is to execute program code and store temporary data. Primary memory is the memory that the processor accesses first. The memory is on chips located on the motherboard. The primary memory stores applications to run the operating system (OS), the user interface and installed software utilities. The computer can manipulate only the data that is in main memory. Every program executed and every file accessed must be copied from a storage device into main memory. The amount of main memory in a computer system determines how many programs can be executed at one time and how much data can be readily available to a program. The components of the primary memory are as following:

a. CPU which is further divided into the Register and the Cache. The cache memory is a type of memory used to hold frequently used data. Cache memory is relatively small but very fast. Most web browsers use a cache to load regularly viewed web pages fast. The most important type of cache memory is the CPU cache. Once the data is stored in cache, it can be used by accessing the cached copy rather than recomputing the original data as in Fig. 58.

Fig. 58: Primary Memory

b. Random access memory (RAM). This consists of one or more memory modules that temporarily store data while a computer is running. RAM is V**olatile Memory**, meaning it is erased when the power is turned off. Therefore, each time you start up your computer, the operating system must be loaded from secondary memory (such as a hard drive) into the primary memory, or RAM. Similarly, whenever you launch an application on your computer, it is loaded into RAM. This is a type of volatile memory and is the most common type of memory found in computer and other devices such as printers. RAM requires a flow of electricity to retain the data such as the computer is powered On. The two types of RAM are(a)SRAM. This is a static RAM (b) DRAM. This is a dynamic RAM.

c. Read Only Memory (ROM).ROM is memory containing hardwired instructions that the computer uses when it boots up, before the system software loads. ROM stores the program required to initially boot the computer. It only allows reading. The data stored on ROM cannot be changed. This is a type of non-volatile memory and is

computer memory on which data has been prerecorded. The ROM will retain data without the flow of electricity. That is when the computer powered is off. That means it can keep the contents of your document without even the power source. The components of the ROM are: (a) PROM which stands for Programmable ROM (b) EPROM which means Erasable Programmable ROM, and EEPROM meaning Electrically Erasable Programmable ROM.

Primary Memory.

This is the memory unit that communicates directly with the CPU. It is called the main memory or primary memory. These primary memories store:

a. The instructions that are waiting to be executed.
b. The data waiting for processing.
c. The instruction currently being executed.
d. The data currently being processed.
e. The information awaiting output.

However, the primary memory contains the following parts:

3.3.2 Power supply.

The electricity available from a standard wall outlet is called Alternative current (AC). However, a microcomputer runs on direct current (DC). The power supply is the device that converts power from AC to DC to run the computer. The on/off switch in your computer turns on or shuts off the electricity to the power supply. To protect your computer from high power distraction, you have to the following two principal types of power protectors:

- Surge protectors
- Uninterruptible Power Supply (UPS).

3.3.2.1 Motherboard.

The components of the motherboard are:

- The **CPU** (Central Processing Unit) performs most of the calculations which enable a computer to function, and is sometimes referred to as the "brain" of the computer. It is usually cooled by a heat sink and fan. Most newer CPUs include an on-die Graphics Processing Unit (GPU).
- The **Chipset**, which includes the north bridge, mediates communication between the CPU and the other components of the system, including main memory.
- The **Random-Access Memory** (RAM) stores the code and data that are being actively accessed by the CPU.
- The **Read-Only Memory** (ROM) stores the BIOS that runs when the computer is powered on or otherwise begins execution, a process known as Bootstrapping, or "booting" or "booting up". The **BIOS** (Basic Input Output System) includes boot firmware and power management firmware. Newer motherboards use Unified Extensible Firmware Interface (UEFI) instead of BIOS.
- **Buses** connect the CPU to various internal components and to expand cards for graphics and sound.
- The CMOS battery is also attached to the motherboard. This battery is the same as a watch battery or a battery for a remote to a car's central locking system. Most batteries are CR2032, which powers the memory for date and time in the BIOS chip.

This is also called the system board. It is the main circuit board in the system unit. This board acts as a container for the different components in the system unit such as the microprocessor, and any coprocessor chips, RAM chips, ROM chips, and other expansion slots where additional circuit boards are plugged in.

3.3.3 Microprocessor.

Most microcomputers today use microprocessor that is made from the following companies:

- Intel chips. Intel makes chips for personal computers such as Compaq, Dell, Gateway, Tandy, Toshiba, Zenith, Advanced Micro Devices (AMD), Cyrix and Technologies. Intel use to identify its chips by number 8086, 8088, 80286, 80386, 80486, and the x86 series (Hutchhnson and Sawyer, 2000). The Intel successor to the x86 chips is the Pentium family of chips such as Pentium 1, 2, 3, 4, 5 and MMX which stands for Multimedia Extension.
- Motorola chips. This is a product from Apple Macintosh computers. They use RISC architecture.

3.3.4 RAM chips

This is memory that temporarily holds data and instructions that will be needed shortly by the processor. The following are the different types of RAM:

- SRAM–Static Random Access Memory.
- DRAM-Dynamic Random Access Memory.
- FPM DRAM-Fast page Mode Dynamic Random Access Memory.
- EDO DRAMA -Extended Data-Out Dynamic Random Access Memory.
- SDRAM–Synchronous Dynamic Random Access Memory.
- DDR SDRAM-Double Data Rate Synchronous Dynamic RAM.
- Credit Card Memory.

3.3.5 ROM Chips.

Unlike the RAM which is constantly being written on and erased, ROM, which stands for read-only memory and is also known as firmware, cannot be written on or erased by the computer user. It is therefore fixed and cannot be written on or erased or altered by regular program instructions or the computer user. It is non-volatile making it an ideal means of storing information to function properly. The followings are the different forms of ROM:

- **Programmable Read-Only Memory (PROM**). This is a blank chips on which the buyer, using special equipment, writes the program. Once the program is written, it cannot be erased.
- **Erasable Programmable Read-Only Memory (EPROM**). It retains its contents until it is changed using burner (ultraviolet light). You can erase the content with special equipment and new material can be written.
- **Electrically Erasable PROM (EE-PROM**). This can be reprogrammed using special electrical impulses. They may not be removed from the computer to be changed.

The main features of this chip are as follows:

- No need of ultra-violet light to erase the program.
- The information can be changed by electrical signals.
- The chip does not have to be removed for rewritten.
- The entire chip need not be completely erased to change a specific portion of it.
- Changing of the contents does not require any additional special equipment.

3.3.6 CMOS.

This is known as Complementary metal-oxide semiconductor (CMOS) chips which provide flexibility and expandability for a computer system. This system is a system clock that enables users to reset the system date and time settings. For example:

a. You can double-click the time in the quick launch taskbar

b. Choose December from the drop-down list

c. Choose 2007 from the drop-down list
d. Select Friday the 28th
e. Click apply to set the new system date and time on the CMOS chip as seen from Fig.59 Below

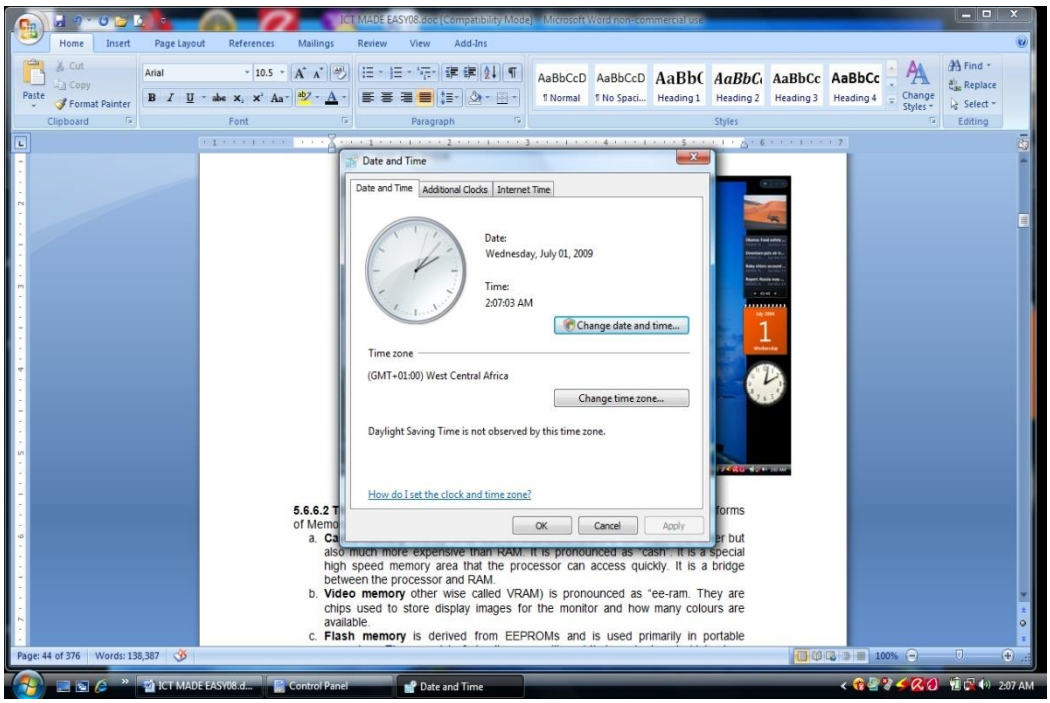


Fig. 59: CMOS

3.3.7 The memory cache (VRAM), flash drives.

Cache memory is among other forms of Memory, which include:

a. **Cache memory**. This is also known as Buffer Memory. It is the small part of RAM which is just a few chips that temporarily store data and instructions that are likely to be retrieved many times during processing, thereby improving the processing speed. It is faster but also much more expensive than RAM. It is pronounced as "cash". It is a special high speed memory area that the processor can access quickly. It is a bridge between the processor and RAM. Data may be transferred automatically between the buffer and the primary storage. This cache memory may be used in both large and small computers.
b. **Video memory** otherwise called VRAM) is pronounced as "ee-ram. They are chips used to store display images for the monitor and how many colors are available.
c. **Flash memory** is derived from EEPROMs and is used primarily in portable computers. They consist of circuitry on credit-card that can be inserted into slops connecting to the motherboard. It retains data even when the power is turned off. This is used to replace or supplement the hard disk drives for permanent storage.

3.3.8 The ports: Connecting peripherals.

Microcomputers have different types of ports, which depends on whether they use the PC or the Mac platform and how recent the model is. A port is a socket on the outside of the system unit that is connected by a bus to an expansion board on the inside of the system unit or connected directly to integrated circuitry on the motherboard. I.e. a port is a connector at the back of the computer where you plug in an external device. It allows you to use a cable to plug in a peripheral device such as monitor, printer, or a modem so that it can communicate with the computer system. There are several types of ports, namely:

- **Parallel ports**. A parallel port has 25 holes. It is known as female connector. It connects a printer or tape drive. The parallel port is named LPT1, LPT2 and so on. There are two types of parallel ports, namely, Enhanced Parallel Port (EPP) and Extended Capabilities Port (ECP). They increase the speed at which information flows between the computer and a device. The parallel lines move information faster than serial lines do, but they can transmit information efficiently only up to 15 feet and they are used principally for connecting printers.
- **Serial ports**. A serial port or RS-232 has either 9 or 25 pins and send bits one after the other in a single sequence. It is known as male connector. It connects a modem or mouse. The label of the serial port with letters known as COM. The first COM is named COM1 for mouse; the second is COM2 for modem and so on. The serial ports are used principally for communications lines, modems, scanners, and mice and a printer in the case of Macintosh computer.
- **Video adapter ports**. They are used to connect the video display monitor outside the computer to the video adapter card inside the system unit. The monitor may have either a 9-pin plug or a 15-pin plug. The plug must be compatible with the number of holes in the video adapter card.
- **SCSI ports**. This is pronounced as "skuzzy" it is short form for Small Computer System Interface that provides an interface for transferring data at high speeds for up to seven or fifteen SCSI-compatible devices. These devices include external hard disk drives, magnetic-tape backup units, scanners and CD-ROM drives.
- **Game ports**. This allows you to attach a joystick or similar game-playing device to the system unit.
- **Infrared ports**. These are wireless, data-transfer ports that are available on new computers and hardware peripherals such as printers. It uses a certain frequency of radio waves to transmit data.
- **USB D-Link**. This is a wireless Card bus Adapter with the following features:
  - Faster wireless networking with speeds up to 108Mbps in Turbor Mode.
  - Compatible with 802.11Ib and 802.11g devices.
  - Better Security with 802.1x and WPA/WAP2.
  - 32-bit Card bus performance/Plug & Pay connectivity.
  - User friendly configuration and diagnostic utilities.
- **USB GPRS/GSM**. This stands for General Packet Radio Service. It is a light wave GPRS wireless modem that provides data and voice transmissions via the USB card. It allows you to use e-mail, access the Internet or even make telephone calls directly from your PC without the need of a phone line. The GPRS consist of EGSM 900, GSM 2000 and GSM 1900. The GPRS wireless modem has the following characteristics:
  - **Tri**-band EGSM900, GSM2000 and GSM 1900
  - **GPRS multi**-slot class 10
  - **GPRS mobile station class B**
  - Compliant to GSM Phase 2/2+
  - Control via AT commands
    - The Wireless Modem has the following Specifications:
      - Standard USB interface
      - Standard SIM Card Interface
      - Supports Data, voice, SMS function
    - Environmental Operating Ranges
      - Operating Temperature:0-55C, Humidity 10-95%
      - Storage Temperature: 20-65C Humidity 10-95%

- Power Consumption
  - Operation max Operation current:840Ma/5V
  - Class 4(2W) at EGSM900
  - Class 1 (1W) at GSM2000 and GSM 1900
- LED indication
  - Power LED, Ative LED
- Driver support
  - Windows 98SE, 2000, ME, XP
- Package contents
  - USB GPRS/GSM Wireless Modem
  - Headset
  - USB Cable
  - BRRP Mobile Phone Tools (BVRP software offers Internet access, SMS & Phonebook management)
  - SIM Card not included

3.3.9 The expansion slots and boards.

Most of today's microcomputers have open architecture that can easily be opened so that users can add new devices and enhance existing capabilities. The advantage of this type of system is that it spares users from having to buy a complete new computer every time they want to upgrade something. The expansion slots are also called bus slots. They are sockets on the motherboard into which you can plug expansion cards after you open the system unit. They provide more memory or control peripheral devices. The following are the categories of expansion cards:

a. **Memory cards**. This memory card allows you to add RAM chips to give you main memory.
b. **Video adapter cards**. These cards allow you to adapt different kinds of color video display monitors for your computer.
c. **Graphics accelerator cards**. They improve the performance of your computer when displaying graphics when handling 3-D graphics such as Accelerated Graphics Port (AGP).
d. **Controller cards**. Controller cards are circuit boards that allow your microprocessor to work with the computer's various peripheral devices such as diskette drives and hard disk.
e. **Sound cards**. These are cards that accept audio input from a microphone and convert it into a form that can be processed by the computer.
f. **Modem cards**. They allow distant computers to communicate with one another by converting electronic signals from within the system unit into electronic signals that can travel over telephone lines and other types of connections.
g. **Network Interface cards (NIC**) is also known as network adapter cards. They are used to connect a computer to one or more other computers. This enables users to share data, programs, and hardware.
h. **TV turnercards**. They enable you to connect and watch television, capture video and surf the Internet at the same time. They are also known as television boards, video recorder cards and video capture cards.
i. **Other add-ons**. This system allows you to add special circuit boards for modems, fax, sound, video capture, and networking as well as coprocessor chips.

3.3.10. The Bus lines and PC slots and cards.

The expansion buses have two basic categories of buses. One category is called system buses which connects the CPU to memory on the system board. The other category is called expansion buses that connect CPU to slots on the system board.

Air Conditioner. A Computer is an electronic machine. It is, therefore, capable of generating heat. A computer is manufactured to operate in an environment with a specific temperature range. When the temperature of the environment in which a computer is kept fall outside the specific range, the computer may function badly and consequently get damaged. The free air is basically, dust laden. Dust is metallic in nature and, as such, capable of conducting electricity. If dust is allowed to settle on a computer, particularly the electronic circuits, the dust can bridge two circuits. The bridging of two electronic circuits may cause a serious damage to the computer. Thus, air conditioners are needed in a computer environment to:
a. Condition the temperature
b. Prevent dust.

Voltage Stabilizer. A computer when switched on, takes off at a cold state, warms up and gradually gets to a hot state. At a hot state, a computer is always roaming in an attempt to find something to do. In a situation where the public electricity such as that of PHCN in Nigeria is cut suddenly, the computer would suddenly be brought to a halt. The sudden power cut may cause the computer to lose the memory of some basic housekeeping operations when power eventually returns and the computer is switched on. The sudden power cut may also cause irreparable damages to the file the computer was processing at the time the power was suddenly cut.

Line Voltage Transformer. We note that computers are built to operate within a specific range of voltages. In the United State of America, computers are built to operate on 110V. A voltage transformer is a device meant to step up or step down a voltage as the case may be. In Nigeria, for example, a 110V computer requires a voltage transformer to step down the 240V to 110V. Similarly, in USA, a 2409V current is connected directly to a 110V computer, the computer power unit will blow up almost immediately. Today, the technology has improved tremendously such that if a 240V current is connected directly to a 110V computer, only a fuse, rather than the power unit will blow up. It is worth mentioning, too, that there is an advanced technology today which permits a computer to operate effectively and efficiently with the power line voltage ranging between 110V and 240V. The technology supports an inbuilt switch which can be operated at two terminals namely: the 110V terminus and 240V terminus. In recent times, the technology has been improved upon such that computers are manufactured in such a way that they can sense the voltage that is adequate. Thus, if one connects a 110V computer to a 240V current, the 110V computer has an in-built line transformer which automatically steps down the 240V current to 110V.

Uninterruptible Power Supply System (UPS). An Un-interruptible Power System (UPS) is an auxiliary hardware that is capable of:

a. Converting the public electricity raw line into fine line that is, conditioning the voltage that is fed into the computer.
b. Storing electrical energy when the public electricity line is life
c. Releasing the stored electrical energy to the computer when the public electricity line is dead.

3.4Secondary Memory / Non Volatile Memory

Secondary memory is external and permanent memory that is useful to store the external storage media such as floppy disk, magnetic disks, magnetic tapes and etc cache devices. Secondary memory are the following:

a. Hard Disk
b. Tertiary memory
c. Flash Drive (USB)
d. CD-ROM

Secondary memory deals with following types of components:

1. **Read Only Memory (ROM):** ROM is permanent memory location that offers huge types of standards to save data. But it works with read only operation. No data lose happen whenever power failure occurs during the ROM memory work in computers.
2. ROM memory has several models such names are following.
   a. **PROM:** Programmable Read Only Memory (PROM) maintains large storage media but can't offer the erase features in ROM. This type of RO maintains PROM chips to write data once and read many. The programs or instructions designed in PROM can't be erased by other programs.
   b. **EPROM:** Erasable Programmable Read Only Memory designed for recover the problems of PROM and ROM. Users can delete the data of EPROM thorough pass on ultraviolet light and it erases chip is reprogrammed.
   c. **EEPROM:** Electrically Erasable Programmable Read Only Memory similar to the EPROM but it uses electrical beam for erase the data of ROM.

Cache Memory: Mina memory less than the access time of CPU so, the performance will decrease through less access time. Speed mismatch will decrease through maintain cache memory. Main memory can store huge amount of data but the cache memory normally kept small and low expensive cost. All types of external media like Magnetic disks, Magnetic drives and etc store in cache memory to provide quick access tools to the users. Secondary memory (also called auxiliary memory) is storage devices: hard drives, solid state drives, removable storage media -- including flash drives and DVDs. Secondary memory is not accessed directly by the CPU as it is with primary memory. Instead, data from secondary memory is loaded into RAM then sent to the processor. It transfers the requested data to an intermediate area in primary storage. While secondary memory is much slower than primary memory, it offers greater storage capacity

Secondary memory or secondary storage or Auxiliary memory is the slowest and cheapest form of memory. It cannot be processed directly by the CPU. It must first be copied into primary storage (also known as RAM). Secondary memory devices include:

a. Magnetic disks like hard drives and floppy disks
b. Optical disks such as CDs and CDROMs
c. Magnetic tapes

Hard Drives

A hard disk is fixed inside the cabinet of CPU (Central Processing Unit). It is made up of many rigid metal platters coated to store data magnetically. The normal speed of hard disks is 3600 revolutions per second. The read/write head of the hard disks moves across its surface. The storage capacity of the hard disks is many times more than the floppy disks.

CD-ROM

CD-ROM stands for Compact Disk – Read Only Memory can store up to 600 to 750 MB of data in it. Once the data is stored into the CD ROM it cannot be erased. In case of Re-writable CDs, the data can be erased and it can be re-used. Fig. 60

Fig. 60: Diagram of CD-ROM

DVD – Digital Versatile Disk can store upto 4.75 GB of data.

Pen Drive

Pen Drive is a small storage device that can be connected to a computer via standard USB (Universal Serial Bus). It is usually removable, re-writable and easy to carry. It operates fast and capable of holding more data than CD and Floppy.

External Hard Disk

An external hard drive is a portable storage device that can be attached to a computer through a USB. External hard drives typically have high storage capacities than pen drives and are often used to back up computers or serve as a network drive.

Secondarymemory(orsecondarystorage)istheslowestandcheapestformofmemory.Itprovidesveryhighstoragecapacity.Itcannotbeaccesseddirectlybythe CPU.Secondarymemorydevicesincludemagneticdiskslikeharddrivesandfloppydisks;opticaldiskssuchasCDsandCDROMs;andmagnetictapes,whichwere the first forms of secondary memory.

Hard Disks:

The hard disk is a magnetic disk. Access to data is faster than access to floppy disks. Hard disks store more data than floppy disks. They are more reliable then floppy disks - there is better protection against dirt. Hard disks are used to store the operating system, application software and users' files. A hard disk is made of a rigid disk. Hard disks spin much more quickly than floppy disks and the disk read/write head is positioned very close to the disk. Because the disk head is positioned so close to the disk hard drives can easily be damaged by dust or vibration. Therefore to protect the disk sealed case is used. This picture shows a hard disk drive with the case removed. Disks in Hard drive are also called Platters.

Secondary storage devices are used to store, save, to backup, and even to transport files consisting of data or programs from one location or computer to another outside the primary storage facilities or outside the CPU. Secondary storage is nonvolatile. Files are written to and read from secondary storage. Today’s secondary storage devices are routinely used for a variety of task that were impossible just a few years ago. For example, CDs and DVDs can be used for storage of data that can be used over and over again. You can use them to download music from the Internet, play it on your computer and create custom CDs with the right hardware and software. This unit consists of the external memory called disk or tape for storing data and information. The purposes of the secondary memory include:

- Storing data/information for retrieval at a later day.
- Supply the data and instructions to the CPU (Output operations).
- Receiving the results from the CPU (Output operations).
- Save data for retrieval at a later day.

Some important characteristics of secondary storage include:

- Media or medium which is the actual physical material that holds the data and programs.
- Capacity measures how much a particular storage medium can hold.
- Storage devices are hardware that reads data and programs from storage media. Most also write to storage media.

- Access speed or access time measures the amount of time required by the storage device to retrieve data and programs.

Most desktop microcomputer systems have floppy, hard and optical disk drives. The popular secondary memory includes:

3.4.1 Floppy Disk.

Floppy disks are removable storage media. This is also called Diskettes. They hold data or programs in the form of magnetized spots on plastic platters. The number of characters that can be stored on disk by a disk drive is dependent on the following three basic factors:

- The number of sides of the disk used.
- The recording density of the bits on a track.
- The number of tracks on the disk.

The traditional floppy disk is divided into the following:

3.4.2 The traditional disk.

This traditional disk has 1.44MB and is 3½ inch disk. The most common type is labeled 2HD which means two-sided, High Density (HD). This means data can be stored on both sides of the disk. This disk has the capacity of 1.44 megabytes, the equivalent of over 350 typewritten pages.

3.4.3 Hard Disk Drive.

This is a standard feature of a modern personal computer. It disk drives stores data on a number of rigid platters covered within a vacuum to protect against dust and contaminants. The advantages include: large storage capacity ranging from 850Mb to 10 GB, equivalent of three million and fourteen million pages of text. Note that 1GB is approximately 1000MB. It is a faster means of storing and retrieving data than a floppy disk. It is relatively inexpensive to purchase or replace. The disadvantages include: It is delicate and easily damaged. It is a fixed part of a computer and it is not portable.

3.4.4 Zip disks.

This is a portable storage device with larger capacity than the traditional floppy disk typically has a 100MB, 250MB, or 750MB capacity. That is over 500 ties such as today's standard floppy disk. The features include: It has a larger capacity capable of storing 100MB of data or more. It is portable and faster than floppy disk drive. They are slow when compared to hard disk drives. They store multimedia, database, and large text and spreadsheet files.

3.4.5 HiFD disks.

They have a capacity of 200MB or 720MB. They are able to read and store data on today's 1.44MB traditional disk as well as on their own higher capacity disks.

3.4.6 Super Disks.

They have a 120MB or 240MB capacity. They are able to use today's 1.44MB standard disks.

3.4.7 Optical Disks.

This is a removable disk on which data is written and read through the use of laser beams. The followings are some of the Optical Disks:

- **CD-ROM.** This is called Compact Disc Ran on Memory. It was launched in 1982. Data is stored by using a laser beam. There are two types of CD-ROM according to their function:
- **CD-R**. This abbreviation stands for Compact Disk Readable. This is the type of CD that write once, read many or record once and cannot be re-written again. After recording, the data cannot be altered or modified. This type of CD is only useful to storing documents such as examinations that can only be read and not to be altered.

- **CD-RW**. This abbreviation stands for Compact Disk Re-writeable or Compact Disk Recordable. In this type of CD, documents are written and can also be erased.

The general storage capacity of the CD-ROMs range from 500MB to 700MB and to a few GB. These devices have become very popular because of their portability and compact size. They have the advantages of storing data in digital form allowing music, graphs and sound to be stored. They have very high storage capacity of about 650Mb – 1000Mb and can contain more than 2 million pages of text or 85 minutes of high-quality music. The cost is very low and the drive can be repaired. Other characteristics of the CD-ROMs are:

a. CD-ROMs are very useful in distributing large amount of information to different users
b. Mass replication of the data by stamping CD-ROMs is inexpensive and fast
c. Since the CD-ROMs are removable and portable, they are good choice for constructing archival storage

The disadvantages of the CD-ROMs are that they are relatively fragile and can easily be damaged by accidental scratches or exposure to heat. The drives are relatively slow. The CD-Rs are read-only medium and cannot be changed. The access time of the CD-ROMs is higher than magnetic devices.

- **Digital Versatile Disc (DVD).** It became popular in 1997. It is similar to CD-ROM. It offers extreme high storage capacity of about 5 GB to 10Gb. Data on DVD can be accessed at very high speeds. Also note that 1gb=1000mb.

3.4.8 Flash Drive otherwise called Universal Serial Bus.

Universal Serial Bus (USB) is Windows –Based compatible. It combines with a Peripheral component interconnect (PCI) with a bus on the system board to support several external devices without using expansion cards or slots. The first USB was called USB 1.1 and is over twice as fast as the AGP bus. A recent new version of USB is called USB 2.0 which has been introduced and it is 40 times faster than the USB 1.1. There are today different capacity of USB such as 1GB, 2GB, 4GB, 8GB, 16GB and 32GB. They are capable of:

- Dual booting.
- Partition Encrypt-free to adjust encrypt space.
- New write-protect message box.
- Driverless.
- No eternal power supply.
- Can re-write one million and above.
- Hot plug and play.
- Anti-shake and waterproof, proof for high or low temperature.
- All good hardware is compatible with USB.

3.4.9 Magnetic Ink Character Recognition (MICR).

Magnetic Ink Character Recognition (MICR) is one of the direct entry devices. It has been a common storage medium for more than three decades. It can identify and decode characters printed with special ink that contains particles of magnetic material. The reading process is called Magnetic Ink Character Recognition.

- **The Advantages of MICR**

a. The MICR possesses a very high reading accuracy.
b. Cheques can be handled directly without transcribing the on floppy disk, magnetic tape etc.
c. Cheques can be read both by human beings and machines.

- **The Disadvantages of MICR**:

a. MICR has found much favor from business.
b. Damaged documents, cheques not encoded with amount etc, have still to be clerically processed.

3.4.10. Optical Character Reader

An optical character Reader (OCR) is one of the direct entry devices that recognizes or interprets printed or handwritten data directly from documents. The essence of OCR is pattern recognition. It has employed a set of printing characters with standard font that can be read by both human and machine readers.

- **Advantages of OCR.**
  - ♦ OCR eliminates the human effort of transcription.
  - ♦ Paper work explosion can be handled because OCR is economical for a high rate of input.
  - ♦ Since documents have only to be typed or handwritten, not very skilled staff is required.
  - ♦ Input preparation devices like typewriters are much cheaper than the keypunch or key to tape devices.
- **Disadvantages of OCR**
  - ♦ Rigid input requirements.
  - ♦ Most optical readers are not economically feasible unless the daily volume of transactions is relatively high.

3.4.11. Bar Code Reader.

This is one of the direct entry devices. Certain data like the product codes of groceries or books etc can be recorded on small strips; optical reading is done by using printed "bar-codes". This type of mark is an alternating lines and spaces which represent data in binary form.

3.4.12. Optical Mark Reader.

Optical Mark Reader (OMR) is commonly used for scoring tests. It is marked by the person taking the test, and can be read by the optical mark page reader. The OMR when on-line to the computer systems can read up to 2000 documents per hour.

3.5 Computer Output

Output devices bring information OUT of a computer system. These output devices are also known as peripherals since they surround the CPU and memory of a computer system. They are grouped into:

1. Image, Video output devices are:
   a. Printer
   b. Monitor
2. Audio output devices are:
   a. Speakers
   b. Headset

3.5.1 Output Devices.

The output devices are systems that allow information to come out of the computer as a result of processing data. The most common types of output are text, graphics, audio, and video. These include the Monitors (black or color), Plotters, Printers (laser, Inject or dot-matrix), Voice Output, Speakers, Modem, and Scanners. The output can appear in a variety of forms

such as binary numbers, as characters, pictures and as printed pages. The output devices include:

3.5.2 Monitors.

The monitoroften implies graphics capabilities often known as visual display unit(VDU). The monitor can be classified based on color (a) Monochrome-two colors as one for the background and one for the foreground. The second one is the grey-scale and the third one is the color. The color can be displayed ranging from 16 to 1 million different colors. The monitor can also be classified based on signals. Thus, digital monitor and analogue monitor. The characteristics of the monitor can be divided into: size, resolution, bandwidth, refresh rate, interlaced or non-interlaced, dot-pitch, and convergence. Again the monitor can have different video standards as Video Graphics Array (VGA) which uses analogue signals; Super VGA is a set of graphics standards designed to offer greater resolution than VGA; and Extended Graphics Array (XGA) is higher than the SVGA.

3.5.3 Plotters. This is use for creating graphics and drawing.

3.5.4 Voice Output.

This is mostly used in the bank, bus terminal, and airline and for handicapped persons.

3.5.5 Sound Card and Speakers.

Sound card enable the computer to output sound through speakers (controlling information during lectures, seminars, symposium and any social gathering).

3.5.6 Modem.

This is a system which is attached to your telephone socket and enables you to send and receive messages over the phone line.

3.5.7 Printers

There are different types of printers that you can choose and use depending on the type of documents you want to use. Basically, there are three types of printers, as indicated in Fig 61:

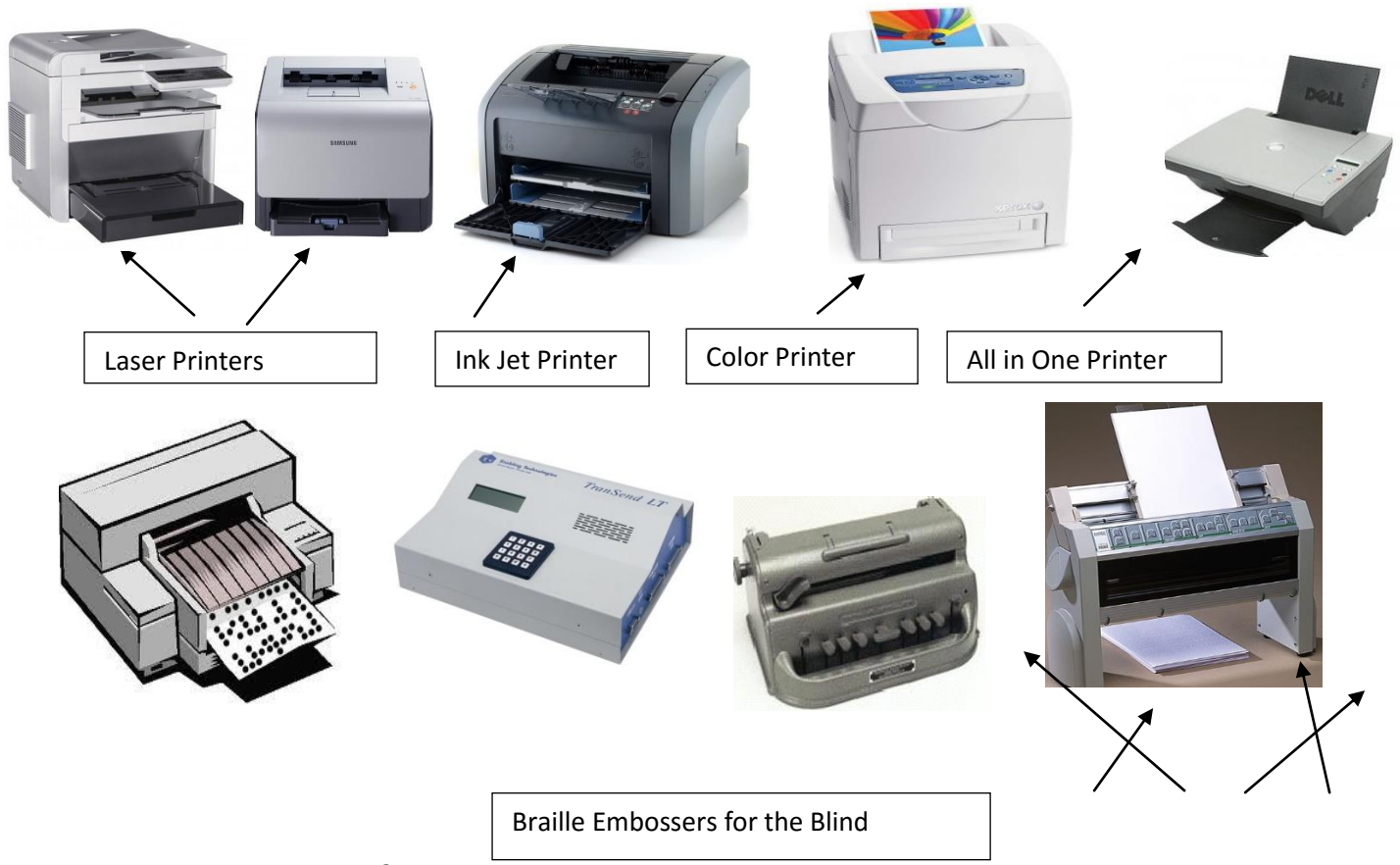


Fig. 61: Varieties of Printers

1. **Laser Printer** is known for providing home, school and business with various versions of printers and less expensive.
2. **Laser colour printer.** A computer printer can now use for everything from legal documents, to high quality photos, to t-shirt prints, to the latest in three-D print technology
3. **Ink jet Printer.** It is a kind of colour non-impact spray small dots of electrically charged ink onto a paper to form images. Ink jet printer are flexible enough to be used as plotters
4. **All in one printer.** Laser all-in-ones are built for high volume, with many capable of printing up to 10,000 pages a month. It has both laser and inkjet with that offer high-yield cartridges. Many laser all-in-ones only print in black-and-white (monochrome), which helps keep printing costs down. Some color lasers even print on glossy paper, which is great for business brochures, but the quality is not on a par with inkjet photo prints.
5. **A braille Printer/embosser.** This is also called a braille display as an electronic device that allows a blind person to read the text displayed on a computer monitor with various types as indicated in Fig… above.

Inkjet Versus Laser Printer. What kind of printer you should buy? Is it inkjet or laser printer. Your choice will depend on how you plan to use your printer. If your primary focus is printing photos, you will want an inkjet. The photo print quality of an inkjet is typically superior to what you would get with a laser printer and you will be able to print on various photo media, including matte papers, in addition to the typical glossy. If your printing needs are more business-oriented, a laser model will likely suit you better, though there are business-oriented inkjets, as well. Laser printers' razor-sharp text printing cannot be beat, nor can their speed.

3.5.8 Combination of Input and Output devices

The following are combination of input and output devices as indicated in Fig. 62:

a. Speaker
b. GSM
c. Fax machines
d. Scanner
e. Telephone
f. Modem
g. Touch screen
h. CD/DVD
i. Headset
j. Pen drive
k. USB

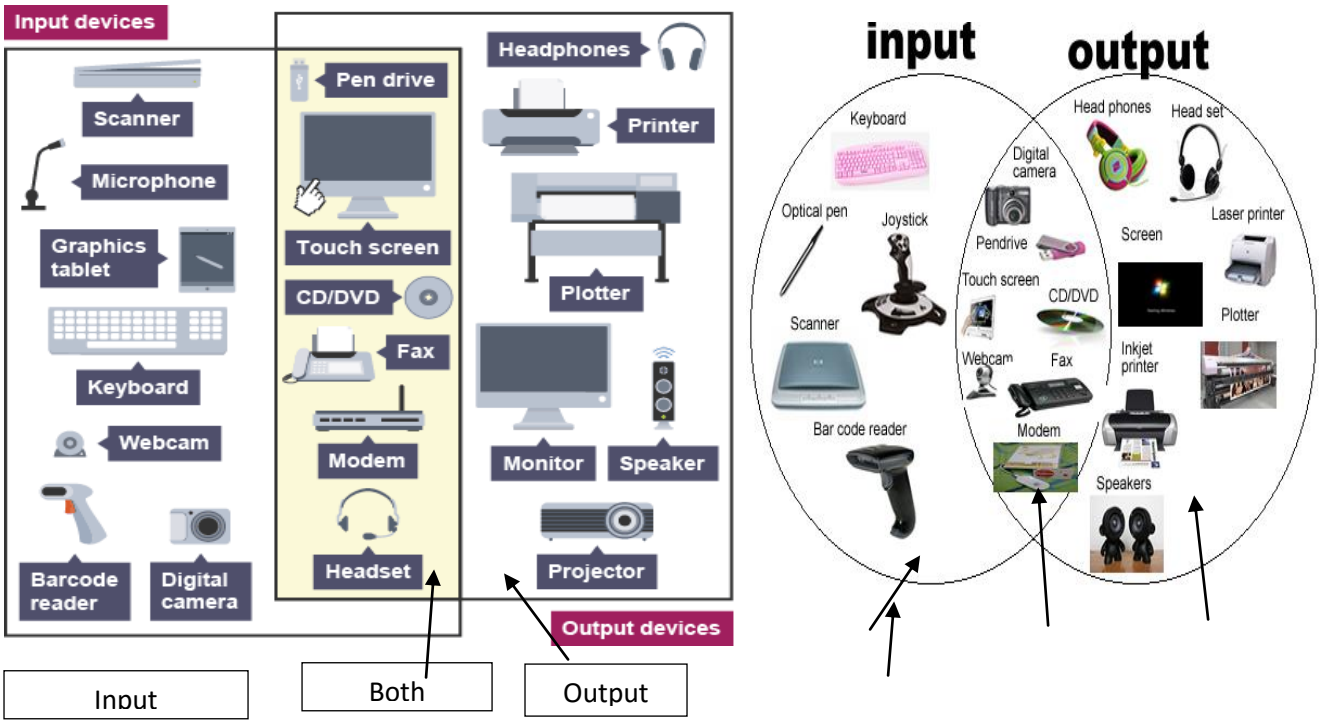


Fig. 62: Input and Output devices

Input devices accept data or commands in a form useable by computers like a Mouse or joystick.
Output devices display the processed information – printers, monitors, speakers as indicated above. Note that there are also devices that perform both functions (Input and Output) like a Camera. You can take the image and at the same time view the images (Input and output function).Output can be both Softcopy and hardcopy.

3.5.9 Difference between Input and Output Devices

Input and output devices perform two types of operations in a computer system. Input is any data that we send to a computer for processing. That can be an image from a Digital Camera, or some letters types via keyboard in a word document. Output is the result of the data we can see through some output device like a picture displayed by the Monitor, a word documented printed by a printer etc

4.0 Conclusion

The computer has different components namely: input unit, CPU unit, primary memory, secondary memory and output units. As such they are expensive resource and so requires adequate protection from electrical damage. Similarly, the UPS is an expensive resource which require adequate protected from electrical damage, too. Therefore, in practice, it is desirable that the UPS be protected by a voltage stabilizer which is rugged and less expensive. This arrangement is desirable in a situation of electrical surge and blown out of system as a result of high current emanating from generator, PHCN, NESCO or any other power source.

5.0 Summary

We have discussed various components of a computer which is really a collection of separate items working together as a team-with the user as the captain. It is also important to note that some of these components are essential while others are simply making your working more pleasant or efficient. There are four different names associated with the computer which are often call: (a) System of a computer (b) Part of a computer (c) Anatomy of a computer and, (d) Elements of a computer. We also examined what constitute the input, the CPU and its generation, Primary memory, Secondary memory and output units of the computer. We were able to identify some auxiliary devices that create a facilitative and conducive environment for smooth operation of computers and the user. Voltage stabilizers also help to protect computing equipment from damage due to power surge. Uninterrupted Power Supply (UPS) was also identified as a device that protects the computing equipment and the software from power outage during computing session. The UPS with the help of its internal battery stores electrical energy while power is on and releases power stored to the computer whenever power is off. This enables the user to end the working session and shut down normally. We discussed that a voltage transformer is a device meant to step up or step down a voltage as the case may be.

6.0 Tutor-Marked Assignment

1. (a). List the five components of the computer
   (b). Identify five systems that serve as both input and output devices of the computer

7.0 References/Further Reading

More recent editions of these books are recommended for further reading.

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Sharp, V. (1996). Computer Education for Teachers. Boston: McGraw Hill.

Turban, E., Rainer, R., Potter, R.E., (2007). Introduction to Information Technology, 2nd Ed. New Delhi. Wiley Indian Edition.
In addition to the above books, you can browse on the Internet to get additional materials on the topics covered in this course.

MODULE 3: COMPUTER SOFTWARE

In this module we shall discuss computer software under the following headings:

a. System software
b. Language translators
c. Utility software
d. Application software

Unit 1: Component of the Computer Software

Content

1.0 Introduction

The computer hardware are driven by the software. The usefulness of the computer depends on the programs that are written to manipulate it. Computer software come indifferent forms: the operating system, utility software, language translators and application software. When you turn on a computer after it has been powered off, you are performing a **cold boot**. When you restart a computer that already has been powered on, you are performing a **warm boot**. You can perform a warm boot by pressing a combination of keys on the keyboard (in Windows, CTRL+ALT+DEL), selecting options from a menu, or pressing a Reset button on the computer. If you watch the screen closely as the POST is conducted, the value for the total amount of memory can be seen to change as it is measured in the memory test. If the POST results do not match the data on the CMOS chip, an appropriate message should appear. The boot program typically is the first side, first track, and first sector of the hard disk. When you install an operating system, one of the installation steps involves making an **emergency disk** from which you can start your computer if the hard disk is damaged. We shall also look at utility software, types and the mail-merge programs as in Fig. 63.

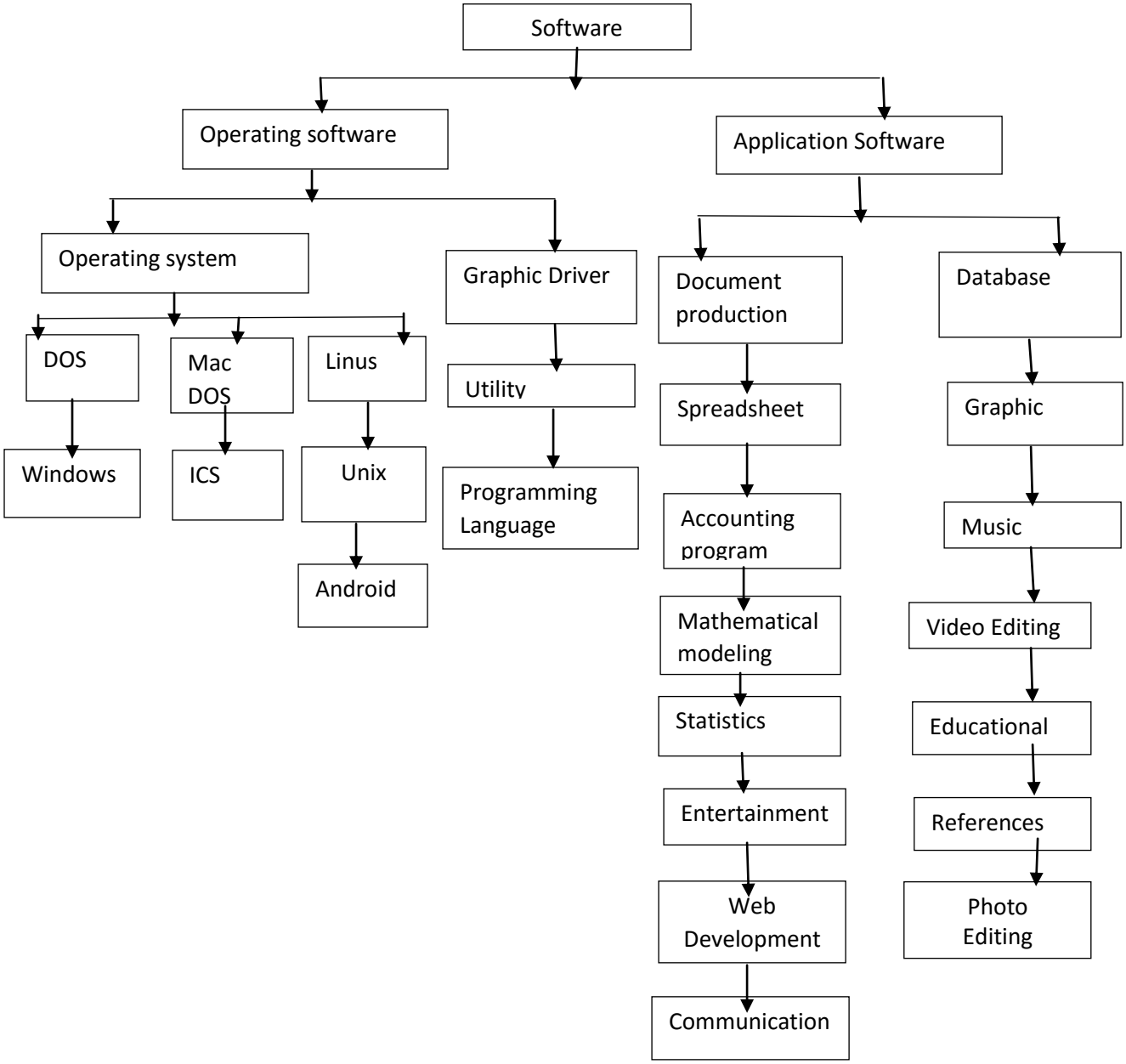

Fig. 63: Type of software

2.0 Objectives

The objective of this unit are to:

a. Identify the different types of computer software.
b. Discuss the importance of each type of software.
c. Explain the language translators.
d. Discuss different categories of utility programs
e. Discuss the mail-merge software

3.0 Main content
3.1 Types of Software

Software are the set of programs that makes the computer system active. However, the computer software could be divided into two major groups namely: System Software (Programs) and Application Software (Programs).

3.1.1 System Software

This refers to the suits of programs that facilitates the optimal use of the hardware systems and/or provide a suitable environment for the writing, editing, debugging, testing and running of User Programs. Usually, every computer system comes with collection of these suits of programs which are provided by the Hardware Manufacturer.

3.1.1.2 Operating System

An operating system is a program that acts as an interface between a user of a computer and the computer hardware. The purpose of an operating system is to provide an environment in which a user may execute programs. The operating system is the first component of the systems programs that interests user. Systems programs are programs written for direct execution on computer hardware in order to make the power of the computer fully and efficiently accessible to applications programmers and other computer users. Systems programming is different from application programming because they require an intimate knowledge of the computer hardware as well as the end users' needs. Moreover, systems programs are often large and more complex than application programs, although that is not always the case. Since systems programs provide the foundation upon which application programs are built, it is most important that systems programs are reliable, efficient and correct. In a computer system the hardware provides the basic computing resources. The applications programs define the way in which these resources are used to solve the computing problems of the users. The operating system controls and coordinates the use of the hardware among the various systems programs and application programs for the various users. The basic resources of a computer system are provided by its hardware, software and data. The operating system provides the means for the proper use of these resources in the operation of the computer system. It simply provides an environment within which other programs can do useful work.

We can view an operating system as a resource allocator. A computer system has many resources (hardware and software) that may be required to solve a problem: CPU time, memory space, file storage space, input/output devices etc. The operating system acts as the manager of these resources and allocates them to specific programs and users as necessary for their tasks. Since there may be many, possibly conflicting, requests for resources, the operating system must decide which requests are allocated resources to operate the computer system fairly and efficiently. An operating system is a control program. This program controls the execution of user programs to prevent errors and improper use of the computer. Operating systems exist because they are a reasonable way to solve the problem of creating a usable computing system. The fundamental goal of a computer system is to execute user programs and solve user problems. The primary goal of an operating system is a convenience for the user. Operating systems exit because they are supposed to make it easier to compute with an operating system than without an operating system. This is particularly clear when you look at operating system for small personal computers. A secondary goal is the efficient operation of any computer system. This goal is particularly important for large, shared multi-user systems. Operating systems can solve this goal. It is known that sometimes these two goals, convenience and efficiency, are contradictory.

While there is no universally agreed upon definition of the concept of an operating system, we offer the following as a reasonable starting point:

A computer's operating system (OS) is a group of programs designed to serve two basic purposes:

1. To control the allocation and use of the computing system's resources among the various users and tasks, and.
2. To provide an interface between the computer hardware and the programmer that simplifies and makes feasible the creation, coding, debugging, and maintenance of application programs.

Specifically, we can imagine that an effective operating system should accomplish all of the following:

a. Facilitate creation and modification of program and data files through an editor program,
b. Provide access to compilers to translate programs from high-level languages to machine language,
c. Provide a loader program to move the complied program code to the computer's memory for execution,
d. Provide routines that handle the intricate details of I/O programming,
e. Assure that when there are several active processes in the computer, each
f. will get fair and non interfering access to the central processing unit for execution,
g. Take care of storage and device allocation,
h. Provide for long term storage of user information in the form of files, and
i. Permit system resources to be shared among users when appropriate, and be protected from unauthorized or mischievous intervention as necessary.

Though systems programs such as editor and translators and the various utility programs (such as sort and file transfer program) are not usually considered part of the operating system, the operating system is responsible for providing access to these system resources.

3.2 Types of operating system

Modern computer operating systems may be classified into three groups, which are distinguished by the nature of interaction that takes place between the computer user andhis or her program during its processing. The three groups are called batch, time-sharedand real time operating systems.

3.2.1 Batch processing operating system

In a batch processing operating system environment users submit jobs to a central place where these jobs are collected into a batch, and subsequently placed on an input queue at the computer where they will be run. In this case, the user has no interaction with the job during its processing, and the computer's response time is the turnaround time-the time from submission of the job until execution is complete, and the results are ready for return to the person who submitted the job.

3.2.2 Time sharing operating system

Another mode for delivering computing services is provided by time sharing operating systems. In this environment a computer provides computing services to several or many users concurrently on-line. Here, the various users are sharing the central processor, the memory, and other resources of the computer system in a manner facilitated, controlled, and monitored by the operating system. The user, in this environment, has nearly full interaction with the program during its execution, and the computer's response time maybe expected to be no more than a few second.

3.2.3 Real time operating system

The third classes of operating systems, real time operating systems, are designed to service those applications where response time is of the essence in order to prevent error, misrepresentation or even disaster. Examples of real time operating systems are those which handle airlines reservations, machine tool control, and monitoring of a nuclear power station. The systems, in this case, are designed to be interrupted by external signal that require the immediate attention of the computer system. In fact, many computer operating systems are hybrids, providing for more than one of these types of computing service simultaneously. It is especially common to have a background batch system running in conjunction with one of the other two on the same computer.
A number of other definitions are important to gaining an understanding of operating systems:

3.2.4 Multiprogramming operating system

A multiprogramming operating system is a system that allows more than one active user program (or part of user program) to be stored in main memory simultaneously. Thus, it is evident that a time-sharing system is a multiprogramming system, but note that a multiprogramming system is not necessarily a time-sharing system. A batch or real time operating system could, and indeed usually does, have more than one active user program simultaneously in main storage. Another important, and all too similar, term is multi processing'.
A multiprocessing system is a computer hardware configuration that includes more than one independent processing unit. The term multiprocessing is generally used to refer to large computer hardware complexes found in major scientific or commercial applications. A **multiprocessing** operating system can support two or more CPUs running programs at the same time. Managing memory involves assigning items to an area of memory while they are being processed. The purpose of **memory management** is to optimize use of random access memory (RAM). With **virtual memory** (**VM**), the operating system optimizes memory by allocating a portion of a storage medium, usually the hard disk, to function as additional RAM. Scheduling **jobs** (operations the processor manages) involves determining the order in which jobs are processed
A networked computing system is a collection of physical interconnected computers. The operating system of each of the interconnected computers must contain, in addition to its own stand-alone functionality, provisions for handing communication and transfer of program and data among the other computers with which it is connected. A distributed computing system consists of a number of computers that are connected and managed so that they automatically share the job processing load among the constituent computers, or separate the job load as appropriate particularly configured processors. Such a system requires an operating system which, in addition to the typical stand-alone functionality, provides coordination of the operations and information flow among the component computers.
The networked and distributed computing environments and their respective operating systems are designed with more complex functional capabilities. In a network operating system the users are aware of the existence of multiple computers, and can log in to remote machines and copy files from one machine to another. Each machine runs its own local operating system and has its own user (or users).

3.2.5 Distributed operating system

A distributed operating system, in contrast, is one that appears to its users as a traditional uniprocessor system, even though it is actually composed of multiple processors. In a true distributed system, users should not be aware of where their programs are being run or where

their files are located; that should all be handled automatically and efficiently by the operating system.

Spooling increases efficiency by placing print jobs in a **buffer** (an area of memory or storage where data resides while waiting to be transferred) until the printer is ready, freeing the processor for other tasks. Configuring devices establishes communication with each device in the computer. A **device driver** is a small program that tells the operating system how to communicate with a device. Accessing the Web may entail including a Web browser and e-mail program in the operating system. Monitoring performance helps to identify and solve system problems.

Network operating systems

Network operating systems are not fundamentally different from single processor operating systems. They obviously need a network interface controller and some low-level software to drive it, as well as programs to achieve remote login and remote file saccess, but these additions do not change the essential structure of the operating systems. True distributed operating systems require more than just adding a little code to a uniprocessor operating system, because distributed and centralized systems differ in critical ways. Distributed systems, for example, often allow program to run on several processors at the same time, thus requiring more complex processor scheduling algorithms in order to optimize the amount of parallelism achieved.

3.3 Operating system components

An operating system provides the environment within which programs are executed. To construct such an environment, the system is partitioned into small modules with a well defined interface. The design of a new operating system is a major task. It is very important that the goals of the system be will defined before the design begins. The type of system desired is the foundation for choices between various algorithms and strategies that will be necessary.

A system as large and complex as an operating system can only be created by partitioning it into smaller pieces. Each of these pieces should be a well defined portion of the system with carefully defined inputs, outputs, and function. Obviously, not all systems have the same structure. However, many modern operating systems share the system components outlined below.

A **performance monitor** is a program that assesses and reports information about various system resources and devices. Providing housekeeping services entails performing storage and file management functions. A **file manager** performs such functions as **formatting** and copying disks; listing the files on a storage medium; checking the amount of used and unused space on a storage medium; organizing, copying, deleting, moving, and sorting files; and creating **shortcuts** (icons on the desktop that run a program when clicked).Administering security involves establishing user accounts on a network. Each account typically requires a **user name** and a **password** to **log on**, or access, the network

Self-Assessment Exercise

a. Discuss the role of operating system in a computing environment.
b. Differentiate between multi-user operating system and network operating system.

3.3.1 Process Management

A process is the unit of work in a system. Such a system consists of a collection of processes, some of which are operating system processes, those that execute system code, and the rest

being user processes, those that execute user code. All of those processes can potentially execute concurrently.
The operating system is responsible for the following activities in connection with processes managed.

a. The creation and deletion of both user and system processes
b. The suspensions are resumption of processes.
c. The provision of mechanisms for process synchronization
d. The provision of mechanisms for deadlock handling.

3.3.2 Memory Management

Memory is central to the operation of a modern computer system. Memory is a large array of words or bytes, each with its own address. Interaction is achieved through a sequence of reads or writes of specific memory address. The CPU fetches from and stores in memory.
In order for a program to be executed it must be mapped to absolute addresses and loaded in to memory. As the program executes, it accesses program instructions and data from memory by generating these absolute is declared available, and the next program may be loaded and executed.
The operating system is responsible for the following activities in connection with memory management.

a. Keep track of which parts of memory are currently being used and by whom.
b. Decide which processes are to be loaded into memory when memory pace becomes available.
c. Allocate and deallocate memory space as needed.

3.3.3 Secondary Storage Management

The main purpose of a computer system is to execute programs. These programs, together with the data they access, must be in main memory during execution. Since the main memory is too small to permanently accommodate all data and program, the computer system must provide secondary storage to backup main memory. Most modem computer systems use disks as the primary on-line storage of information, of both programs and data. Most programs, like compilers, assemblers, sort routines, editors, formatters, and so on, are stored on the disk until loaded into memory, and then use the disk as both the source and destination of their processing. Hence the proper management of disk storage is of central importance to a computer system. The operating system is responsible for the following activities in connection with disk management

a. Free space management
b. Storage allocation
c. Disk scheduling.

3.3.4 I/O System. One of the purposes of an operating system is to hide the peculiarities of specific hardware devices from the user. For example, in Unix, the peculiarities of I/O devices are hidden from the bulk of the operating system itself by the I/O system. The I/O system consists of:

a. A buffer caching system
b. A general device driver code
c. Drivers for specific hardware devices.

Only the device driver knows the peculiarities of a specific device.

3.3.5 File Management

File management is one of the most visible services of an operating system. Computer scan store information in several different physical forms; magnetic tape, and drum are the most common forms. Each of these devices has it own characteristics and physical organization. For convenient use of the computer system, the operating system provides a uniform logical view of information storage. The operating system abstracts from the physical properties of its storage devices to define a logical storage unit, the file. Files are mapped, by the operating system, onto physical devices. A file is a collection of related information defined by its creator. Commonly, files represent programs (both source and object forms) and data. Data files may be numeric, alphabetic or alphanumeric. Files may be free-form, such as text files, or may be rigidly formatted. In general a files is a sequence of bits, bytes, lines or records whose meaning is defined by its creator and user. It is a very general concept.

The operating system is responsible for the following activities in connection with file management:

a. The creation and deletion of files
b. The creation and deletion of directory
c. The support of primitives for manipulating files and directories
d. The mapping of files onto disk storage.
e. Backup of files on stable (non-volatile) storage.

3.3.6 Protection System

The various processes in an operating system must be protected from each other's activities. For that purpose, various mechanisms which can be used to ensure that the files, memory segment, CPU and other resources can be operated on only by those processes that have gained proper authorization from the operating system. For example, memory addressing hardware ensures that a process can only execute within its own address space. The timer ensures that no process can gain control of the CPU without relinquishing it. Finally, no process is allowed to do its own I/O, to protect the integrity of the various peripheral devices. Protection refers to a mechanism for controlling the access of programs, processes, or users to the resources defined by a computer controls to be imposed, together with some means of enforcement.

Protection can improve reliability by detecting latent errors at the interfaces between component subsystems. Early detection of interface errors can often prevent contamination of a healthy subsystem by a subsystem that is malfunctioning. An unprotected resource cannot defend against use (or misuse) by an unauthorized or incompetent user.

3.3.7 Networking

A distributed system is a collection of processors that do not share memory or a clock. Instead, each processor has its own local memory, and the processors communicate with each other through various communication lines, such as high speed buses or telephone lines. Distributed systems vary in size and function. They may involve micro processors, workstations, minicomputers, and large general purpose computer systems. The processors in the system are connected through a communication network, which can be configured in the number of different ways. The network may be fully or partially connected. The communication network design must consider routing and connection strategies, and the problems of connection and security. A distributed system provides the user with access to the various resources the system maintains. Access to a shared resource allows computation speed-up, data availability, and reliability.

3.3.8 Command Interpreter System

One of the most important component of an operating system is its command interpreter. The command interpreter is the primary interface between the user and the rest of the system. Many commands are given to the operating system by control statements. When a new job is started in a batch system or when a user logs-in to a time-shared system, a program which reads and interprets control statements is automatically executed. This program is variously called (1) the control card interpreter, (2) the command line interpreter, (3) the shell (in Unix), and so on. Its function is quite simple: get the next command statement, and execute it. The command statement themselves deal with process management, I/O handling, secondary storage management, main memory management, file system access, protection, and networking.

Stand-Alone Operating Systems

Bill Gates, founder of Microsoft and one of the wealthiest men in the world, began his fortune with the MS-DOS operating system. Although developed for IBM, Microsoft retained the rights to the operating system and licensed the source code to several hardware manufacturers, which resulted in multiple variations. An application written for one type of DOS, however, will work with any other variation. A number follows each version of PC-DOS or MS-DOS. The integer portion of the number indicates a major release, while the decimal portion indicates updates. Thus, MS-DOS 6.2 means major version six, which has been updated twice. To a great extent, the popularity of DOS was a result of the large number of applications written to work with the operating system.

Windows 1.0, released in 1985, was Microsoft's first attempt with a graphical user interface. It was not until five years later, however, with the release of Windows 3.0, that computer users began to take Windows seriously. Windows required 2 MB of memory (with 4 MB recommended) and an 80386 or newer processor, so it could not be used with many older PCs. Nevertheless, because Windows 3.0 was easier to use than DOS, eventually most software was written, and many popular DOS programs were rewritten, to work with Windows.

Despite the advantages of Windows 95 and a heavily-funded promotional campaign, a poll of DOS and Windows 3.x users showed not everyone immediately embraced the new operating system. When asked how likely they were to adopt Windows 95 within the next six months, respondents replied:

a. extremely likely 10%
b. possible 35%
c. not likely 53%
d. don't know 2%

Why are people often reluctant to adopt a new operating system?

The inclusion of Internet Explorer in the Windows 98 operating system led to an antitrust suit against Microsoft. Prosecutors insisted that the incorporation of a browser was an attempt by Microsoft to eliminate competition from rival Web browsers (such as Netscape Navigator). Microsoft maintained that the addition simply was an enhancement to the operating system. Although Microsoft advertised Windows 98 less heavily than Windows 95, many vendors took up the slack. One retailer offered Windows 98 with the opportunity to buy a new computer for $98. The promotion evidently worked. A buyer waited in line 11 hours for a chance to buy the new operating system and discount computer. When asked if he would have come out simply for Windows 98 (his current computer ran Windows 3.1), he replied, "Not a chance."

Windows 2000 was released in February, 2000 and was touted as a boon for all businesses, from small companies with no more than two desktop computers to large corporations with

vast networks. Windows Millennium is a result of Microsoft's recognition that the needs of business and home users are different.

For years, the Macintosh operating system had features that made it far easier to use than other operating systems. For example, people could give files sensible names (like "Letter to Grandma") instead of the cryptic, eight-character strings (like "letgrand.txt") demanded by DOS and Windows 3.x. While Windows 95 incorporated many of these features, Macintosh devotees still feel their operating system is easier to use. Until recently, the Macintosh operating system was proprietary. In 1994 the operating system was licensed, but experts feel Apple's promotion has been lukewarm. New standards let IBM computers run Apple software. More than 4,000 applications are designed to run under the Mac OS. Microsoft has developed the more popular Mac OS applications.

IBM supplies OS/2 (Operating System/2) Warp with its high-end personal computers. OS/2 originally was developed jointly by IBM and Microsoft to replace MS-DOS. As an interim measure, Microsoft developed Windows, an operating environment to work with DOS. The eventual popularity of Windows, coupled with the initial poor sales of OS/2, resulted in Microsoft and IBM going their separate ways, with Microsoft concentrating on Windows and IBM continuing to develop OS/2. Features offered in OS/2 Warp include:

a. An enhanced graphical user interface
b. Integrated business application software
c. Speaker-independent speech recognition software
d. Desktop objects that allow users to connect directly to the Internet
e. Integrated Java programming language that allows Java applications to run without a Web browser
f. Support for multiple CPUs using multiprocessing

Network Operating Systems

Many consider UNIX to be the most portable operating system. Although it has some shortcomings, UNIX often is used in "turnkey" systems designed for retail stores, doctors, dentists, veterinarians, and other small- to medium-businesses. Do you know what operating system is mentioned in the film *Jurassic Park*? UNIX. Despite the current dominance of Windows, some believe Linux is the operating system of the future. Because Linux is freeware, users can modify and improve the program code. In addition, Linux is capable of running efficiently with less powerful processors, even the 80386.

Embedded Operating Systems

The latest Palm handheld computer, Palm IIIC, offers a color screen. When paired with a portable, expandable, attachable, nearly full-sized keyboard and file compression software, some reviewers say the Palm IIIC almost can replace a laptop. The Visor handheld computer runs the same operating system as the Palm but offers several additional features – videogames, cell telephone, modem, MP3 player, and two-way pager – at about half the cost.

3.4 Language Translator

A programming language is a set of notations in which we express our instructions to the computer. At the initial stage of computer development, programs were written in machine language conducting the binary system i.e. 0 and 1. Such programs were hard to write, read, debug and maintain. In an attempt to solve these problems, other computer languages were developed. However, computers can run programs written only in machine language. There is therefore the need to translate programs written in these other languages to machine language. The suites of languages that translate other

languages to machine language are called **Language Translator.** The initial program written in a language different from machine language is called the **source program** and its equivalent in machine language is called object program. Three examples of classes of language translators are Assemblers, Interpreters and Compilers.

1. **Assemblers:** It is a program used for converting the code of low level language (assembly language) into machine level language. This is a program, which translate assembly language into machine code. It also a computer program that accepts a source program in assembly language program reads and translates the entire program into an equivalent program in machine language called the object program or object code. Each machine has its own assembly language, meaning that the assembly language of one machine cannot run on another machine. One machine instruction is generated for each source instruction. The resulting program can only be executed when the assembly process is completed. The assembler reserves space for the instructions and data, replaces mnemonic operating codes by machine codes and symbolic addresses by numeric addresses while it determines the machine representation of constants.
2. **Functions of the Assembler**.
    a. It translate mnemonic operation codes, and symbolic addresses into machine addresses.
    b. Includes the necessary linkages for closed subroutines and insert appropriate machine code for macros.
    c. Allocates area of storage.
    d. Detects and indicates invalid source language instructions.
    e. Produces the object program on disk as required.
    f. Produces a printed listing of the source and object program with comments.

3. **Interpreter:** An Interpreter is a program that read source program, translates it and goes ahead to execute it. It is a program that accepts program find a source language, reads, translates and executes it, line by lone into machine language. The Interpreter is more easily understood by comparing them with compiler. Both compilers and interpreters are commonly used for the translation of high-level language program but they perform the translation in two completely different ways. In the compiler, the whole of the high level language source program is converted into machine code object program prior to the object program being loaded into main memory for execution. This in contrast to the interpreter which deals with the source program one instruction at a time, completely translating and executing each instruction before it goes onto the next. Interpreter seldom produce object codes but call upon in-built routines instead. However, some intermediate codes are usually produced temporarily. The interpreter does not produce object program, rather, it read source program, translates it and goes ahead to execute it. The object program provided by a compiler fastens execution than any interpreter can do in the running of a program, the use of object program may however pose a problem where there is an error as it is very time consuming to discover the source of error, a compiler is capable of producing a machine code generated by it at any time, whereas an interpreter can only execute the source program. If a computer is used, the same program needs only to be translated once. Thereafter, the object program can be loaded directly into main storage and executed. However, when an interpreter is used, the source program will be translated every time the program is executed. Execution carried out in this way may be ten times slower than the execution of the equivalent object programs. Interpreters are

widely used, particularly for the programming language BASIC on small computers, because they are easier to use for beginners than compilers.

Use of Interpreters.

The following are the uses of Interpreters:

a. Handling user commands in an interactive system.
b. They debug programs as they run (i.e. removing faults) i.e. for each line of coding before implemented.
c. Handling software produced for or by different computer. In this case, the interpreter may be essential if:
   - Two dissimilar machines are to be connected together for operation, or
   - If software produced on an old model and not yet converted had to be run on a new one. This procedure is referred to as SIMULATION since interpreter allow the new computer to simulate the behavior of the old
d. Interpreter can also be used to simulate a new machine not yet provided but for which software is already written.

4. **Compilers:** Compilers translate a high level language into machine language. The compiler translate the whole source program into machine code or object program prior to the object being loaded into main memory and execution. The resulting program can only be executed when compilation is completed. The storage of the object program into a diskette facilities future usage of the high level language source program any other time it is needed In a nutshell, a Compiler is a computer program that accepts a source program in one high-level language, reads and translates the entire user's program into an equivalent program in machine language, called the object program or object code.

3.5 Difference between Assembler, Compiler and Interpreter:

Assembler:

a. It is the Computer Program which takes the Computer Instructions and converts them in to the bits that the Computer can understand and performs by certain Operations.

Compiler:

a. It Converts High Level Language to Low Level Language.
b. It considers the entire code and converts it in to the Executable Code and runs the code.
c. C, C++ are Compiler based Languages.

Interpreter:

a. It converts the higher Level language to low level language or Assembly level language. It converts to the language of 0' and 1's.
b. It considers single line of code and converts it to the binary language and runs the code on the machine.
c. It founds the error, the programs need to run from the beginning.
d. BASIC is the Interpreter based Language.

How the Compiler Does Assembler Work.

The compiler perform the following tasks:

a. Translates the source program statements into machine code.
b. Includes linkage for closed subroutines.
c. Allocates areas of main storage.
d. Generates the object program on cards, tapes or disc as required.

e. Produces a printed copy of the source and object program when required.
f. Tabulates list of errors found during program compilation e.g. the use of 'word' or statement not included in the language vocabulary, the rule of syntax or lexis.

The stages in compilation include the following:

a. Lexical analysis
b. Syntax analysis
c. Semantic analysis
d. Code generation

For each high-level language, there are different compilers. We can therefore talk of COBOL Compilers, FORTRAN Compilers, BASIC Compilers, etc. A Compiler also detects syntax errors, errors that arise from the use of the language. Compilers are portable i.e. a COBOL Compiler on one machine can run on a different machine with minimum changes.

3.6 **Comparison of compiler and Interpreter** as in Table 10

Compiler	**Interpreter**
Fast, creates executable file that runs directly on the CPU	Slower, interprets code one line at a time
Debugging is more difficult. One error can produce many spurious errors	Debugging is easier. Each line of code is analysed and checked before being executed
More likely to crash the computer. The machine code is running directly on the CPU	Less likely to crash as the instructions are being carried out either on the interpreters' command line or within a virtual machine environment which is protecting the computer from being directly accessed by the code.
Easier to protect Intellectual Property as the machine code is difficult to understand	Weaker Intellectual property as the source code (or bytecode) has to be available at run time. For example if you write a Flash Action script application, you can easily get de-compilers that convert the p-code back into action script source code (unless you use encryption, but that is another story).
Uses more memory - all the execution code needs to be loaded into memory, although tricks like Dynamic Link Libraries lessen this problem	Uses less memory, source code only has to be present one line at a time in memory
Unauthorized modification to the code more difficult. The executable is in the form of machine code. So it is difficult to understand program flow.	Easier to modify as the instructions are at a high level and so the program flow is easier to understand and modify.

3.7 Comparison of Assembler, compiler and Interpreter, Table 11

Assembler	**Compiler**	**Interpreter**
a. It Converts Machine Manipulation Code Directly into Binary Machine Instruction,	a. It Converts Human Developed Codes into Machine Executable Codes,	a. It reads Source Code one Instruction at a Time,
b. It Gives Most Efficient Executable,	b. Easy for Humans to Create Source code,	b. Converts that Single Line Coding into Machine Code and

c. Some How Difficult to Work with

c. Slight Difficult to Execute,
d. Ex-C,C++,Java, Cobol

Executes it,
c. Ex-PHP, Perl, Java Script.

3.8 Utility Software

This is system software designed to help analyze, configure, optimize or maintain a computer. This is a set of commonly used programs also called service or general-purpose programs. These utility software grouped into the following:

a. Disk defragmenters
b. System Profilers
c. Virus scanners
d. Application launchers
e. Network managers
f. Encryption utilities

They perform the following operations:

1. File sorting
2. File renaming
3. File conversion (e.g. convert a sound file to MP3)
4. File repair
5. Disk monitoring and defragmentation (defragging)
6. Printing jobs
7. Disk defragmenters
8. System Profilers
9. Virus scanners
10. Application launchers
11. network managers
12. Encryption utilities.
13. time utility
14. date utility
15. Dick defragmenter/ back-up / anti-virus / dick clean up / recycle bin
16. Disk formatter: FDISK, format
17. Disk checker: Fsck disk cleaner, system profiler, backup file system compression
18. Files and directories
19. list directory: Ls, dir copy, move,
20. remove: Cp, mv, rm, xcopy
21. archive: Tar compression: Zip format conversion: Atob comparison: Diff sort: Sort
22. Security authentication: Login
23. firewall: Zone Alarm, Windows firewall
24. encryption: Gpg)
25. Editors for general-purpose formats (as opposed to specific formats like a word processing document)
26. text editor: Emacs binary editor, hex editor
27. Communications mail transfer agent: Send mail e-mail notification: Biff file transfer: Ftp, rcp, Firefox file synchronisation: Unison, briefcase chat: Gaim, cu directory services: Bind, nslookup, whois network diagnosis: Ping, trace route remote access: Rlogin, ssh
28. Software development compiler: Gcc build: Make, ant code walker preprocessor: Cpp debugger: Adb, gdb installation: Apt-get, msiexec, patch compiler compiler: Yacc
29. Hardware device configuration: PCU, devman, stty
30. **Anti-virus** utilities such as Avast, Norton Antivirus scan for computer viruses.

31. **Archivers** output a stream or a single file when provided with a directory or a set of files. Archive utilities, unlike archive suites, usually do not include compression or encryption capabilities. Some archive utilities may even have a separate un-archive utility for the reverse operation.
32. **Backup software** can make copies of all information stored on a disk and restore either the entire disk (e.g. in an event of disk failure) or selected files (e.g. in an event of accidental deletion). So a backup **utility** copies, or backs up, selected files or an entire hard drive onto another disk or tape.
33. **Clipboard managers** expand the clipboard functionality of an operating system.
34. **Cryptographic** utilities encrypt and decrypt streams and files.
35. **Data compression** utilities output a shorter stream or a smaller file when provided with a stream or file.
36. **Data synchronization** utilities establish consistency among data from a source to target data storage and vice versa. There are several branches of this type of utility:
    a. **File synchronization** utilities maintain consistency between two sources. They may be used to create redundancy or backup copies but are also used to help users carry their digital music, photos and video in their mobile devices.
    b. **Revision control** utilities are intended to deal with situations where more than one user attempts to simultaneously modify the same file.
37. **Debuggers** are used to test and "debug" other programs, mainly to solve programming errors. Also utilized for reverse engineering of software or systems.
38. **Disk checkers** can scan operating hard drive.
39. **Disk cleaners** can find files that are unnecessary to computer operation, or take up considerable amounts of space. Disk cleaner helps the user to decide what to delete when their hard disk is full.
40. **Disk compression** utilities can transparently compress/uncompress the contents of a disk, increasing the capacity of the disk.
41. **Disk defragmenters** can detect computer files whose contents are scattered across several locations on the hard disk, and move the fragments to one location to increase efficiency.
42. **Disk partitions** can divide an individual drive into multiple logical drives, each with its own file system which can be mounted by the operating system and treated as an individual drive.
43. **Disk space analyzers** for the visualization of disk space usage by getting the size for each folder (including sub folders) & files in folder or drive. showing the distribution of the used space.
44. **Disk storage** utilities
45. **File managers** provide a convenient method of performing routine data management, email recovery and management tasks, such as deleting, renaming, cataloging, uncataloging, moving, copying, merging, generating and modifying data sets.
46. **Hex editors** directly modify the text or data of a file. These files could be data or an actual program.
47. **Memory testers** check for memory failures.
48. **Network utilities** analyze the computer's network connectivity, configure network settings, check data transfer or log events.
49. **Package managers** are used to configure, install or keep up to date other software on a computer.
50. **Registry cleaners** clean and optimize the Windows Registry by removing old registry keys that are no longer in use.

51. **Screensavers** were desired to prevent phosphor burn-in on CRT and plasma computer monitors by blanking the screen or filling it with moving images or patterns when the computer is not in use. Contemporary screensavers are used primarily for entertainment or security such as a dancing baby.
52. **System monitors** for monitoring resources and performance in a computer system.
53. **System profilers** provide detailed information about the software installed and hardware attached to the computer.
54. A **file viewer** is a utility that allows you to display and copy the contents of a file.
55. A **file compression utility** shrinks the size of a file. A **diagnostic utility** compiles technical information about a computer's hardware and certain system software programs and then prepares a report outlining any identified problems.
56. An **uninstaller** is a utility that removes an application, as well as any associated entries in the system files. When an application is installed, the operating system records information it uses to run the software in the system files ° The uninstaller removes this information
57. A **disk scanner** is a utility that (1) detects and corrects both physical and logical problems on a hard disk, and (2) searches for and removes unnecessary files.
58. File Conversion: This covers data transfer from any medium to another, making an exact copy or simultaneously editing and validating. For example, copying from a hard disk to a diskette.
59. File Copy: It makes an exact copy of a file from one medium to another or from an area of a medium to another area of the same medium.
60. Housekeeping Operations: These include programs to clear areas of storage, writing file labels and updating common data. They are not involved in solving the problem at hand. They are operations that must be performed before and after actual processing.
61. Antivirus software, as the name suggests, helps to protect a computer system from viruses and other harmful programs
62. Backup software helps in the creation of a backup of the files on your computer
63. A **device driver** is a computer program that controls a particular device that is connected to your computer. Device drivers act as a translator between the operating system of the computer and the device connected to it.
64. **Firmware** is a combination of software and hardware. It includes the instructions to control hardware, which is just like software. It also includes hardware in the form of the actual memory chip where the instructions are stored. Technically, firmware consists of permanent software stored into read-only memory. Computer systems use a special type of firmware known as *BIOS*, or Basic Input/Output System. It represents the basic code to get the computer started. You can think of BIOS as the firmware for the motherboard of your computer

4.0 Conclusion

Operating system occupies a central place in computer operations. Likewise the utility program manages the hardware and the software. Apart from the operating systems, we need program translators to program and use the computer effectively. Since computers do not understand natural languages, there is the need to have language translators such as assemblers, interpreters and compilers. Utility programs such as file conversion and scandisk on the other hand, enable us to maintain and enhance the operations of the computer.

5.0 Summary

In this unit, we have learnt the following:

a. The operating system is the executive manager of the computer.

b. Different types of operating system.
c. Different functions of operating system.
d. Differences between standalone and networked operating systems
e. Utility programs organize the computer

6.0 Tutor-Marked Assignment

1. (a)Define the term operating system
(b. In a tabular form, differentiate between compiler and interpreter

7.0 References And Further Reading

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UNIT 2: COMPUTER APPLICATION SOFTWARE

Content

1.0 Introduction

Application programs are meant to accomplish specialized tasks they are designed for. There are many different kinds of applications, all with lots of spiffy features namely Word processing, spreadsheet, presentation software, web browser, database and so on. Word processing is the application that is used most often and most widely. We will start with it to learn about the terms and features that are common to most applications and what they do.

2.0 Objectives

The objectives of this unit are to:

a. Explain the concept of application software
b. Discuss the types of application programs.
c. Examine the functions of application software

3.0. Application Software

3.1 The concept of application software

Application software is a program that utilizes the capacities of a computer directly for a dedicated task. Application software is able to manipulate text, numbers and graphics. It can be in the form of software focused on a certain single task like word processing, spreadsheet or playing of audio and video files. Here we look at the application software types along with some examples of application software of each type. Application software is a program or group of programs designed for end users. These programs are divided into two classes: system software and application software. While system software consists of low-level programs that interact with computers at a basic level, application software resides above system software and includes database programs, word processors, spreadsheets, etc. Application software may be grouped along with system software or published alone. Application software may simply be referred to as an application. Applications can also be classified by computing platform such as a particular operating system, delivery network

such as in cloud computing and Web 2.0 applications, or delivery devices such as mobile apps for mobile devices. The operating system itself can be considered application software when performing simple calculating, measuring, rendering, and word processing tasks not used to control hardware via command-line interface or graphical user interface. This does not include application software bundled within operating systems such as a software calculator or text editor. Application software can be classified in different categories: (a) custom-written software (b) off-the-shelf software as in Fig.64

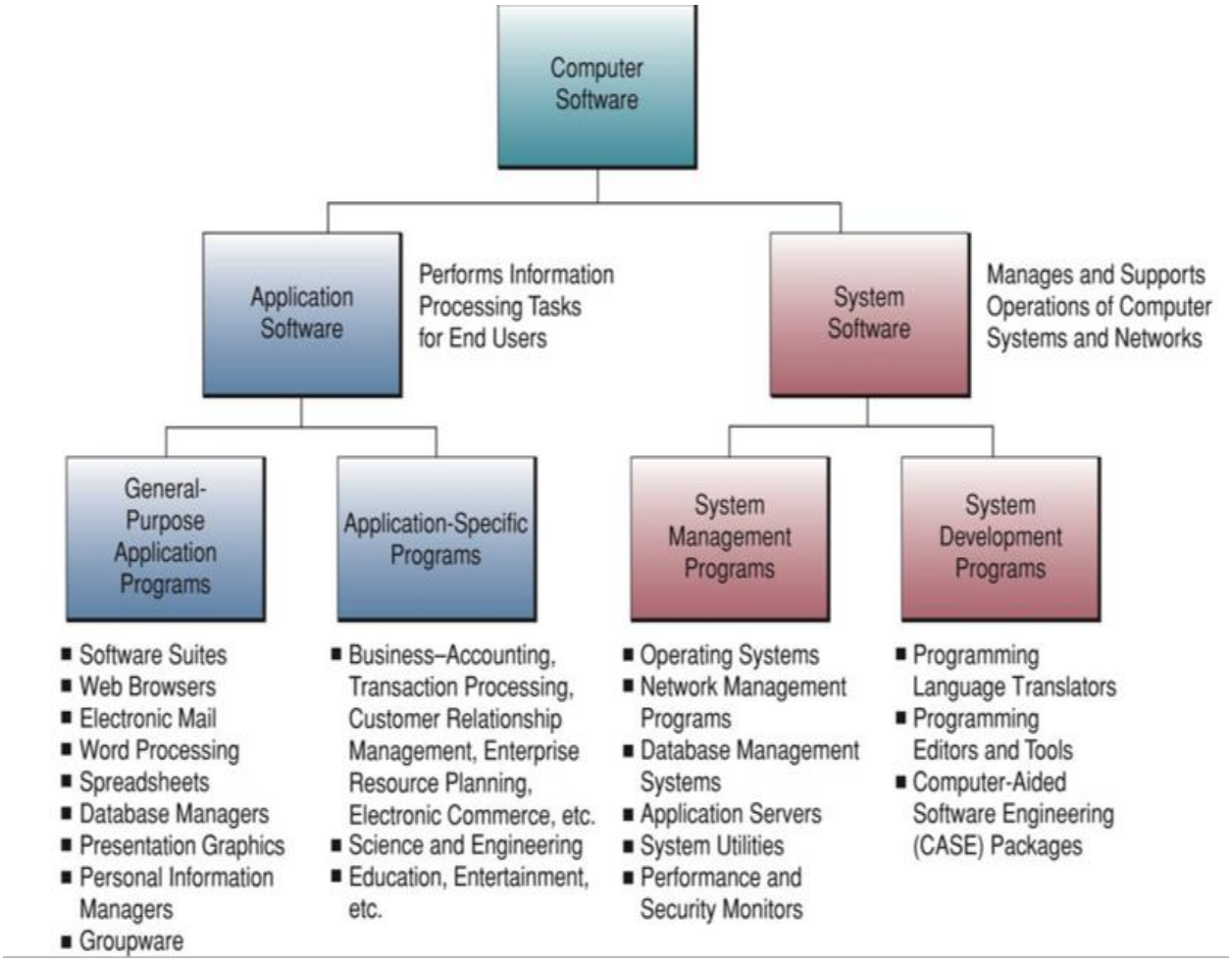

Fig. 64: Computer Software

3.2 Different Types of Application Software.

The different types of application software are:

3.2.1Productivity Software. Productivity software helps you work more effectively. The productivity software also known as *application suite* consists of multiple applications bundled together. They usually have related functions, features and user interfaces, and may be able to interact with each other, e.g. open each other's files. Business applications often come in suites, e.g. Microsoft Office, LibreOffice and iWork, which bundle together a word processor, a spreadsheet, etc.; but suites exist for other purposes, e.g. graphics or music. The classification of this software are : (a) Word Processing, (b) Spreadsheets, (c) Database Management, (d) Electronic Mail, (e) Graphics, (f) Desktop Publishing and (g) Scheduling.

a. **Word processing software.** Word Processing software helps you produce documents such as reports, letters, papers and manuscripts. To use word processing software you type in the text of a document. As you type, you can easily edit your work and make connections. You can also move text to improve the logical flow of ideas in your document. Word processing is the most popular type of application software. A Word Processor is used to create, edit, save and print reports. It affords user the opportunity to make amendments before printing is done. During editing character, word sentence or a number of lines can be removed or inserted as the case may be. Another facility possible is spell checking. A document can be printed as many times as possible. Word processors are mainly used to produce:

(a) Letters, Mailing lists, Label, Greeting Cards, Business Cards, Reports,
(b) Manual, Newsletter. Examples are: WordPerfect, WordStar, Display
(c) Writer, Professional Writer, LOTUS Manuscript, Ms-Word, LOCO
(d) Script, MM Advantage II etc. The full-featured word processors usually support the following features:

- **File management:** Many word processors contain file management capabilities that allow you to create, delete, move, and search for files.
- **Font specifications:** Allows you to change fonts within a document. For example, you can specify bold, italics, and underlining. Most word processors also let you change the font size and even the typeface.
- **Footnotes and cross-references:** Automates the numbering and placement of footnotes and enables you to easily cross-reference other sections of the document.
- **Graphics:** Allows you to embed illustrations and graphs into a document. Some word processors let you create the illustrations within the word processor; others let you insert an illustration produced by a different program.
- **Headers, footers, and page numbering:** Allows you to specify customized headers and footers that the word processor will put at the top and bottom of every page. The word processor automatically keeps track of page numbers so that the correct number appears on each page.
- **Layout:** Allows you to specify different margins within a single document and to specify various methods for indenting paragraphs.
- **Macros:** A *macro* is a character or word that represents a series of keystrokes. The keystrokes can represent text or commands. The ability to define macros allows you to save yourself a lot of time by replacing common combinations of keystrokes.
- **Merges:** Allows you to merge text from one file into another file. This is particularly useful for generating many files that have the same format but different data. Generating mailing labels is the classic example of using merges.
- **Spell checker:** A utility that allows you to check the spelling of words. It will highlight any words that it does not recognize.
- **Tables of contents and indexes:** Allows you to automatically create a table of contents and index based on special codes that you insert in the document.
- **Thesaurus:** A built-in thesaurus that allows you to search for synonyms without leaving the word processor.
- **Windows:** Allows you to edit two or more documents at the same time. Each document appears in a separate *window*. This is particularly valuable when working on a large project that consists of several different files.

- ***WYSIWYG(what you see is what you get):*** With WYSIWYG, a document appears on the display screen exactly as it will look when printed.

3.1.2 Spread sheet. Is an application mainly designed for numerical figures and reports. Spreadsheets contain columns and rows, in which numbers can be entered. It is possible to change numbers before printing is done. Other features of spread sheets is the ability to use formulas to calculate, use sum and average function, ability to perform automatic recalculation and has the capacity to display reports in graphical modes. Spreadsheet is used for Budget, Tables, Cost analysis, Financial reports. Tax and Statistical analysis. Examples are: LOTUS 123, Super calc, MS Multiplan, MS-excel, VP Planner etc. The advantages of spreadsheets include the following:

- It is a very useful tool for business to log their daily transactions and expenditures.
- Spreadsheets can compute by using some formulation for large amounts of data or repeated calculations.
- Allows the use of different functions including the SUM, AVERAGE, MIN, MAX, COS, COUNT, etc
- It can also be a very good tool for employee's database to track down and record their salaries.
- Data can easily be visualized in form of charts.
- Spreadsheets answer "What if" questions.
- Computations can be done very quickly.
- Data can easily be updated in a spreadsheet than on paper-based accounting sheets.
- Spreadsheets are frequently used for financial information because of their ability to re-calculate the entire sheet automatically after a change to a single cell is made

3.1.3 Presentation Software: The software that is used to display information in the form of a slide show is known as presentation software. This type of software includes three functions, namely, editing that allows insertion and formatting of text, methods to include graphics in the text and a functionality of executing slide shows. Microsoft PowerPoint is the best example of presentation software. Spreadsheet Software helps you work with number. The software displays a grid of rows and columns on the screen. Each box formed by this grid is called a cell. Each cell shows an address that indicates its row and column position. For example, cell address B3 means a cell in column B, row 3. You enter number and formulas in the grid and the computer automatically performs the calculations. Spreadsheets are frequently used by financial analysis to examine investment opportunities, by managers to create budgets, by entrepreneurs to create business plans, and even by the educators to keep track of student grades. Example of spreadsheet include: Excel, Lotus 1-2-3 and Apple.

The advantages of using a PowerPoint presentation:

- Communication delivered over *multiple channels* is more efficient than communication over a single channel. Multiple channels make it more likely that the whole message will be received. An appropriate picture adds another channel.
- You can use charts, images, multimedia content, sound, etc. to represent and idea or simulate a case.
- You can keep your audience (students) motivated by using animated PowerPoint and funny slides describing a topic or problem.

- PowerPoint can be shared with your students and support the learning process. Especially using PPT sharing platforms like Slide Online.
- You can separate different topics and chapters using sections and why not creating different PowerPoint files so can be shared separately.
- PowerPoint can motivate the staff and students. You can use collaboration tools to let user see in real time what you edit in PowerPoint and use a versioning system, for example using Office Web Apps.
- Students can print PowerPoint handouts.
- Presentation software is incredibly easy to learn how to use
- It is supplied with a large library of background templates and custom layouts
- Multimedia can easily be added to the presentation
- Presentations are easy to edit
- Presentations can be easily output to different formats e.g. interactive whiteboard, digital projector, handouts
- Excellent for summarising facts
- Great for showing graphs/charts/diagrams to an audience
- Can create a set of handouts for people to write on whilst presentation being given
- Allows you to face your audience and make eye contact rather than facing the screen
- A Power Point presentation could get and enhance the attention and interest of the intended audience because people would traditionally pay attention to presentations or shows that use visuals especially dynamic images, animation and other visuals that could move or be maneuvered by the presenter.
- Learning to use a Power Point presentation does not necessarily involve a formal lesson because an individual could easily learn and teach himself in using Power Point because its tools are user-friendly and easy to follow with the various tips and sample templates offered by the program.
- Power Point could be used as an effective tool for illustrating images and visuals that are difficult to draw with the use of traditional drawing tools such as pencils and pens compared to the graphics applications that could be used in Power Point.
- Can easily input images
- Templates are built in for different appearances
- Can add notes pages
- Can easily add media and recordings
- More exciting than a simple word document or hand written presentation
- Master slides make presentations consistent

The disadvantages of using a Power Point presentation.

- Lot of slides and lot of text can make presentations really boring.
- Sometimes PowerPoint can’t be opened in the classroom computer, especially if you save the PPT in an old format.
- Overuse can bore learners and diminish PowerPoint’s effectiveness.
- The resolution may not be the appropriate.
- A successful presentation can take several hours to develop and practice.
- Computers crash, networks go down, viruses can plague computers so save your work several times and make backups.
- Some features such as animations and backgrounds can distract the audience from the actual information in the presentation
- File size can become quite large on medium to large presentations

- Some of the features can be quite complicated to use and even the simple features require some getting used to
- When at work, you cannot rely on someone else's computer or laptop to run your presentation, there are too many software conflicts and disk space barriers.
- Takes quite a bit of time to create a complete presentation
- A Power Point presentation that uses too many animations, graphics, background images and other dynamic visuals could distract the audience from the actual message and other information being conveyed to them.
- Power Point is not suitable in using for some types of presentations such as commencement speeches, poetry recitations, and technical reports that require detailed processes or procedures.
- A PowerPoint requires a set of system requirements. A presentation for a medium to large size audience would need an interrupted source of electricity during the presentation, a computer system that is free from technical problems and software breakdowns, a projector, speaker system, and other system requirements for carrying a successful presentation.

Guideline for design of presentation using PowerPoint

The art of creating effective presentations can be summarized using the following points to make good presentations:

a. Keep it simple
b. Limit bullet points and text
c. Limit transitions and builds (animations)
d. Use high quality graphics
e. Use good charts and visualization tools
f. Have a visual theme with PPT templates but avoid using the built in PowerPoint templates
g. Choose your fonts well
h. Embed video or audio
i. Spend time in the slider sorter
j. Finally, make sure to practice your presentation

3.1.4 Database Management Software (DBMS). It helps you work with facts and figures, such as the customer names and addresses you might store on file cards or in a Rolodex. Database management software helps hospitals and doctors to keep track of patient records; the IRS to keep track of tax payments, the phone company to keep track of names, addresses, and phone numbers; and the record clubs and book clubs to keep track of members and sales. It is software for designing, setting up and subsequently managing a database. (A database is an organized collection of data that allows for modification taking care of different users view). Examples are Dbase II, III, IV, FoxBASE, Rbase Data Perfect, Paradox III, Revelation Advanced and MS-Access. The advantages of using DBMS are as follows:

- controls data redundancy
- consistency
- improved data integrity
- security and enforcement of standards and economy of scale
- balance conflicting requirements
- easy to access data and maintain it
- increase in productivity and concurrency

- provides back up and recover services
- improved data sharing
- improved data security
- better data integration
- minimized data inconsistency
- improved data access
- improved decision making
- increased end-user productivity

Disadvantages

a. management complex
b. Increased cost of purchase and maintenance
c. adverse effect of failure
d. problem of maintaining currency
e. frequent upgrade/replacement cycles.

3.1.5 Electronic mail software provides you with a computerized mail box that collects documents or "mail" you receive electronically from other computers users. You can send electronic mail messages, you can read you electronic mail on your computer screen, you can save or throw away your electronic mail after you read it or you can compose electronic reply's to the mail you receive.

The advantages of email system are explained as follows:

- **Email is cheap.** E-mails turns to be a cheaper alternative to telephone conversation because it is a person to person communication system. It offers low cost.
- **Email is fast.** It eliminates the time spent in establishing telephone calls. It is faster compared to traditional mail.
- **Failure notification.** For some reason if your email can not be send to receiver a failure notification send to you so that you can understand that your mail is not send.
- **Attachment.** One of most important advantages of email is attachment facility. Email gives you a facility of attachment so that you can attach anything like picture, audio file, video file, document file, PDF etc.
- **Product advertisement.** Now a day's email is the most popular way of product advertising because it gives you an opportunity to send email to thousand even millions of your client at very little time with very little effort and this kind of email marketing is very less expensive.
- **Paper less communication.** Communication thorough email is paper less communication. So, email save our environment because traditional communication need paper and paper is produced from tree. So, we should increase use of email to save our environment.
- **No chance of missing.** In other traditional communication we can miss some message like in phone call sometime we can't attend the call or we may miss some word for network problem. In case of physical mail it may lost or destroy for any reason but in case of email you there is no chance of missing or destroy.
- **No time barrier to send email.** Email can be used nonstop 247 it is not like other traditional communication process. So, you can send email at any time as your demand.

- **Auto response.** Email can provide auto response when it receives email from any person so, it ensure the sender that email is send successfully. Most people give their basic information with this confirmation message.
- **Remained address.** Email automatically remained email address of both receiving and sending so, there is no hazel to mind email address.
- **Record.** Email carries a record or evidence all the time because if you don't delete mail from your mail box a mail never destroyed. So, if you need this next time you may see it any time anywhere.
- **Communication without physical presence.** It permits communication between two parts without the parties actually being present simultaneously
- **Privacy is maintained.** Privacy of communication is ensured because the mail is delivered to video individual's mailbox which can be opened by the intended recipients only.
- **Reduction in consumption of papers.** It reduces the consumption of paper in the office because internal memos and reports can be exchanged electronically without using paper.
- **Increase in efficiency.** It offers increased access to the employees. So it can increase the efficiency and the goodwill of the office.
- **World Access.** Email has no country barrier, someone can send email to everywhere to the world. It can be sent to any network in the world. It can be sent through Local Area Network (LAN) or worldwide network.
- **Easy to Operate.** The communication through email is easy. When any messages -comes, the recipient can read the messages first and then he decides how to respond. If the recipient likes to respond he can do so or if he thinks not to respond to the messages, he can just delete it. The message can be saved and print out of the message can also be taken.
- **Flexibility.** It provides flexibility. A message can be sent to more than one person at a time.
- **More Convenient.** Email is more convenient than any other mode of communication. The sender can send multiple copies of an email message.
- **Storage.** Most people now use email as safe storage for their important document or data. For example most people scan their important document like academic document, passport, CV, photo, and many more official document and attach with a email so that, they can find it any time in anywhere. This is one of the most important advantage of email.

Disadvantage of email (Electronic Mail). We know email is recognized method of communication, but face the disadvantages below:

- **Absence of privacy.** There is a chance of leakage of information through email if mail server is hacked.
- **Lost password.** You may lose or forgot your email login password. Though there is an option to recover password but that also need another email address. And last option is security question that also should be reminded. Suppose if you lose both password and security question it is very difficult to recover your email address though it is vast important to you.
- **Virus.** Viruses are computer programs which have the potential to harm computer systems. An email may carry virus to you. So, all the time you should be careful about it. It is one of the greatest disadvantages of email.

- **No alert.** Email does not give any alert like phone or mobile so, some time we can be late to see the important message.
- **Overlooking of message.** Busy people may not give attention or may overlook any message due to receiving of thousands of email every day.
- **Lack of personal touch.** It cannot convey emotion or personal touch the way a face-to-face conversation or even a phone call can.
- **Missing of Non-verbal communication.** Body movement or facial expressions are not involved in email. So, quick attention of the receiver is not possible here.
- **Change of sudden rumour.** Email can spread rumour suddenly as it requires a click only to send a bad message to thousand receivers.
- **Unwanted email.** Email can spread mail containing virus or spam contents which can damage computer systems totally.
- **Spam**. Emails when used to send unsolicited messages and unwanted advertisements create nuisance and are termed as spam. Email spoofing is commonly used for spamming. The act of spoofing involves deceiving a recipient by altering email headers or addresses from which a mail is sent.
- Hacking. The act of breaking into computer security is termed as hacking. In this form of security breach, emails are intercepted by hackers. Email accounts are vulnerable to hacking by professional hackers.
- Not Suited for Business. This is because urgent transactions which require signatures cannot be easily managed through emails.
- Crowded Inbox. The email inbox tends to get crowded with mails after a certain period of time. Thus, it becomes difficult for users to manage huge chunks of emails.
- Internet Access is required. There are many parts in the world where people don't have access to Internet. The email service doesn't serve any purpose in such areas.
- Misinterpretation. One has to be careful while posting content through an email. If typed in a hurry, the matter can be misinterpreted by readers.
- Lengthy Mails. If a mail is too long or not drafted properly by the sender, the reader may lose interest; he/she may not read the mail till the end.
- Checking the Inbox Regularly. In order to stay updated, one has to check his/her email account regularly. If a person, due to his/her busy daily routine, does not check the inbox, he/she can miss out on some of the important and urgent messages.

3.1.6 Communication Packages: Examples are Carbon Plus, Data talk V3.3, Cross talk, SAGE Chit Chat, Data Soft. There are so many packages around, virtually for every field of study but these are just to mention a few of them. Advantages of these packages include quick and cheaper implementation, time saving, minimum time for its design, they have been tested and proven to be correct, and they are usually accompanied by full documentation and are also very portable. While old-fashioned face-to-face communication may be preferred, the fast-paced nature of some businesses makes the use of other communication channels necessary or beneficial. Your business likely uses several channels of communication for internal and external message sharing. Each channel has strength and weaknesses that you must understand to optimize organizational communication. Face-to-Face. Face-to-face is still the preferred communication channel if clarity of message is a primary factor. Communication in person allows you to interact with the listener in a back-and-forth discussion. It also allows you to utilize nonverbal gestures, facial expressions and personal charisma to enhance the message. A drawback is the potential that a conflict could become more heated or emotional in a face-to-face

channel. Tension or stress is also more likely if you have personal conflict with the other person. Telephone. Land or mobile telephones have taken up the communication slack in businesses where distance and travel prevent face-to-face conversation. The telephone still allows immediate interaction between two parties in the communication. Mobile phones also expand your ability to communicate with distant workers or offices. The lack of non verbal or facial expressions removes those elements from the message. This can inhibit the ability to interpret the context or emotion of a message sender. The phone is also less personal than a face-to-face meeting. E-mail. E-mail is a vital communication channel in geographically dispersed companies or ones in which employees travel. E-mail allows for more flexible response times. You can send a message one day and receive a response in a few hours or the next day. It allows for conversation that isn't time-pressured, but can serve for fast turnaround times. It also allows for the inclusion of files, such as documents or images. E-mail is less personal than either face-to-face or phone. The missing context of the message may lead to misunderstandings or misinterpreted messages. Discussion Forums. Many companies maintain internal discussion forums through intranet websites. These are sites with files and other resources available only to employees through personal log-ins. Internal discussion forums allow employees and managers to engage in company-wide or small-group discussions about suggestions, problems and solutions on a wide range of topics. Forums offer a low-pressure way for employees to present ideas and feedback. They allow the company to gain insights in a non-confrontational way. Lack of personal connectivity and the potential for anonymous postings are drawbacks. Similarly, delays can occur between comments and responses.

3.1.7 Graphics Software helps you draw pictures, 3-D images and animations. If you have limited artistic ability, you can use graphics software to retrieve pre-draw images called clip art, which you can use as-is or modify. Presentation graphics software helps you represent information using screen-based slide shows of bulleted lists, graphics and charts. These are packages that enable you to bring out images, diagrams and pictures. Examples are PM, PM Plus, Graphic Writer, Photoshop. The advantages of graphic software include the following:

- it's cheaper and you can do the same stuff with it that you could do with Illustrator.
- comes along with a Photoshop equivalent bundled in
- its interface/shortcuts are fully customizable, so if you are used to other ones, you can change almost everything.
- cleaner interface than Illustrator's
- less steps to tackle the same chores
- quick to load and produces small-weighted files
- if your pre-press bureau doesn't handle native draw files, just convert to PDF
- you can generate basic ttf, ot or t1 font files with it
- more export and import filters than Illustrator

Disadvantages:

- Photo Paint has been neglected in the last few versions.
- The improvements in the last version (X3) were few.

3.1.8 Desktop Publishing Software provides you with computerized tools for page layout and design that combine text and graphics. Although many desktop publishing features are available in today’s sophisticated word processing software, desktop publishing software provide additional features to help you to produce professional looking, quality output for newspaper, newsletters, and brochures. These are packages that can be used to

produce books and documents in standard form. Examples are PageMaker, Ventura, Publishers, Paints Brush, Xerox Form Base, News Master II, Dbase Publisher.

3.1.9 Scheduling software helps you keep track of appointments, due dates, and special dates such as birthdays and holidays. You can use the scheduling software to print a daily, weekly or monthly calendar.

3.1.10 Application Suite: Has multiple applications bundled together. Related functions, features and user interfaces interact with each other. An application suite is also an important type of application software. It consists of a group of applications combined to perform related functions. OpenOffice.org and Microsoft Office are the best examples of this type of application software. These application suites, as you know, come as bundles of applications like word processors, spreadsheets, presentation software, etc. Applications in the suite can work together or operate on each other's files

3.1.11 Enterprise Software: Addresses an organization's needs and data flow in a huge distributed environment. Examples include enterprise resource planning systems, customer relationship management (CRM) systems and supply chain management software. Departmental Software is a sub-type of enterprise software with a focus on smaller organizations and/or groups within a large organization. (Examples include travel expense management and IT Helpdesk.). It provides capabilities required to support enterprise software systems. (Examples include databases, email servers, and systems for managing networks and security.)

3.1.12 Information Worker Software: Addresses individual needs required to manage and create information for individual projects within departments. Examples include time management, resource management, analytical, collaborative and documentation tools. Word processors, spreadsheets, email and blog clients, personal information system, and individual media editors may aid in multiple information worker tasks.

3.1.13 Content access software is used primarily to access content without editing, but may include software that allows for content editing. Such software addresses the needs of individuals and groups to consume digital entertainment and published digital content. It use to access contents and addresses a desire for published digital content and entertainment. Examples include media players, web browsers, and help browsers.

3.1.14 Simulation software simulates physical or abstract systems for research, training or entertainment purposes. Used to simulate physical or abstract systems, simulation software finds applications in both, research and entertainment. Flight simulators and scientific simulators are examples of simulation software.

3.1.15 Multimedia Software: It allows users to create and play audio and video files. They are capable of playing media files. Audio converters, audio players, burners, video encoders and decoders are some forms of multimedia software. Examples of this type of software include Real Player and Media Player. It also generates print and electronic media for others to consume, most often in a commercial or educational setting. This includes graphic-art software, desktop publishing software, multimedia development software, HTML editors, digital-animation editors, digital audio and video composition, and many others. It also addresses individual needs to generate and print electronic media for others to consume.

3.1.16 Product engineering software is used in developing hardware and software products. This includes computer-aided design (CAD), computer-aided engineering (CAE), computer language editing and compiling tools, integrated development environments, and application programmer interfaces. This software is used in the design and development of hardware and software products. Integrated development environments (IDE) and computer language editing tools falls under this type of application software. Interestingly, software products are developed using other software,

and software communicate with one another through software. Application programming interfaces which aid the communication of two or more software, are examples of this application software type.

3.1.17 Integrated Packages: They are programs or packages that perform a variety of different processing operations using data that is compatible with whatever operation is being carried out. They perform a number of operations like Word Processing, Data-base Management and Spreadsheet. Examples are: Office writer, Logistic Symphony, Framework, Enable, Ability, Smart ware II, Microsoft Work V2.

3.1.18 Statistical packages. These are packages that can be used to solve statistical problems, e.g. MS Excel, Stat graphical, Statistical Packages for Social Scientists (SPSS), GENSTAT and Statistical Analysis System (SAS).

3.1.19 Game packages. These are packages that contain a lot of games for children and adults. Examples are Chess, Scrabble, Monopoly, Tune Trivia, Star Trek 2, California Game, Soccer Game, War Game, Spy Catcher Dracula in London.

3.1.20 User Programs. This is a suit of programs written by programmers for computer users. They are required for the operation of their individual business or tasks. Example is a payroll package developed for salary operation of a particular company.

3.1.21 Education and Reference Software. Education Software is designed to help you learn more about a particular topic. One sub category of education software is called CAI or tutorial software. CAI stands for "Computer Aided Instruction". Other terms used to describe tutorial software include ""Computer-based instruction", "Computer-based learning" and "Computer-mediated learning", CAI software can help you learn how to do things how to type, fix your car, use your word processor, speak French, or prepare for the GMAT/GRC exam. It is also related to content access software, but has the content and/or features adapted for use in by educators or students. For example, it may deliver evaluations (tests), track progress through material, or include collaborative capabilities. It has the capabilities of running tests and tracking progress. It also has the capabilities of a collaborative software. It is often used in teaching and self-learning. Dictionaries like Britannica and Encarta, mathematical software like Matlab and others like Google Earth and NASA World Wind are some of the well-known names in this category. On the other hand, **Reference Software**, such as electronic encyclopedia, helps you look up facts on any topic. Other reference software includes collections of classic literary works, electronic dictionaries, the phone directories, two phone directories of a city, a trip planner with maps of a country, and medical reference guides.

3.1.22 Entertainment Software: It is no surprise that entertainment software is designed to entertain you. With entertainment software, you can play different types of games, battle monsters or explore new world. For example, the "Paper Planes" software is entertaining while showing you how to construct several types of paper airplanes. *Entertainment Software* can also refer to video games, screen savers, programs to display motion pictures or play recorded music, and other forms of entertainment which can be experienced through use of a computing device

3.1.23 Business Software: Business Software is divided into two categories: horizontal market software and vertical market software.

a. **Horizontal Application software**. A horizontal application is any software application that targets a large number of users with different knowledge and skill sets. Because these types of applications can extend across markets and be used in a range of industries, they typically do not offer market-specific features. A "horizontal market" is a group of different types of business that, despite their difference, have some of the same software needs. Horizontal market software refers to generic software packages that can be used for many different kinds of business. Horizontal

applications are more popular and widespread, because they are general purpose, for example word processors or databases. Productivity software, such as word processing, spreadsheet, or database management applications, can be considered horizontal market software because they can be used in virtually any business. Accounting and payroll applications are also good examples of horizontal market software. Accounting Software is designed to computerize the bookkeeping and financial reporting tasks typically required in most business. Payroll software keeps track of employee houses and produces the reports required by the government or any organization for income tax reporting. Horizontal applications can be off-the-shelf solutions or integrated and proprietary vendor solutions. Some examples of horizontal applications include word processors, spreadsheets, financial software and Web browsers

b. **Vertical Application Software**. A *vertical application* is any *software application* that supports a specific business. A vertical application is a group of a similar business – travel agencies, for example – that need specialised software. Vertical market software is designed for specialized tasks in a specific market or business. Vertical applications are niche products, designed for a particular type of industry or business, or department within an organization. Integrated suites of software will try to handle every specific aspect possible of, for example, manufacturing or banking systems, or accounting, or customer service.

3.3 Mail Merge.

Mail merge is a very useful tool that helps you create multiple copies of a document like letters, invitations, circulations etc. each with small difference in them. In spite of its immense utility, very few people are really using it. Most people do tedious task of copy and paste and perform required modification not because Mail Merge is inefficient but because they tend to take it as complex process. Poor them! I wonder why, even training institutes exclude mail merge from their course when teaching Office Package (MS Word, MS Excel, MS Access, and MS PowerPoint). How could anybody afford to skip such practically useful topic? Truly speaking, Mail Merge as much easier as it is useful. The next thing surprises me is a whole lot of mail merge software and applications flourished over the net. There is not lack of mail merge template, nor fax mail merge programs. Some are free downloadable and some are paid. They might be useful for advanced and complex type of merging and mass mailing but consider if you really need them? Is Mail Merge tool provided in MS Word not sufficient for what you intend - forced you to look for other applications?

When to use Mail Merge?

There might be numerous situations when mail merge is suitable solution to accomplish your tasks quickly and efficiently. Some examples are:

a. You needed to print envelopes to mail letters. Recipients name, street address, city, state, country, zip code, contact etc might have stored on Excel spreadsheet, or Access database, or even in Word document itself.
b. You needed to send same message but personalized emails to many people.
c. You needed to fax a memo to all of your branches and officials.
d. Print Students' Report Cards or Marks Cards of an examination.
e. Send notice to different concerned people, and many

Components of Mail Merge

The process involves three major components:

Main Document. This is the format and structure of document with text and graphics where we insert the placeholders for data to fall in. The merged document will be created exactly like main document with different content coming from data source document. Main documents can be Letters, E-Mail Message, Envelopes, Labels, Directory or any custom document structure.
Data Source. This is the storehouse of data. Most often this file is already created for different other purposes. Your company database or spreadsheet or even a list created can be used as data source if it contains the data items you require to fill up in your main document. When there is no file, required for mail merge, don't worry! The option to create a new data source always exists. The most useful data source could be your Outlook Contacts if you need to merge and send to email addresses.
Merge Process. This is a process that picks data items from Data Source and fills the place holders in Main Document to create a new merged document or send in mail or even send in fax. You can send merge to the printer directly, send to fax or to outlook.
An example and procedure
After talking all this, it would be easier to understand through an example. I'm going to show you how you can create envelopes using mail merge in Word 2013.
Step 1. Create Main Document
Step 2. Create or identify data source
Step 3. Merge
Take a new document, then:

1. Click the Mailings ribbon
2. From 'Start Mail Merge' button choose 'Envelopes'. Choose the required 'Envelope size' and specify the preferred font for 'Delivery address' and 'Return address'. For my purpose I selected Size 10 Envelop size and default fonts
3. Click OK to accept and close the dialog box.
4. Now, type your return address. This won't be changing for each recipient so you can simply type on envelop.
5. Since we don't have recipients yet, let us choose the data source. Click on Select Recipients button.
6. If you have the data source already created you can choose 'Use Existing List…'. For current purpose, I'm creating a new list. So choose 'Type a New List' menu. MS Word will open 'New Address List' dialog box. This will be suitable for most cases. If not, you can customize columns. Look at the button at the bottom.
7. Type the list of your recipients in this box. When finished click OK and save the data source file giving it a name.
8. After you specify recipients, now you can return to your main document and insert the place holders.
9. Place the insertion line in Recipients text box and Click on 'Insert Merge Field' button and Choose Title.
10. Similarly, inset other fields as shown in figure.
11. Done. You are ready to merge now. If you wish how the data will be filled in, click on Preview Results button on Mailings ribbon.
12. To merge, click on Finish and Merge button and choose suitable menu. You should get something like below:

3.4 Difference between operating system software, utility software and application software.

The following are the differences between operating system, utility software and application software:

a. An **operating system** is the software that bridges the gap between the system and the user.
b. **Utility software** performs actions essential for protecting, guiding, securing, and storing information or data appropriately in the system.
c. **Application software** manages specific actions, for example, browsers, word processors, etc.

3.5 Difference between utility program and application program

3.5.1 Utility software is system software designed to help analyze, configure, optimize or maintain a computer. A single piece of utility software is usually called a **utility** or **tool**. Utility software usually focuses on how the computer infrastructure (including the computer hardware, operating system, application software and data storage) operates. Examples of Utility Software as indicated above are:

a. **Anti-virus utilities** scan for computer viruses.
b. **Backup utilities** can make a copy of all information stored on a disk, and restore either the entire disk
c. **Data compression utilities** make the files smaller to occupy lesser space on the storage media
d. **Disk checkers** can scan the contents of a hard disk to find files or areas that are corrupted in some way, or were not correctly saved, and eliminate them for a more efficiently operating hard drive.
e. **Disk cleaners** can find files that are unnecessary to computer operation, or take up considerable amounts of space. Disk cleaner helps the user to decide what to delete when their hard disk is full.
f. **Disk defragmenters** can detect computer files whose contents are broken across several locations on the hard disk, and move the fragments to one location to increase efficiency.
g. **Disk partitions** can divide an individual drive into multiple logical drives, each with its own file system which can be mounted by the operating system and treated as an individual drive.
h. Disk space analyzers for the visualization of disk space usage by getting the size for each folder (including sub folders) & files in folder or drive showing the distribution of the used space.
i. Disk storage utilities
j. **Network utilities** analyze the computer's network connectivity, configure network settings, check data transfer or log events.
k. Registry cleaners clean and optimize the Windows registry by removing old registry keys that are no longer in use.

3.5.2 Application Software is the software which allows users to do things like creating text documents, playing games, listening to music or viewing websites. Examples of application software as mention above are:

a. Microsoft Office
b. Adobe Photoshop
c. Windows and other Media Player
d. Web Browsers like Internet Explorer, Firefox, Chrome

Self-Assessment Exercise

a. Identify the types of utility software
b. Explain the functions of utility software

3.6 Difference between operating system and application system

Computers run two types of software: system software and application software.

a. **System software** consists of the operating system and utility programs that control a computer system and allow you to use your computer. These programs enable the computer to boot, to launch application programs, and to facilitate important jobs, such as transferring files from one storage medium to another, configuring your computer to work with the hardware connected to it, managing files on your hard drive, and protecting your computer system from unauthorized use.
b. **Application software** includes all the programs that allow you to perform specific tasks on your computer, such as writing a letter, preparing an invoice, viewing a Web page, listening to a music file, checking the inventory of a particular product, playing a game, preparing financial statements, designing a home, and so forth. In practice, the difference between system and application software is not always straightforward. Some programs, such as those used to burn DVDs, were originally viewed as utility programs. Today, these programs typically contain a variety of additional features, such as the ability to organize and play music and other media files, transfer videos and digital photos to a computer, edit videos and photos, create DVD movies, copy CDs and DVDs, and create slide shows. Consequently, these programs now fit the definition of application programs more closely. On the other hand, system software today typically contains several application software components. For example, the Microsoft Windows operating system includes a variety of application programs including a Web browser, a calculator, a calendar program, a painting program, a media player, a movie making program, an instant messaging program, and a text editing program. A program's classification as system or application software usually depends on the principal function of the program, and the distinction between the two categories is not always clear cut.

The system software vs application software can be distinguished in Table12

System software	Application software
The system software helps in operating the computer hardware, and provides a platform for running the application software	Application software helps the user in performing single or multiple related computing tasks.
System software executes in a self-created environment.	Application software executes in the environment created by the system software.
It executes continuously as long as the computer system is running.	It executes as and when the user requires.
The programming of system software is complex, requiring the knowledge of the working of the underlying hardware.	The programming of application software is relatively easier, and requires only the knowledge of the underlying system software.
There are much fewer system software as compared to application software.	There are many more application software as compared to system software.
System software runs in the background and the users typically do not interact with it.	The application software run in the foreground, and the users interact with it frequently for all their computing needs.
System software can function independent of the application software.	The application software depends on the system software and cannot run without it.
Examples: Windows OS, BIOS, device	Windows Media Player, Adobe Photoshop,

firmware, Mac OS X, Linux etc.	World of War craft (game), iTunes, MySQL etc.

4.0 Conclusion

System software is computer software that is designed to operate the computer hardware, and to provide and maintain a platform for running the application software on. On the other hand, application software is computer software which is designed to help the user in performing single or multiple related tasks. Although there is a clear distinction between application and system software, it is important to note that both of them work in tandem. It is the capability of both to interact with each other in different ways that allows a computer system as a whole to function. System software can function independent of the application software. However, the application software depends on the system software and cannot run without it.

5.0 Summary

In this unit, we have discussed the types and the tasks perform by utility software as follows:

a. Language translators such as the assembler, interpreters and the compilers.
b. Utility programs such as file conversion, file copy programs and housekeeping programs such as scandisk
c. Application programs such as word processors, spreadsheets and statisticalpackages.

6.0 Tutor-Marked Assignment

a. Discuss the purpose of the following utilities: file viewer, file compression, diagnostic, uninstaller, disk scanner, disk defragmenter, backup, and screen saver
(b). In a tabular form, differentiate between operating system and application software

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MODULE 3: PROGRAMMING THE COMPUTER

This topic shall be discussed under the following sub-topics:

a. Computer programming languages
b. Basic principles of computer programming
c. Flowcharts
d. Algorithms

UNIT 1: COMPUTER LANGUAGES

Content

1.0 Introduction

In this unit, we shall take a look at computer programming with emphasis on:

a. The overview of computer programming languages.
b. Evolutionary trends of computer programming languages.
c. Programming computers in a Beginner All-Purpose Symbolic Instruction Code (BASIC) language environment with emphasis on:

2.0 Objective

The objective of this unit is to introduce the student to the background information about programming the Computer.

3.0 Main Content

3.1 Overview of Computer Programming Languages

Basically, human beings cannot speak or write in computer language, and since computers cannot speak or write in human language, an intermediate language had to be devised to allow people to communicate with the computers. These intermediate languages, known as programming languages, allow a computer programmer to direct the activities of the computer. These languages are structured around unique set of rules that dictate exactly how a programmer should direct the computer to perform a specific task. With the powers of reasoning and logic of human beings, there is the capability to accept an instruction and understand it in many different forms. Since a computer must be programmed to respond to specific instructions, instructions cannot be given in just any form. Programming languages

standardize the instruction process. The rules of a particular language tell the programmer how the individual instructions must be structured and what sequence of worlds and symbols must be used to form an instruction.

a. An operation code.
b. Some operands.

The operation code tells the computer what to do such as add, subtract, multiply and divide. The operands tell the computer the data items involved in the operations. The operands in an instruction may consist of the actual data that the computer may use to perform an operation, or the storage address of data. Consider for example the instruction: a = b + 5. The '=' and '+' are operation codes while 'a', 'b' and '5' are operands. The 'a' and 'b' are storage addresses of actual data while '5' is an actual data. Some computers use many types of operation codes in their instruction format and may provide several methods for doing the same thing. Other computers use fewer operation codes, but have the capacity to perform more than one operation with a single instruction. There are four basic types of instructions namely:

a. input-output instructions;
b. arithmetic instructions;
c. branching instructions;
d. logic instructions.

An input instruction directs the computer to accept data from a specific input device and store it in a specific location in the store. An output instruction tells the computer to move a piece of data from a computer storage location and record it on the output medium. All of the basic arithmetic operations can be performed by the computer. Since arithmetic operations involve at least two numbers, an arithmetic operation must include at least two operands.

Branch instructions cause the computer to alter the sequence of execution of instruction within the program. There are two basic types of branch instructions; namely unconditional branch instruction and conditional branch instruction. An unconditional branch instruction or statement will cause the computer to branch to a statement regardless of the existing conditions. A conditional branch statement will cause the computer to branch to a statement only when certain conditions exist. Logic instructions allow the computer to change the sequence of execution of instruction, depending on conditions built into the program by the programmer. Typical logic operations include: shift, compare and test.

3.2Definition of Programming Language

Programming is the correct sequences of instructions. Programming language on the other hand is a set of rules that provides a way of instructing the computer to perform certain operations. It requires the use of programming packages to help programmers develop, translate, and convert programming language instructions into machine language instruction codes. Therefore, the effective utilization and control of a computer system is primarily through the software of the system. We note that there are different types of software that can be used to direct the computer system. System software directs the internal operations of the computer and applications software allows the programmer to use the computer to solve user made problems. The development of programming techniques has become as important to the advancement of computer science as the developments in hardware technology. More sophisticated programming techniques and a wider variety of programming languages have enabled computers to be used in an increasing number of applications. Programming languages, the primary means of human-computer communication, have evolved from early stages where programmers entered instructions into the computer in a language similar to that used in the application.

3.3 Reasons for the study of programming languages.

Hundreds of different programming languages have been designed and implemented. There are excellent reasons for a study of programming languages. Therefore, there are lots of debates and controversy on whether pupils, teachers and student-teachers should be involved in teaching and learning of programming languages? The following are reasons advanced by Appleby and VandeKopple, (1997) and Pratt and Zelkowitz (2001) for the study of computer programming languages:

:

- To improve your ability to develop effective algorithms.
- To improve the use of your existing programming language. Familiarity with a single programming language tends to have a similar constraining effect. When you know data such as arrays, strings, lists, or records are created and manipulated, will lead you to understand the implementation details of recursion.
- To increase your vocabulary of useful programming constructs as a result of studying a wide range of languages.
- To allow a better choice of programming language, thereby reducing the required coding effort.
- To make it easier to learn and design a new programming language because most of this learning software is rapidly changing as a result of technological and globalization challenges, social and economic challenges, pedagogical, equity and quality challenges, research, publication, communication and management challenges all over the world.
- There are the cognitive gains from learning to program to develop the intellect as evident from the work of Seymour Paper in 1980.
- By developing techniques for structured analysis, pupils and students will develop intellectual skills for solving other problems.
- Programming can promote meta cognitive skills such as planning and strategic problem solving, the challenge of semantics and syntax need to be known, the pedagogical fantasy and the need to develop an instructional science for programming.
- Programming provides a medium for the development of general problem-solving skill.
- Programming provides an environment in which children may directly explore other curricular areas such as mathematics, sciences.
- Programming included facility with heuristics and debugging, meta cognition and the ability to clearly distinguish process from product.
- Programming language gives teachers the opportunity to produce educational software for their own classes.
- The strongest rationale for teaching programming to all students is the positive effect programming may have on the development of problem-solving skills.
- Students who would want to proceed for further studies and to specialize in computer science would highly need such knowledge and skills to prosper.
- The knowledge of computer programming would enable students to break problems into smaller pieces more amenable to solution.
- The aim of teaching programming in tertiary institutions of learning is to produce programmers who will in turn provide relevant programming experience that will benefit pupils and student in the future.
- Programming helps you to understand computers and how they work.

- Writing a simple program increases your confidence level. This is because many people find great pleasure and satisfaction in creating a set of instructions that solve a problem.
- Learning Programming can improve your ability to develop effective algorithms. This is because improper use of programming languages may lead to waste of large amounts of computer time, and time consuming logical errors.
- Learning programming can give you a better choice of programming language. Knowledge of a variety of languages may allow the choice of just the right language for a particular project, thereby reducing the required coding effort.
- Learning programming makes it easier to learn a new language. A thorough knowledge of a variety of programming language constructs and implementation techniques allows the programmer to learn a new programming language more easily when the need arises.
- Learning programming makes it easier to design a new language. Get familiar with a lot of programming languages.

3.4 Classification of computer programming languages

Therefore, computer programming languages can be classified into the following categories:

a. Machine language
b. Assembly language
c. High level symbolic language
d. Very high level symbolic language.
e. Artificial language

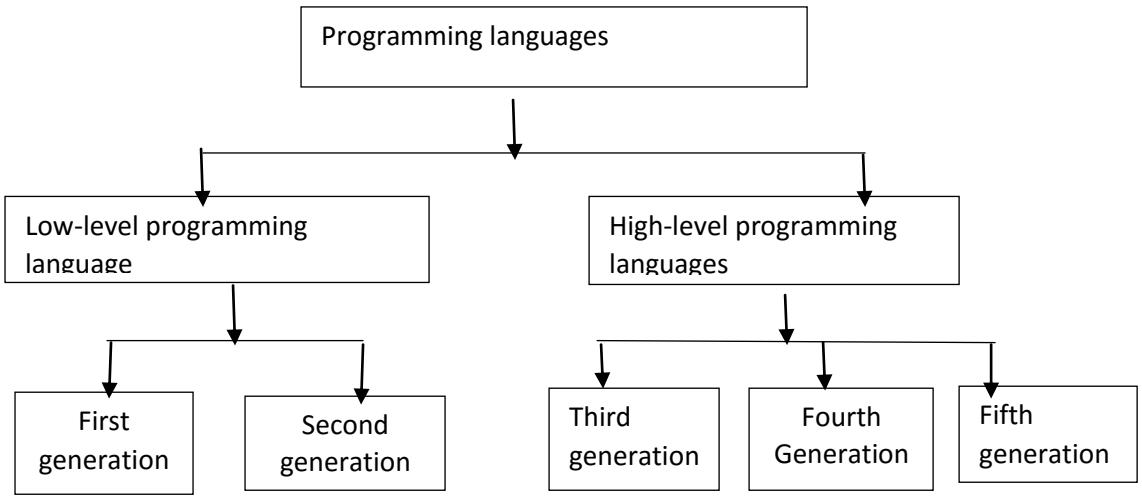

Fig 65: Types of programming languages

3.4.1 Machine Language

The earliest forms of computer programming were carried out by using languages that were structured according to the computer stored data that is, in a binary number system. Programmers had to construct programs that used instructions written in binary notation1 and 0. Writing programs in this fashion is tedious, time-consuming and susceptible to errors. Each instruction in a machine language program consists, as mentioned before, of two parts namely: operation code and operands. An added difficulty in machine language programming is that the operands of an instruction must tell the computer the storage address of the data to be processed. The programmer must designate storage locations for both instructions and data

as part of the programming process. Furthermore, the programmer has to know the location of every switch and register that will be used in executing the program, and must control their functions by means of instructions in the program. A machine language program allows the programmer to take advantage of all the features and capabilities of the computer system for which it was designed. It is also capable of producing the most efficient program as far as storage requirements and operating speeds are concerned. Few programmers today write applications programs in machine language. A machine language is computer dependent. Thus, an IBM machine language will not run on NCR machine, DEC machine or ICL machine. A machine language is the First Generation (computer) Language (IGL).

3.4.2 Assembly (Low Level) Language

Since machine language programming proved to be a difficult and tedious task, a symbolic way of expressing machine language instructions is devised. In assembly language, the operation code is expressed as a combination of letters rather than binary numbers, sometimes called mnemonics. This allows the programmer to remember the operations codes easily than when expressed strictly as binary numbers. The storage address or location of the operands is expressed as a symbol rather than the actual numeric address. After the computer has read the program, operations software are used to establish the actual locations for each piece of data used by the program. The most popular assembly language is the IBM Assembly Language. Because the computer understands and executes only machine language programs, the assembly language program must be translated into a machine language. This is accomplished by using a system software program called an assembler. The assembler accepts an assembly language program and produces a machine language program that the computer can actually execute. The schematic diagram of the translation process of the assembly language into the machine language is shown in the below diagram. Although, assembly language programming offers an improvement over machine language programming, it is still an arduous task, requiring the programmer to write programs based on particular computer operation codes. An assembly language program developed and run on IBM computer would fail to run on ICL computers. Consequently, the portability of computer programs in a computer installation to another computer installation which houses different makes or types of computers were not possible. The low level languages are, generally, described as Second Generation (computer) Language(2GL).

3.4.3 High Level Language

The difficulty of programming and the time required to program computers in assembly languages and machine languages led to the development of high-level languages. The symbolic languages, sometimes referred to as problem oriented languages reflect the type of problem being solved rather than the computer being used to solve it. Machine and assembly language programming is machine dependent but high level languages are machine independent, that is, a high-level language program can be run on a variety of computer. While the flexibility of high level languages is greater than that of the machine and assembly languages, there are close restrictions in exactly how instructions are to be formulated and written. Only a specific set of numbers, letters, and special characters may be used to write a high level program and special rules must be observed for punctuation. High level language instructions do resemble English language statements and the mathematical symbols used in ordinary mathematics. Among the existing and popular high level programming languages are Fortran, Basic, Cobol, Pascal, Algol, Ada and P1/1. The schematic diagram of the translation process of a high level language into the machine language is shown in the diagram below. The high level languages are, generally, described as Third Generation (computer) Language (3GL).

3.4.4 Very High Level Language

Programming aids or programming tools are provided to help programmers do their programming work more easily. Examples of programming tools are:

a. Program development systems that help users to learn programming, and to program in a powerful high level language. Using a computer screen (monitor) and keyboard under the direction of an interactive computer program, users are helped to construct application programs.
b. A program generator or application generator that assists computer users to write their own programs by expanding simple statements into program code'.
c. Database management system.
d. Debuggers that are programs that help computer user to locate errors (bugs) in the application programs they write.

The very high level language generally described as the Fourth Generation (computer) Language (4GL), is an ill-defined term that refers to software intended to help computer users or computer programmers to develop their own application programs more quickly and cheaply. A 4GL, by using a menu system for example, allows users to specify what they require, rather than describe the procedures by which these requirements are met. The detail procedure by which the requirements are met is done by the 4GL software which is transparent to the users. A 4GL offers the user an English-like set of commands and simple control structures in which to specify general data processing or numerical operations. A program is translated into a conventional high-level language such as Cobol, which is passed to a compiler. A 4GL is, therefore, a non-procedural language. The program flows are not designed by the programmer but by the fourth generation software itself. Each user request is for a result rather than a procedure to obtain the result. The conceptual diagram of the translation process of very high level language to machine language is given in the diagram below. The 4GL arose partly in response to the applications backlog. A great deal of programming time is spent maintaining and improving old programs rather than building new ones. Many organizations, therefore, have a backlog of applications waiting to be developed. 4GL, by stepping up the process of application design and by making it easier for end-users to build their own programs, helps to reduce the backlog.

3.5 Generation of computer programming languages

Computer Programming Language are as indicated in Table 14 below:

Generation	Language/Type	Content
1	Machine language	Use binary coded instruction such as 010101000001001
2	Assembly Language	Use symbolic coded instruction such as Sub a, b
3	Procedure language	Use procedural statements or arithmetic notation such as C; Basic
4	Object Oriented Language	Use natural language and nonprocedural statements and a combination of object and procedures such as C++; Objective-C; Java, Visual Basic; Net
5	Artificial intelligence	Combination of natural language(voices) and symbols

Table 14:Generation of computer language

Self-assessment Exercise

a. What are computer programming languages?
b. Explain any five reasons for studying computer programming languages

The following are some of the major popular programming languages:

- **Windows Applications:** C#, Visual C++, Visual Basic.Net, DirectX API's, HTML 5, Java
- **Mac OS Applications:** Objective C, X Code with Cocoa Framework, Java
- **iPhone Apps:** Objective C with Cocoa Framework
- **Android Apps:** Java and some C#
- **Web Pages:** HTML, CSS, Flash, JavaScript, Java, PHP, Perl, ASP.net
- **TV's & Electronics:** Assembly and C#

3.6 Why are there many computer programming languages in the world?

Languages evolve with people. And people have their own tastes and their own latitudes and cultures. In a nutshell, there are so many languages for the same reasons we have different tongues: different cultures, communities, aesthetics and means. (Think of HTML, vs a Shell script language. In the past
ALGOL, was a quite popular language during the 70'. PL\SQL, Pascal, Delphi, Fox Pro and many others, uses a decantation of it syntax C as a graceful simple syntax, which has been replicated in C#,C++, Java, JavaScript, Groovy, PHP, etc. Perl syntax was implemented in Python, Ruby and Groovy. The following are other reasons for the development of so many programming languages in the world:

- That there are many different types of programs and computers. Some programming languages are designed to be used by many different computer configurations and operating systems
- Different tools for different jobs. Programming languages are tools, and we choose different tools for different jobs. For example, Ruby and JavaScript are great for building web sites; Java and C++ are often used for financial trading; Python and R are the tools of choice for analyzing statistics
- Developers have tastes. Beyond mere utility, developers choose tools based on personal tastes. As such, people have to use a programming language as a tool for humans to *expression of ideas* to computers which is a natural variety in the way our minds work.
- People first. Beyond utility, and beyond taste, businesses run on people. Often, you will choose a programming language based on what you, or the people around you, know.
- Variety is strength. As such we have a variety of programming languages because there is a variety of jobs to be done and a variety of people who do those jobs. This diversity makes interesting programs, and interesting companies, and interesting careers possible
- Some languages just control elements inside of a program, (these are usually referred to as scripting languages such as HTML) while others define and create the entire program themselves (these are referred to as system programming languages like C++).
- We have an abundance, perhaps an over abundance, of programming languages
- we are discovering/creating new sorts of programming
- Programming for a smart phone (App Inventor, Touch Develop) is different from programming for the web which is very different for creating old-fashioned batch programming on mainframes (anyone else remember COBOL

- And there are new paradigms (or at least increased importance of those paradigms) such as parallel processing (which used to be almost exclusively FORTRAN with extensions and is now often functional programming languages like F#).
- Also computer scientists are coming up with new programming ideas such as anonymous classes
- These new programs do not fit easily into existing languages because they require big changes to the language
- With new power comes new complexity though. The languages that professional developers use become harder and harder to use for training beginner programmers
- The gap between beginner languages and professional languages is growing over time.
- Today many people (teachers often more than students) find the professional development tools (IDEs like Visual Studio or Eclipse) so complex that even though they could probably learn small subsets of a language the IDE adds more to the learning curve. This in part drives the interest in easier to use tools (think BlueJ or Small Basic) or easier languages (block languages or increasingly Python) for teaching purposes
- Change is the big constant in computer science and computer science education
- To teach programming. every language designed since binary has existed to make it easier for humans to write reliable, human-readable instructions for a machine, without anyone clawing their eyes out from the boredom and redundancy of writing in binary
- making real-life gadgets is often the most palatable way into programming concepts for people who are turned off just staring at code
- The ego copy. Person would attempt to do things their own way, Best Way
- Abstraction. People are always trying to create reusable bits of code, because they seek to not repeat themselves.
- New Infrastructure. you need a new language because there are tectonic changes that need adapting to
- Many developers would already prefer to have their apps running as services, because a website has lots of advantages making web apps cheaper to run at scale has caused an explosion in popularity for Node.js, which is written in JavaScript.
- Culture. Programming languages are made by people for other people. As a result, they carry all the cultural artifacts of their makers, and some of those cultural artifacts are turnoffs to other groups of engineers, who turn around and make their own version
- Because there are choices to be made:
  - Mode of specification: Imperative vs. functional
  - Typing: Statically typed vs. dynamically typed
  - Order of evaluation: call-by-value vs. call-by-name
  - Modularity: class-based vs. abstract data type-based
  - Execution model: sequential vs. concurrent

4.0 Conclusion

Computer programming languages are means by which programmers manipulate the computer. The programming languages emanates from the need to program the computer in languages that would be easy for non-experts to understand and to reduce the enormity of task involved in writing programs in machine code. Programming languages have evolved from the machine language to assembly language, high level language and very high level

programming language and artificial intelligence because many of culture, new infrastructure, ego copy, and many people want it translated into their own languages.

5.0 Summary

We summarize the study of computer programming language as follows:

a. Machine language is the binary language and is made up of only 0s and 1s which represent the 'off' and 'on' stages of a computer's electrical circuits.
b. Assembly language has a one-to-one relationship with machine language, but uses symbols and mnemonics for particular items. Assembly language, like machine language, is hardware specific, and is translated into machine language by an assembler.
c. High level languages are usable on different machines and are designed for similar applications rather than similar hardware. They are procedural in that they describe the logical procedures needed to achieve a particular result. High level languages are translated into machine language by a compiler or an interpreter.
d. In a high level language one specifies the logical procedures that have to be performed to achieve a result. In a fourth generation language, one needs to simply define the result one wants, and the requisite program instructions will be generated by the fourth generation software. Fourth generation languages are used in fourth generation systems in which a number of development tools are integrated in one environment.
e. In the fifth generation computer, a programmer needs to specify the logical procedures with voices and sound both audio and visual

6.0 Tutor-Marked Assignment

Explain any five reasons for having so many programming languages in the world today.

7.0 References and Further Reading

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UNIT 2: BASIC PRINCIPLES OF COMPUTER PROGRAMMING

Content

1.0 Introduction

Computer programming is both an art and a science. In this unit, we students shall be exposed to some arts and science of computer programming including principles of programming and stages of programming.

2.0 Objectives

The objective of this unit is to expose students to the programming tools, programming environment, reasons why there are bugs, principles of programming, the stages involved in writing computer programs and the challenges of writing a good program.

3.0 Main Content

3.1 Programming Tools.

To write a program, some tools may be required. These tools help to communicate the steps for solving problems. Some of the major tools in programming languages are:

a. **Algorithm**–A step by step problem solving procedure that can be carried out by a computer. It has the following characteristics:
   - ♦ An algorithm starts with input instructions.
   - ♦ Each and every instruction should be precise.
   - ♦ It should be universal and unambiguous.
   - ♦ The total time to carry out all steps in the algorithm must be finite.
   - ♦ It should produce results.
   - ♦ Each algorithm must have an end statement.
   - ♦ Obtain algorithms must have an end statement.

b. **Flowchart**–A pictorial or diagrammatic representation of the steps involved in solving a problem.

3.2 Programming Environment.

A language as described earlier, is a set of rules for writing programs which are no more than sequences of symbols. The components of a programming environment involve the following:

- **Editor**. This is a tool used to create and modify source files, which are files of characters that comprise a program in a language.
- **Compiler**. It translates the symbols in a source file into an object module, which contains machine code instructions for a specific computer.
- **Librarian**. It maintains collections of object files.
- **Linker**. It collects the object files of the components of the program and resolves external references from one component to another in order to form an executable file.
- **Loader**. It copies the executable file from the disk into memory, and initializes the computer before executing the program.
- **Assembler**. It converts a symbolic program into a machine language. The source code is a symbolic language program that must be translated into machine language. It can also be software that represents operation codes and strings characters to represent address.
- **Debugger**. This is a software tool that enables the programmer to control the execution of a program at the level of individual statements, so that bugs can be diagnosed.
- **Profiler**. This software measures the relative amount of time spent in each component of a program.
- **Source program**. The process of translating a program from High Level Language (source program) to a machine understandable (object) language is known as compilation. The process of compilation consists of the following steps:
  - The user enters the source program on the terminal and stores it in a RAM.
  - The compiler is called and asked to perform the translation.
  - The object program is executed in order to derive the desired results.
- **Interpreter**. An interpreter takes a source statement checks for syntax, executes it, checks the next statement, and executes it.

Reasons why there are bugs/defects in software development

- Human factor: To err is human and to forgive is divine. Human error is inevitable.
- Communication failure: Miscommunication can occur during software development such as gather stage, documentation stage, implementation stage.
- Unrealistic development timeframe: Unrealistic deadlines and hasty development can cause defects in software.
- Poor design logic: Software developer requires some brainstorming to reach reliable solution to his work.
- Poor coding practice: Bad coding can cause error and lack of validation
- Lack of version control: If a version control system such as visual source Safe is in place, obviously error will occur
- Buggy third-party tools: The use of class libraries, shared, Compiler, HTML, editors, debuggers can save time as well as causing defects when not appropriately used.
- Lack of skilled testing-poor testing: Lack of competency in testing your software can lead to software defects.
- Lack of minute changes: Changes made to requirement infrastructural tools, platform can be dangerous if not properly checked

3.3 Problem solving with the Computer

The computer is a general-purpose machine with a remarkable ability to process information. It has many capabilities and its specific function at any particular time is determined by the user. This depends on the program loaded into the computer memory being utilized by the user. There are many types of computer programs. However, the programs designed to convert the general-purposes computer into a tool for a specific task or applications are called 'Application programs'. These are developed by users to solve their peculiar data processing problems. Computer programming is the act of writing a program which a computer can execute to produce the desired result. A program is a series of instructions assembled to enable the computer to carry out a specified procedure. A computer program is the sequence of simple instructions into which a given problem is reduced and which is in a form the computer can understand, either directly or after interpretation.

3.3.1 Programming Methodology

Factors to consider when writing good progam

It is generally accepted that a good computer program should have the characteristics shown below:

a. **Accuracy:** The Program must do what it is supposed to do correctly and must meet the criteria laid down in its specification.
b. **Reliability:** The Program must always do what it is supposed to do, and never crash.
c. **Efficiency:** Optimal utilization of resources is essential. The program must use the available storage space and other resources in such as way that the system speed is not wasted.
d. **Robustness:** The Program should cope with invalid data and not stop without an indication of the cause of the source of error.
e. **Usability:** The Program must be easy enough to use and be well documented.
f. **Maintainability:** The Program must be easy to amend having good structuring and documentation.
g. **Readability:** The Code of a program must be well laid out and explained with comments.
h. **Compatibility:** A good program must be compatible with others similar to extendible

3.4 Stages of writing Programs

The preparation of a computer program involves a set of procedure. These steps can be classified into six major stages as follows:

a. Defining the Problem
b. Designing or Planning the Solution (Algorithm)
c. Coding/refine or writing the Program
d. Testing the program
e. Documenting the program
f. Program Maintenance

3.4.1 Defining the problem.

When you want to travel, you have to think of your destination, the cost, type of transportation, time etc. involved. The same procedure is involved in the case of writing a program. A programmer must bear in mind the following steps or procedures or principles to take while writing a computer program

a. Determining program objectives. That is what you want to achieve. Is it to develop computerized students records? Is it how to manage a large class? Is it how to mark and post assignments to students on the net? etc

b. Determining the Desired output. You need to determine the output first before the input. Looking at the end-user and not the programmer. So you want the output printed or displayed on the monitor? Or both?
c. Determining the input. Once you know the output, you can determine the input and the source of this data. So you need cards, pencil, keyboards, laptop etc.
d. Determining the processing requirements. This involves defining the processing of tasks such add, subtract, multiple, divide etc.
e. Determining the program's specifications. In this case, you need to record program objectives, desired outputs, needed inputs, and required processing.

3.4.2 Designing or Planning the Solution (Algorithm). This stage involves a solution technique such as:

a. Top-down program design. This involves designing a program beginning from the highest to the bottom. This enables you to identify the program's processing steps in module and their statements by obtaining their input, process and output.
b. Bottom-up program design. It is a design of a program in reverse of the top-down program beginning from the lowest modules expanded to the highest modules.
c. Pseudo code. This is pronounced "soo-doh-code". It is an outline of the logic of the program you will write. It is like doing a summary of the program before it is written.
d. Flowcharts. It is a pictorial representation of an algorithm. This involves program flowchart which graphically present the detailed sequence of steps needed to solve a programming problem as indicated under the types of flowcharts below.
e. Determining the logic structures. This is the combination of three logic structures that link the various parts of the flowcharts, namely: sequence structure (one program statement that follows another); selection structure (the paths to follow in a decision table such as If-then-else structure); the loop structure or iteration (process that might be repeated such as until or while).

3.4.3 Coding/refine or writing the Program.

This is the actual writing of the program using a programming language. The coding of the program means expressing the solution of your problem using any of the languages. This involves:

a. The good program. The good program involves speed, accuracy, reliability, maintainability, readability, performance and storage capacity.
b. Which language? This involves the selection of programming languages that are most popular with microcomputers such as: BASIC, COBOL, PASCAL, FORTRAN, Object Oriented Programming, Visual programming, C++ etc. with appropriate syntax that is available on your computer.

3.4.4. Testing the Program.

This is a stage which involves checking and reviewing your computations in a precise and careful manner to eliminate errors (debugging). The type of errors or bugs you will be checking to remove or debug involves:

a. Syntax Errors. This is a violation of the rules of the programming language.
b. Logic Errors. This occurs when the programmer uses an incorrect calculation procedure. They are present in a program whenever the program does not solve the intended problem. They occur as a result of wrong solution method, missing logic or incorrect reasoning or incorrect sequence of instructions.

c. Typographical Errors. This type of error comes from clerical errors occurring during transcription of a program or coding or preparing input. So if the input is not reliable, the output will not be accurate either.
d. Computational Errors. These errors occur when we compute a number outside the allowable numerical range of a variable. They also occur when two numbers of unequal precision are numerically combined in a manner.

3.4.4.1 Testing process. This is the process of removing errors as follows:

a. Desk check. A programmer sits at a desk, check his statement and proofread the printout of the program. He looks for syntax, logic, typographical and computational errors line by line.
b. Manual testing with same data. The programmer tests the incorrectness of the program manually without the computer.
c. Translation. The programmer translates the program using translator program into the machine language. Errors are identified and must be free of syntax errors.
d. Testing sample data on the computer. Logic errors are now tested after it has been corrected.
e. Testing by a select group of potential users. This is the final step in testing a program. The programmer tries out the program and equally provides feedback.

3.4.5 Documenting the Program.

It involves writing a description of the purpose and process of the program in a clear step bearing in mind:

a. The Users. Users need to know how to use the software using manuals that accompany the software, and the help option within most microcomputer applications.
b. The operators. The computer operators need to know what to do when computer sends in error signals.
c. The programmers. The programmers need to update and modify the programs, perform program maintenance to include program flowcharts, program listings, and sample output.

3.4.6 Program Maintenance.

This involves adjustment of programs to make it error free, efficiently and effectively such as:

a. The Operations. This concerns locating and correcting operational errors, making programs easier to use and standardizing software.
b. The Changing Needs. The program needs to be changed to include new tax laws, new information needs, new company or institutional policies and the changing world.

Self-Assessment Exercise

a. Discuss any five programming tools you know.
b. Briefly explain any five programming environment when writing software

3.5 Twelve (12) Steps to consider when creating a Professional Web Design

When measuring the professionalism of a web design and website, one must take into consideration a number of factors/steps to take:

3.5.1 Conceptualization and planning (flowcharts)

When designing a website, one should not begin the process inside of a text editor or website builder application (Dreamweaver, Go Live, etc). Instead, the process should begin on a piece of paper or within flowchart software. According to Wikipedia, a flowchart is: a schematic

representation of an algorithm or a process. It is a pictorial representation of an object. How many main navigational items will your website contain? What will these items be called? Will there be any pages contained within the main pages? What will they be called? By planning out your website using a flowchart, you get a head start on:

a. Information organization
b. Usability
c. Determining the volume of content required

Modeling (wireframes).

This modeling stage, involve static "wireframe" mockups which are created for each unique web page. To create wireframes, one may use either:

a. paper and pencil
b. mockup software such as Adobe Photoshop or our personal choice.

These wireframes contain a bare-bones skeleton which illustrates the layout of a particular web page. The following questions and many more are pertinent for a developer to know and answer in the modeling stage.

a. Where will the logo go?
b. Where will the content be located?
c. Will there be breadcrumbs?
d. Will you have a login box?

Similarly, the following should be taken into consideration when creating wireframes:

- be sure to include all important elements that will be used (logo, navigation, content placement, images/video placement, login box, search, breadcrumbs, etc)
- reference the flowchart which you created in Stage 1.1
- don't use graphics – wireframes are meant to be bare-bones: boxes/circles/ovals which illustrate the placement of objects
- only use text to label the elements, don't use body text (that is for the third stage, 1.3)
- focus on clean, well-organized, user-friendly layout and avoid cluttered layouts

Execution.

The third stage in our professional web design process includes:

a. Creating the graphical user interface (GUI), also known as the design
b. Creating the content
c. Converting the web designs from images into code (markup) which web browsers use to present your website on the Internet

In the final stage, reference both the flowcharts created in Stage 1.1 and the wireframe mockups created in Stage 1.2 to create the final page layouts and designs. The design should be finalized in Photoshop or whatever image editing software you choose to use because it is a pain to make changes to the design once it has been converted into markup (code).

3.5.2 Project collaboration tools.

At this stage, if you are the only one working on your project, then you can skip this step. Project collaboration tools are only recommended for projects which have two or more people involved. Communication is one of the most important elements in a project. When multiple people are building a website, there usually are quite a few e-mails sent back and forth between one another. The more e-mails exchanged, the longer it can take to find a certain e-mail and the easier it can be to misplace important bits of information. This was one of the biggest problems that professional web designers can face when they first began. The issue is that there would be no easy way to organize the e-mails, attachments, milestones, etc. Projects would not fail from a lack of charts, graphs, stats, or reports, they fail from a lack of clear communication. When it comes to project collaboration and communication, nothing

beats a web application like Base camp. If you're serious about your project and want to have the best communication possible, then you must try Base camp. A project collaboration tool such as Base camp is especially useful for a professional web designer which handles a number of projects and clients at any given time.

3.5.3 High-quality design.

Who and what determines a "high-quality design"? There isn't one answer. Often times something that is appealing to one person may be extremely unappealing to another. Despite this fact, the following are several things that a high-quality design should have:

a. **Balance**. Balance refers to the equal distribution of the heavy and the light elements on a single page.
b. **Unity**. Unity keeps all of the similar elements in the website alike and those that are diverse further apart; everything should be pulled into one integrated whole.
c. **Emphasis**. Emphasis involves the main points where the eye is drawn into the design; also known as "focal points".
d. **Contrast**. Not just color contrast, but also contrasting shapes, sizes, textures, and even typography.
e. **Rhythm**. Also known as repetition, rhythm brings internal consistency into your web design.

3.5.4 Attention to detail.

When professionally designing a website, every little detail is thought out and planned. Should there be a line above the headers, and if so, why? If you use rounded corners for your main body, should you be consistent and use rounded corners for everything else? Does your logo look better with a reflection underneath? The only way to answer any of these questions is to experiment. Sometimes the best results come from accidental experimentation. Don't always be happy with the first design. Work to improve upon the design and go through a few revisions, each time asking yourself "What can be done to make the design look better?", be more consistent, and most importantly, give your website a stronger identity and image. When we say "detail", we're not just talking about graphic design elements. No, graphic design is just the tip of the iceberg. In this case detail is all about typography (font faces i.e. Arial, Verdana, Trebuchet MS, font sizes i.e 10 pixels, 12 pixels, 18 pixels, font weight/style i.e. bold, italic, font placement), the use of negative space, and other elements of design. Attention to detail is important because it is oftentimes the details in your design which make your website stand out from the competition. People get bored with the same old design. Give them something different, unique, and attractive, and they will come back and visit.

3.5.5 Current web design technology.

Use Cascading Style Sheets (CSS) which replaced table-based website layouts some years ago. The problem is, a lot of web designers are still using tables to create their designs. Not only is this unprofessional, but tables just plain suck. Here are a number of reasons why using tables for your web design is a bad idea:

a. **Tables slow down your website**. Everything inside of a table's cell is loaded before being shown to the user. This is especially apparent for people using dial up connections.
b. **Tables make messy code and add unnecessary junk markup**. File sizes are increased due to the excessive lines of code which means slower load times. Also, having to sift through hundreds (sometimes thousands) of lines of code just to make a change isn't a lot of fun.

c. **Universal layout updates are difficult and time consuming when using tables**. Making universal edits with tables involves opening each file, sifting through the code and junk markup, and making a change (again, on each page). Often times with CSS, all one must do is open the style sheet and change a single value.
d. **Tables should only be used to show data, not be used to design websites**.
e. **Tables limit your creativity and design**. Table layouts are limited to boring, grid-based layouts. With CSS, you can place anything anywhere. The layout possibilities with CSS are endless.
f. **CSS will save you time and increase your revenue in the long run**. Updates and edits are much easier using CSS than tables. Because of faster load times, fewer visitors are likely to become impatient and leave. Longer visits = more browsing, more ad-clicking, lower bounce rates = more money for you if you are paying as you brows
g. **Display your CSS website on tons of high-quality CSS Showcase websites**. Tons of exposure if your website is featured. Table-based layouts are not welcome.

Some people will argue that table-based layouts are better than layouts which are built using CSS. However, oftentimes the person arguing that tables are better than CSS is the person who spent thousands of dollars on a table-based layout. Despite what anyone tells you, table-based layouts are inferior to CSS and should be avoided at all costs. Again, to be blunt, if your website is created using tables, it is not professional web design quality. Start using CSS style sheets today and keep the tables in your spreadsheet application.

3.5.6 Well written, interesting, grammatically-correct content.

One thing that greatly compromises the quality and credibility of a website is poorly written, grammatically incorrect, misspelled content. This kind of content is unfortunately present in an extremely high number of websites – especially "professional" company websites. If you don't know how to write, then hire someone to write the content of your website. It does not give you any good image. Even if you do know how to write, mistakes are easy to make. Run through your content a few times to confirm that everything makes sense, is interesting, and is spelled correctly. You'll look more professional and people will take what you have to say more seriously. You will be boosting your image.

3.5.7 Usability.

Website usability is extremely important. According to usability.gov:
In general, usability refers to how well users can learn and use a product to achieve their goals and how satisfied they are with that process. Usability is seen as the quick and easily accessibility to the tasks the user wants to accomplish. Usability may also consider such factors as cost-effectiveness and usefulness. If website usability is poor, then people can easily become frustrated and leave your website. A great deal of importance must be placed on website usability if you want your web design to be of professional quality. It is usually poor usability which separates the regular websites from the professionally designed websites. Usability is the most important element of a professionally designed website**.**

3.5.8 XHTML and CSS validation.

Some people will argue that validating your website with XHTML and CSS validation from W3.org is a waste of time. To be blunt, they are wrong for the following reasons:

a. **Accessibility**. Without accessibility, you run the risk of being sued. For example: a disabled person who cannot use a "conventional" browser can sue you if your website is inaccessible to them. Although validation doesn't necessarily guarantee

accessibility, it is an important component of exercising ones due diligence and is reason enough that you should validate your website's XHTML and CSS.

b. **Cross browser compatibility**. The more validation errors your website has, the higher the chances are that your website will not look the same in all web browsers.
c. **You look more professional with a valid website**. Again, like having interesting content free of grammatical errors and misspellings, having a valid website makes you look more professional to your visitors. It tells them "Hey, I care about my website's image, I took the time to validate it".

If you're building a website for the first time, then you may find that your website has a lot of validation errors. Don't worry this happens to the best of us. The more websites you build and the more time that you take to learn the rules of validation, the fewer errors you will get and the easier it will be to validate your website.

3.5.9 Standards-compliant.

Perhaps the most difficult, time-consuming aspect of professional web design is making sure your website is standards-compliant. Standards-compliant is a term often used in describing websites & user agents' (often web browsers) relative compliance with web standards proposed by the World Wide Web Consortium (W3C).In addition, achieving interoperability lowers costs to content providers since they must only develop one version of a document. So creating a standards-compliant website will take a good deal of time and can even involve using basic hacks in order for certain elements to appear the same across all major browsers. Major browsers include: Internet Explorer 6 (IE6 -PC), Internet Explorer 7 (IE7 – PC), Internet Explorer 8(IE8),Firefox (PC and Mac), Safari (PC and Mac), and Opera (PC and Mac). These browsers control the majority of the browser market share and therefore the website which you create should be tested extensively in each of these browsers to ensure standards-compliance. In addition, XHTML and CSS validation (as mentioned in Step 8: XHTML and CSS validation) are extremely important when programming a website to be standards-compliant. Validate your website, validate your CSS style sheet, validate yourself (okay, you can't validate yourself, but if you could, would you?).

3.5.10 Optimization.

Website optimization is another crucial factor that must be taken into consideration when professionally designing a website. Website optimization includes:

a. **Image optimization**. Next to audio and video, images can severely compromise the speed in which your website loads. Always compress your images using Photoshop or your favorite image compression utility. By compressing images, you decrease the size of a file which allows a web page to load quicker which ultimately decreases the chance that your visitor will leave your website due to long load times.
b. **Audio/Video optimization**. Another major annoyance which screams "unprofessional" is having enormous video and audio files embedded in your web pages. Try to use Flash Video (.flv) compression for your video files and (.mp3) compression for your audio files. Not only are the file sizes smaller than using (.avi) or (.mpg) for video or (.wav) for audio, but the video/audio loads faster which means other elements on your web page will load faster, too.
c. **Clean code (just say no to tables)**. In case you skipped Step 5, do not use tables when designing your website – use CSS (cascading style sheets). Tables have a ton of junk markup which will slow down your page load time, increase file sizes, and make editing and updating quite difficult.
d. **Validate your XHTML and CSS**. As indicated in Step 8, XHTML and CSS validation is an integral part of professional website optimization and therefore should not be skipped. Validate your XHTML and CSS.

3.5.11 Search Engine Optimization (SEO) friendly.

Professionally designed websites should be designed with a solid SEO friendly foundation. To make your website SEO friendly:

a. **Don't use Flash**. If you must use Flash, make sure it is used sparingly. Flash content is not crawlable by search engine spiders and therefore the content located inside of Flash files cannot be indexed in the search engines such as Google, Yahoo, MSN, or Ask.
b. **Don't use Frames**. Search Engine Spiders have a difficult time crawling through a website that uses frames. Many Search Engine Spiders will receive the following message when visiting a website designed using frames:"Sorry! You need a frames-browser to view this site."
c. **Keyword Research**. Optimize your web pages by including keywords relevant to the content on your website. Use keyword research tools such as Word tracker or Overture to find the best, most relevant keywords for your content.
d. **Researched Keywords in Title of web pages**. Arguably the most important element in SEO, make sure that your title tags include the keywords found in the keyword research stage.
e. **Researched Keywords in URL**. Be sure to include the researched keywords in the title of your web pages as well. For example, if a page on your website is about computer education, make sure that the file is saved as "computer education.html". Use dashes instead of underscores, if possible.
f. **CSS Navigation/CSS Style sheets**. CSS navigation guarantees that your website navigational text is crawlable by search engine spiders. CSS navigation also loads very quickly and anyone will be able to view the navigation using any browser.
g. **Researched Keywords in Anchor Text**. For hyperlinks inside and outside of your website, be sure to include the researched keywords in the anchor text of your hyperlinks. This helps search engines better determine what a particular page is about and will help that page rank higher with the researched keyword(s).
h. **Images: ALT tags, no text in images**. Not only are ALT tags required for XHTML validation, but they are necessary components of web accessibility. Try to avoid placing text inside of your images since search engine spiders cannot crawl image text. However, if you must place text inside of an image, use the text inside of the image as that image's ALT tag. Search engine spiders can read ALT tags, just not the text inside of images.

3.5.12 Abuse of Flash, Java script, and sound effects.

The last step in creating a professional web design and website is to avoid the abuse of Flash, Java script, and sound effects. Not everyone has Flash or Java script enabled on their computer, and therefore your website should not be built around them. If you're going to use Flash or Java script, use it sparingly. Try not to use Flash Intros on your website. Most people hate waiting for Flash Intros to load, hate being forced to sit through them, and hate being surprised by the sound that many of them have. Do not create your website using only Flash. Again, what about the users who do not have Flash enabled on their computer? That could be a potential client, customer, or reader who you're missing out on because of an unnecessary technological limitation. If you're going to use sound effects, make sure that they only play if the user enables sound on your website – never force sound effects onto your visitors. Nothing screams "unprofessional" like having a sound effect play each time a navigational item is rolled over or even worse, when the visitor lands on the home page of your website. As a matter of fact, Flash and sound effects should generally be avoided when creating a

professional web design. Java script is the only exception as long as you program the website to work even if Java script is disabled. Flash and sound effects are a nuisance to a lot of people, so for that reason alone, try to stay away from them.

3.6 Constrains of Teaching Programming to Secondary schools students.

The constraints in teaching programming in secondary schools may include:

a. The student's knowledge of the real world which limits the kinds of problems that can be tackled.
b. Hardware constraints.
c. Software constraints.
d. The time allocated to the teaching of the programming.

4.0 Conclusion

The intelligence of a computer derives to a large extent from the quality of the programs.In this unit, we have attempted to present in some details, the principles and the stagesinvolved in writing a good computer program.

5.0 Summary

In this unit we have discussed the following:

a. Programming tools
b. Programming environment
c. Factors to consider when writing software
d. Problem solving with computer.
e. Principles of writing programming.
f. Stages of writing programming.
g. The challenges of writing good computer program

6.0 Tutor Marked Assignment

1. Explain any five factors to consider when writing good software

7.0 References/Further Reading

More recent editions of the following books are recommended for further reading.

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UNIT 4: PROGRAMMING WITHBEGINNERS ALL PURPOSE SYMBOLIC INSTRUCTION CODE (BASIC), PSEUDO CODE/FLOWCHART

Content

1.0 Introduction

In this unit you are introduced to the history of BASIC, principles of flowcharts and algorithms. The importance of these concepts is presented and the detailed steps and activities involved are also presented.

2.0 Objectives

The objective of this unit is to enable the students grasp the history of BASIC, advantages of BASIC, structure of a Basic program, principles of good programming with pseudo code and different types of flowcharting.

3.0 Main Content

3.1 History of BASIC.

BASIC was developed in 1963-1964 at Dartmouth College under the directions of Professors John Kemeny and Thomas Kurtz. Because of its simplicity, it was adopted by several commercial as timesharing services. As microcomputer became the most widely used world over, computer manufacturers wishing to remain competitive adopted BASIC as their standard programming language. The convenience and simplicity of BASIC has been a major contributor to the rapid proliferation of computer devices which made its language to be automatically built-in the computer. Most of the microcomputers include a BASIC interpreter as part of their internal circuitry. In 1978 the American National Standards Institute (ANSI) standardized an essential subset of BASIC in order to promote uniformity from one version of BASIC to another. This BASIC has variations with special instructions for carrying out graphics, for generating sounds and for controlling various microcomputer peripherals such as floppy-disk drives, printers, light pens and joysticks.

3.2 Advantages of BASIC.

There are many advantages of using BASIC as a language. Among these advantages are:

- Its conversational nature. Basic language is similar to the instructions you would write for a person. It makes communication with a computer in a natural, simple and straightforward way.
- Its built-in conveniences. The built in conveniences of the BASIC can handle a large table of numbers that are difficult in other programming languages. This means you can command the computer to print a table of more than 100 numbers or names with one simple instruction.
- Its simplicity. The newer versions of BASIC have excellent files handling capabilities. They are easy to use and friendly language whose instructions resemble elementary algebraic formulas, embedded by certain English keywords such as LET, READ, PRINT, GO TO, IF, THEN etc.
- Its wide applicability. The use of BASIC is not restricted to elementary applications. It is often used for a variety of more advanced applications in such areas as business, science, engineering, education, mathematics.
- It is the basic of all languages. BASIC is the principal language used with microcomputers. So it can be used for computer games that require the use of graphics and sound generation as well as more traditional application such as personal finance and database management.
- It is a time-sharing Language. The BASIC time-sharing language makes it interactive. This includes dedicated microcomputer applications as well as large-computer timesharing applications.
- BASIC is friendly. Its friendliness makes it people oriented. So it is easy to learn and fun to use. Any well-organized person can learning to program in BASIC.
- BASIC is flexible. Its flexibility allows programmer to develop new programs and to alter existing programs with relatively little effort.
- BASIC is Universal. BASIC program is universally available on both large and small computers. It has become the standard programming language for most microcomputer applications.
- The Features of BASIC is relatively standard. Many versions of BASIC programs can be run on a variety of different computers with little or no modification.

3.3 Structure of a BASIC Program.

Each instruction in a BASIC program is written as a separate statement. This means the statements will be executed in the order in which they appear unless a deliberate 'jump'. The following rules apply to the older and more traditional version of BASIC:

- Every statement must appear on a separate line.
- A statement cannot exceed one line in length. This cannot be continued on the next line.
- Each statement must begin with a positive integer quantity known as a statement number. No two statements can have the same statement number.
- Successive statement number must have increasing statement numbers.
- Each statement number must be followed by a BASIC keyword, which indicates the type of instruction that is to be carried out.
- Blank spaces may be inserted whenever desired in order to improve the readability of the statement.

3.4 Area of a Circle in BASIC.

Here is a simple Basic Program to calculate the area of a circle whose radius is specified. You should note that writing a program of this nature does not require long grammar.

```
Input  R
20     Let A = 3.14159*R'^2
```

Print R, A
end

Guidelines for drawing flowcharts

a. Each symbol denotes a type of operation Input, Output, Processing, Decision, Transfer or branch or Terminal.
b. A note is written inside each symbol to indicate the specific function to be performed.
c. Flowcharts are read from top to bottom.
d. A sequence of operations is performed until a terminal symbol designates the end of the run or "branch" connector transfers control.

3.5 Programming with Flowcharts

3.5.1. Flowchart.

Definition of a Flowchart. A flowchart is a pictorial representation of an algorithm with step of the algorithm enclosed in a box of various shapes and the flow of control. It is also a systematic representation of a process in a diagrammatic procedure.

Shapes of Flowcharts. Diagram of a flowchart as in Fig. 66

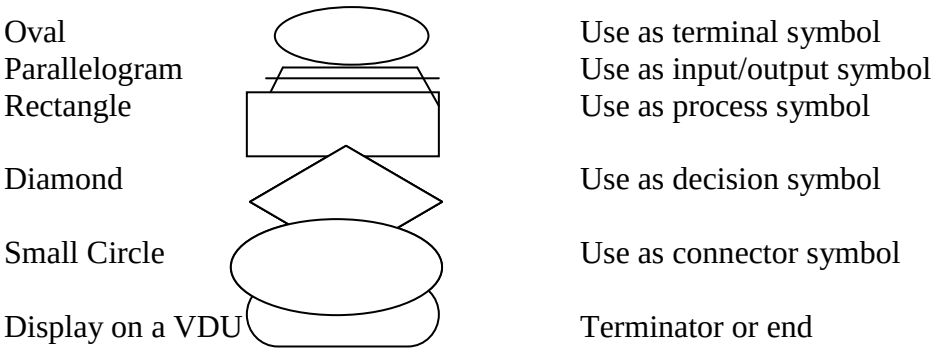


Fig. 66: Shapes of Flowcharts.

3.5.2 Special shapes of Flowcharts.

The following shapes of a flowchart use special shapes to represent different types of actions or steps in a process. Lines and arrows show the sequence of these steps, and the relationships between them as in Fig. 67

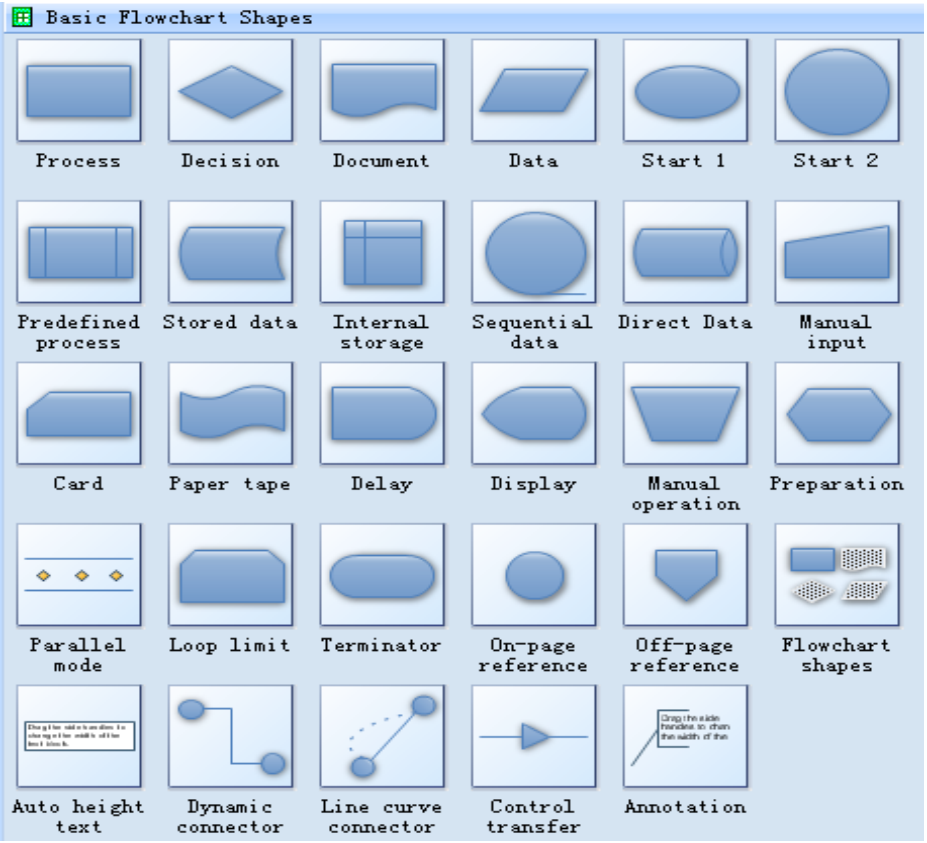


Fig. 67: Special shapes of Flowcharts

3.5.3 Audit Flowchart Shapes

The following shapes is similar with the basic flowchart symbols but are specially used in the audit flowchart as in Fig. 68

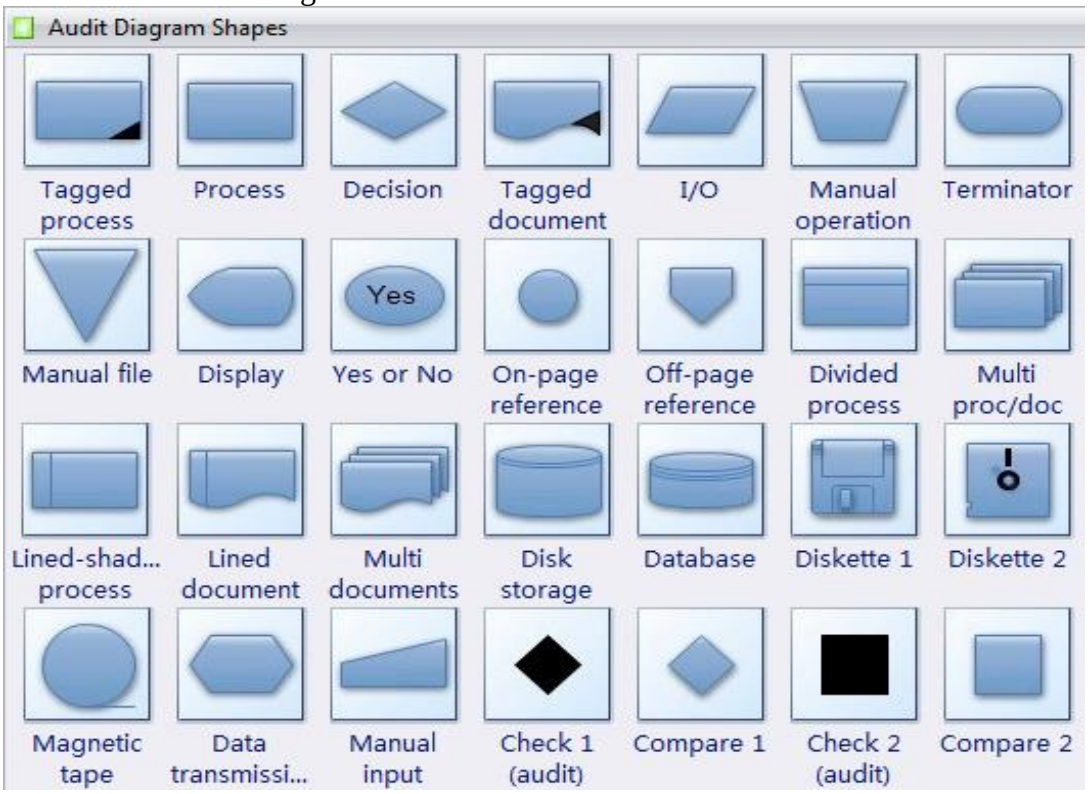


Fig. 68: Audit Flowchart Shapes

3.5.4 The Flowchart Symbols and Their Usage

Process represents a step in your process as in Fig. 69

Fig. 69: Process flowchart

Predefined process indicate a set of steps that combine to create a sub-process that is defined elsewhere, often on another page of the same drawing.

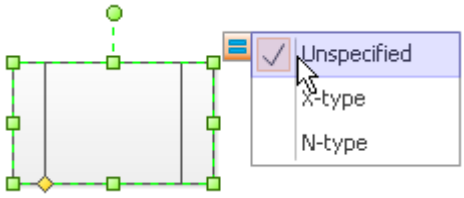


Fig. 70: Predefined Process

Decision indicates a point where the outcome of a decision dictates the next step. There can be multiple outcomes, but often there are just two - yes and no.

Fig. 71: Decision process

Terminal points indicates the starting and ending points of a process.

Fig. 72: Terminal Points

Data Shape Indicates that information is coming into the process from outside, or leaving the process.

Fig. 73: Data Shape

Delay shape Represents a waiting period where no activity is done. In Process Mapping, delays are often important as they may result in adding to the cost of the product or simply delaying its production.

Fig. 74: Delay Shape

Database shape Use this shape for a step that results in information being stored.

Fig. 75: Database Shape

Step represents a single step within a process, and usually contains the name of a specific action.
Page symbols refer to individual web pages, which may or may not contain multiple elements.
File symbols represent those data elements that exist independently of navigational properties outside of that page, e.g., audio sounds, movie clips, or a portable document file (PDF).
A **decision point** indicates a sequence in the process at which the end user chooses an option, i.e., a "yes-no", or "true-false" response, and then branches to different parts of the flowchart.
Arrows and connecting lines diagram the logical progression through the course, subject to the choices made at decision or action points within the process.
The **input/action symbol** represents a user response that directs the course flow from that point onwards, i.e., an online test, or questionnaire form.

Fig. 76: Input/action symbol

Represents the choice made by the user from mutually exclusive options, e.g., a student choosing among different lesson plans.
Conditional selector is similar to the conditional branch except that the user has the option to choose from a number of paths that will fulfill the requested conditions, e.g., the results of a search engine request.
Pages that share one or more common aspects, and are functionally identical may be simplified as a rounded corner rectangle, such as an on-line test or feedback form.
Annotations provide helpful comments or explanations, e.g. denoting the location where an undeveloped new page/process will fit into the navigational flow structure, or notes for specific team members for further development.
Flow references and flow areas are symbols for reusable sequences, such as logging in with a specific user id and password to enter the course or to initiate an on-line quiz. The flow reference symbol acts as a placeholder for the flow area sequence in the chart in every situation in which it is repeated.
Flow area is used as a flow area; it documents sections that share similar components/repeated steps within that flow, and requires the use of the following two symbols: entry and exit points.

Exit point concludes the subroutine, such as when the proper user id and password are verified, and documents where the user re-enters the master flowchart.
Entry point documents the place within the master flowchart where the process deviates into a subroutine.
Reference is used as a connecting point when the flowchart necessitates using more than one page, or refers to a complicated subroutine that would be impossible to contain on the main flowchart page.
On-page reference Indicates that the next or previous step is somewhere else on the flowchart. It is particularly useful for large flowcharts as in Fig. 77

Fig. 77: On-page Reference

Off-page reference Use the a set of hyperlinks between two pages of a flowchart or between a sub-process shape and a separate flowchart page that shows the steps in that sub-process as in Fig.78

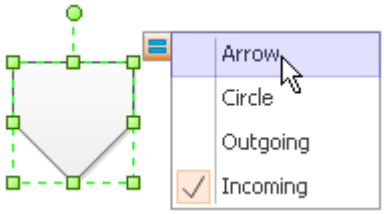


Fig. 78: Off-page Reference

Flowchart Shapes The designers can click this multi-shape to set to any of the following shapes: Data, Document, Decision, or Process. Any text you type onto the shape, or information you add to its Shape Data, remains with the shape as in Fig. 79

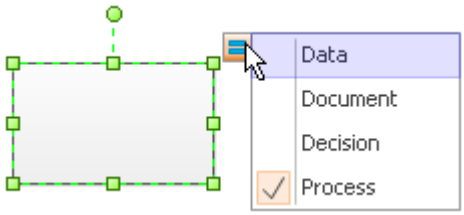


Fig. 79: Flowchart Shapes

Document Represents a step that results in a document as in Fig. 80

Fig. 80: Document shape

3.5.5 Types of Flowcharts.

There are many types of flowcharts, namely:

- **Sequential flowchart**. This is the simplest type of flowchart. This includes no decisions, no branches and no loops. The steps are taken in an explicitly prescribed sequence.
- **Branch or jump Flowchart**. This is the type of flowchart that has one or more decision boxes. This is sometimes called conditional flow. It involves a decision as to

which of the various available paths is to be followed. The action taken will all depends upon the result of the decision whether 'Yes' or 'No'

- **Loop Flowchart**. It is also called repetitive flowchart. This type of flowchart represents a procedure which may be repeated in a definite or indefinite number of times. Computer excels in this direction but human get bored.
- **Nested Loops**. This has an inner loop that represents procedure of processing.
- **System Flowchart**. This indicates the type of input/output media, the type of files storage (random-access or sequential) and the type of process. It shows the path taken as data pass from one organizational unit or processing machine to another within a company. It is also a flowchart diagrams that has a flow of data throughout a data processing system, as well as the flow into and out of the system. The symbols of system flowcharts include: Punched cards; sequential file (circle); direct-access file; printed document, processing operation (rectangle); preparation; visual display; sort; collate; merge; telecommunication link, and input/output using on-line storage.
- **Program Flowcharts**. This is a graphic representation of an algorithm, often used in the design phase of programming to work out the logical flow of a program. It demonstrates how a program works within a system. They picture the sequence of instructions for solving a particular problem. The symbols of program flowcharts include: terminal symbol (oval); input/output symbol (parallelogram); connector symbol (small circle); process symbol (rectangle), and decision symbol (diamond).
- **Document Flowchart.** It is commonly used to trace the movement of a document, such as internal memos, payroll information and interoffice mail, through a system.
- **Workflow Diagram.** It is use to create diagrams of information flow, business process automation, business process re-engineering, accounting, management, and human resources tasks
- **Highlight Flowchart.** This is used to create good looking style flowcharts
- **Process flowchart.** It is used to show a progression or sequential steps in a task, process, or workflow as in Fig.81.

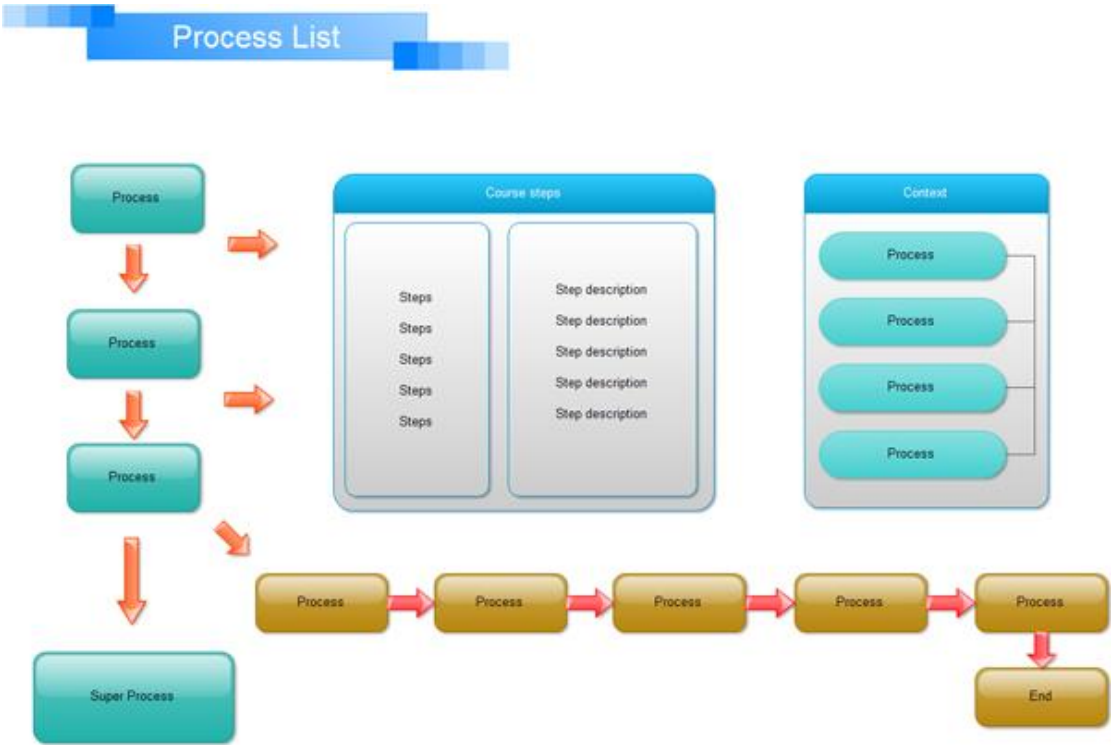


Fig. 81: Process Flowchart

- **Cross Functional Flowchart.** This is often used to show the relationship between a business process and the functional units (such as departments) responsible for that process as in Fig 82.

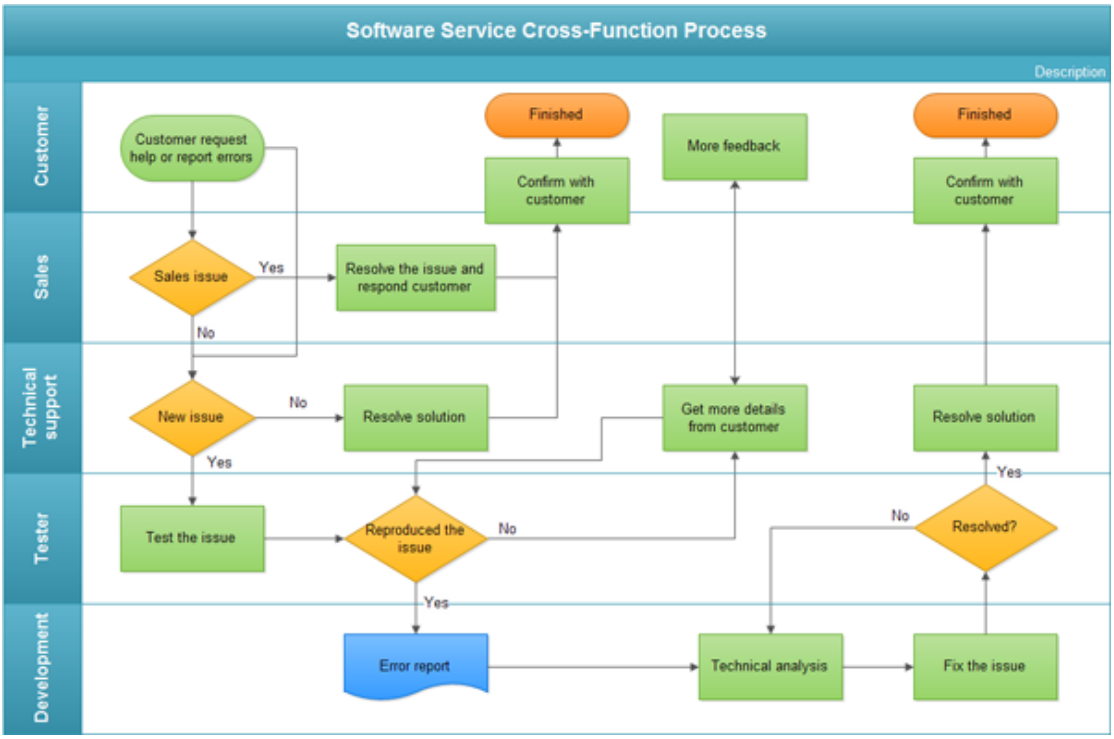


Fig. 82: Cross Functional Flowchart

- **Basic Flowchart** is often used to define and document basic work and data flows, financial, production and quality management processes to increase efficiency of your business.
- **Business Process Modeling Diagram.** This is a graphical representation for specifying business processes in a workflow.
- **Value Stream Mapping** flow chart. This is a mechanism to improve cycle times and productivity by visually separating value-adding from non-value-adding activities

3.5.6. Advantages of Flowcharts.

The flowcharts have the following advantages:

- They are brief and to the point.
- They express clearly the logic of a given procedure.
- They are unambiqous. There can only be one direction of logic at any one time.
- They are easier to draw and write the program directly.
- They are important aid to the development of the algorithm itself.
- They are easier to understand than a program itself.
- They are independent of any programming language so that a given flowchart can be used to translate an algorithm into more than programming language.
- They show readily whether all eventualities are covered.

3.5.7 Composition of a Flowchart.

The compositions of a flowchart include:

a. The objective or problem must be defined.

b. The choice of starting point.
c. The determination of the sequence of events leading towards the end result.
d. The decisions resulting in more than one possible action.

3.5.8 Levels of Flowcharts.

This involves the differences in the degree of detail involved such as:

a. **Block chart**. This shows the sequence of the main procedures within a system without showing in detail how they will be carried out.
b. **System Flowchart**. They expand each rectangle of the block chart by breaking down each procedure into more detail.
c. **Program flowchart**. This indicates in details what operations the computer will perform, and using this chart.

3.5.9 Main Points in Flowcharting

To design a good flowchart, the following matters need to attract enough attention

1. For a new process design, it's better to begin from planning the first major steps from the main subsystems.
2. The process direction of flowcharting should be rendered on the page in descending order, from left to right consistency.
3. It's necessary to use the generic, unified flowchart symbols within a certain range.
4. The process flowchart should be as simple as possible and the text in the graphics must be brief clear.
5. Under normal circumstances, a process box should be a separate work or event.
6. The structure of the flowchart should be complete. In addition to the form the graphics, the title, author, date, text, number of pages, revise number should be completely and accurately marked on.
7. Attention to process the starting point and end point. It should be noted to avoid the start point too early or too late to appear. Because this situation impedes attention and correct understanding of the key steps. It should also be noted to avoid the end point too early or too late to appear, because the endpoint too early means throw away the key steps, too late means that the process appears redundant activities, both cases are harmful.
8. Avoid the appears of the cross-flow line.
9. Reduce the numbers of connect line.
10. Facilitate the reader as much as possible.

3.6. Sequential flowchart and its process of buying a meal in a restaurant:

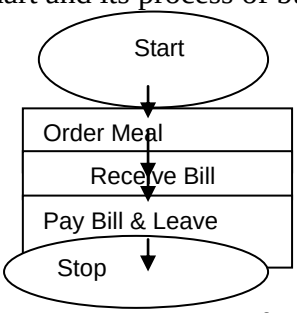


Fig. 83: Sequential flowchart

3.6.1 The process of buying an envelope. This is an example of a Pseudo code and Flowchart as in Fig. 84

Step in Pseudo code

- ♦ Enter supermarket.
- ♦ Get to stationery Department.
- ♦ Look for envelopes.
- ♦ Select the right size.
- ♦ Pay Money.
- ♦ Leave supermarket.

Step in Flowchart

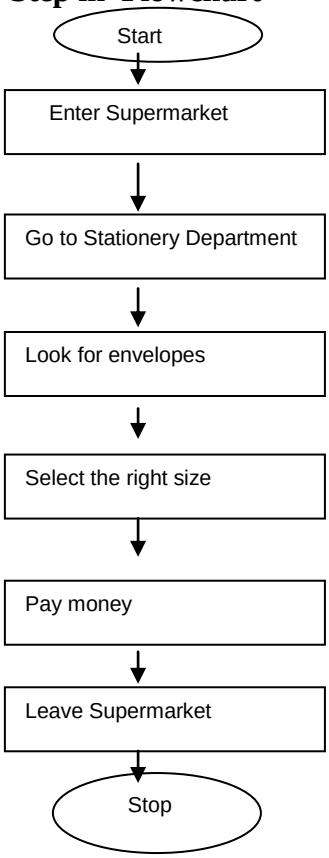


Fig. 84: Step in Flowchart

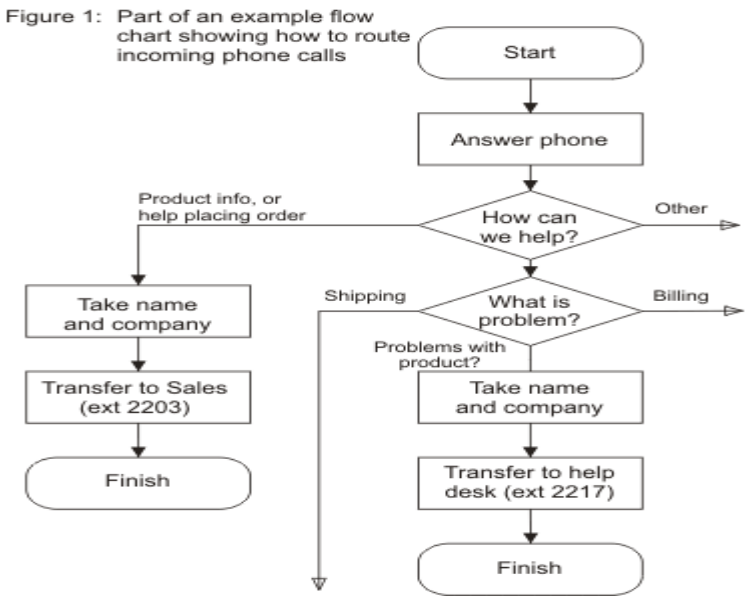


Fig. 85: Flowchart showing incoming phone calls

3.6.2 Draw a Flowchart showing incoming phone calls

The example below shows part of a simple flow chart which helps receptionists route incoming phone calls to the correct department in a company:

What you should note here is that:

a. Flow charts are simple diagrams that map out a process so that it can easily be communicated to other people.
b. To draw a flowchart, brainstorm the tasks and decisions made during a process, and write them down in order.
c. Then map these out in flow chart format using appropriate symbols for the start and end of a process, for actions to be taken and for decisions to be made.
d. You have to challenge your flow chart to make sure that it's an accurate representation of the process, and that it represents the most efficient way of doing the job

3.6.3 Use a flowchart to compute the gross pay of an employee.

The percentage of the gross pay is to be remained as tax, to yield the net pay.

- Input name, hours worked wage/hour.
- Calculate gross pay.
- Calculate tax.
- Calculate net pay.
- Output name, net pay.

3.6.4 Use a flowchart to calculate the average numerical grade for 5 students in a class to determine their final letter grade for the course.

1. Print headings.
2. Input – student names and find numerical grades each student received.
3. Output – print name, average and final grade (total students' grade average).
4. Calculate the student's grade average.
5. Determine the final letter grade based on the grade scale.
6. Print name, average, and final grade.
7. Repeat steps 2-6 for all students
8. Stop

3.6.5 Use a flowchart to calculate the product of 5 given numbers.
The following steps should be followed.

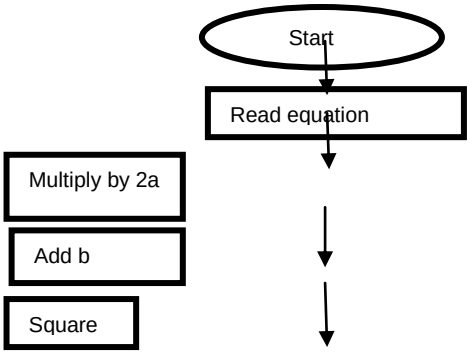
10. Input A,B,C,D,E
20. Let P = A*B*C*D*E*
30. Print A,B,C,D,E,
40. Print P
50. End

3.6.6 Use a Pseudo code and Flowchart to calculate the roots of a quadratic equation as in Fig.86. If $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

a. Pseudo code Method

1. Read numeral values for a, b, c.
2. Calculate a value for $\sqrt{b^2-4ac}$
3. Calculate the values for x^1, and x^2 Using the above formulas
4. Print the value for a, b, c, x^1 and x^2
5. Stop

b. Flowchart Method



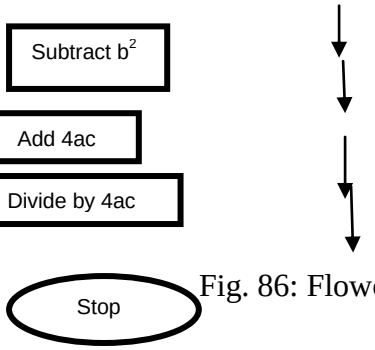


Fig. 86: Flowchart Method

3.6.7 Draw a Flowchart showing a student going to school.

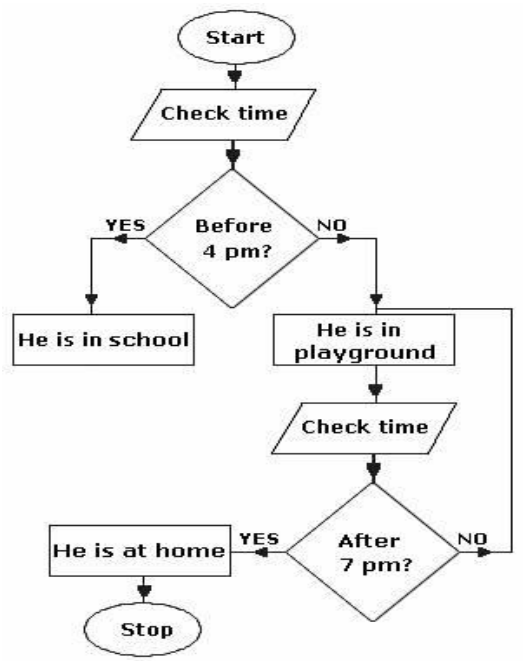


Fig. 87: Flowchart showing a student going to school

3.6.8 Draw a Flowchart showing somebody Drinking Juice

The following steps showed somebody drinking a juice:

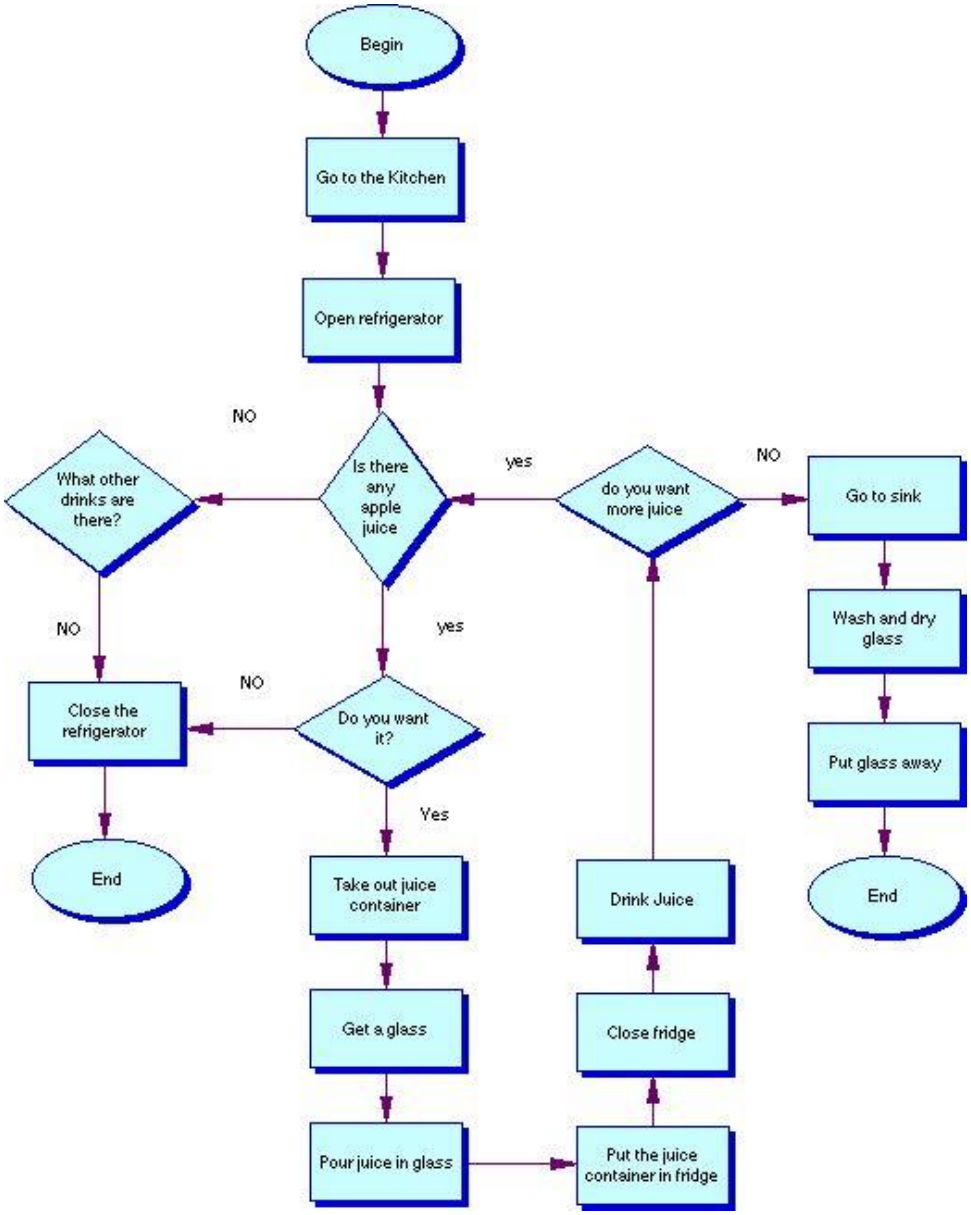


Fig. 88: Flowchart showing somebody Drinking Juice.https://www.lucidchart.com/ *2012*

SELF-ASSESSMENT EXERCISE

a. Discuss any five advantages of using flowchart in programming
b. Draw a flowchart to calculate the average numerical grade for 5 students in a class to determine their final letter grade for the course

3.6.9 Draw a Flowchart on Bloom's domain of Learning

The following are steps showing Bloom's domain of learning as in Fig.89

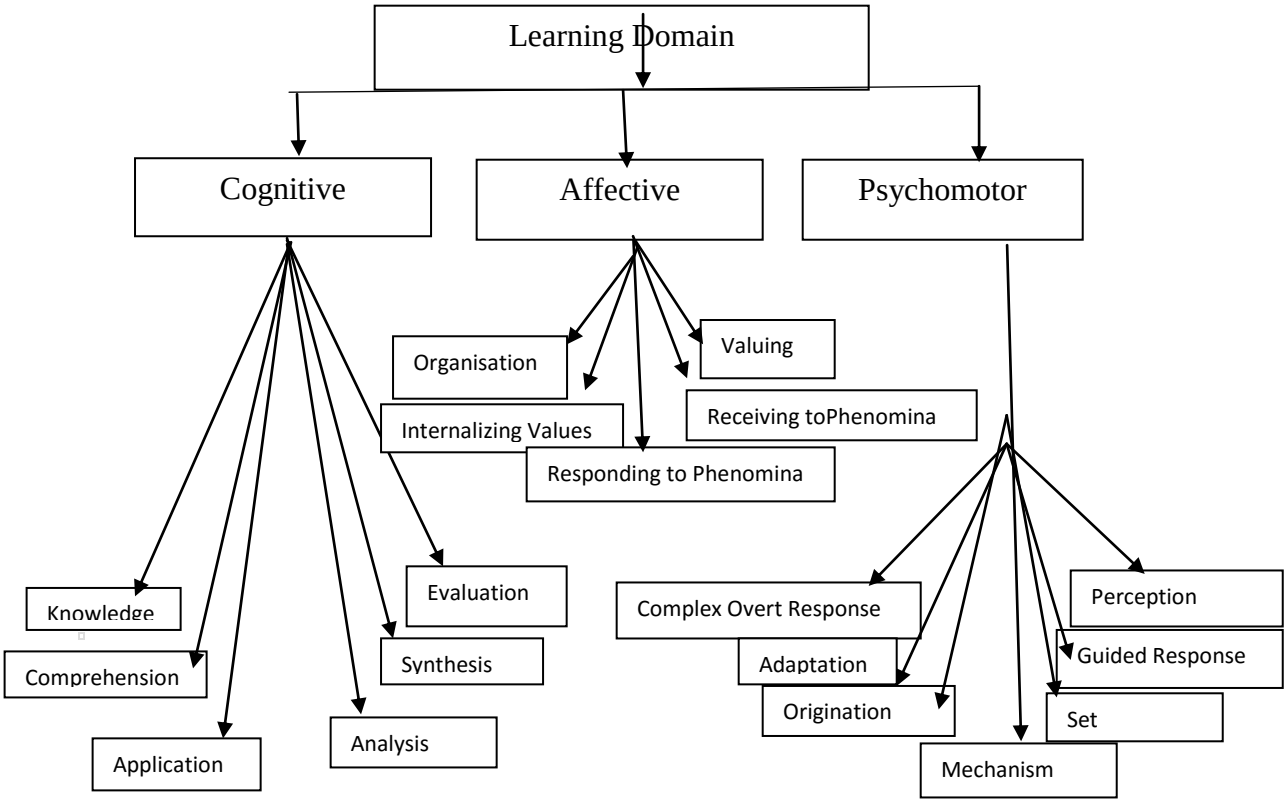


Fig. 89: Flowchart on Bloom's domain of Learning

3.6.10Draw a Flowchart to indicate Bloom's Cognitive Internet Taxonomy

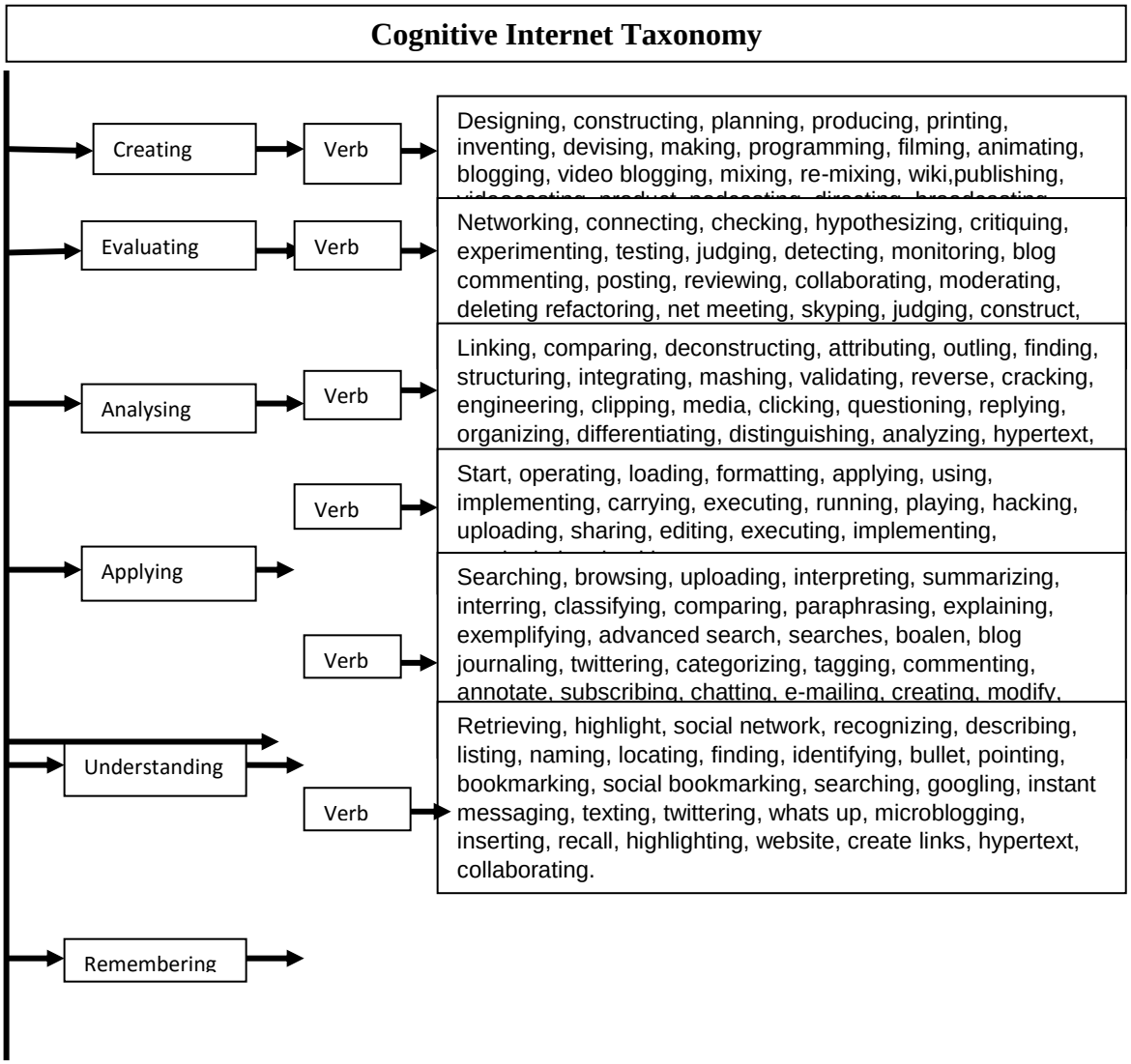


Fig. 90: Flowchart on Bloom's Cognitive Internet Taxonomy

We should Note that:

a. Before we can *understand* a concept we have to *remember* that concept
b. Before we can *apply* the concept we must *understand* what we are applying
c. Before we *analyse* it we must be able to *apply* what we are analyzing
d. Before we can *evaluate* its impact we must have *analysed* what we are evaluating
e. Before we can *create* we must have *remembered, understood, applied, analysed,* and *evaluated what we or has been created*.

3.6.11 Draw a Flowchart to show how to write Learning Objectives using the Cognitive Domain

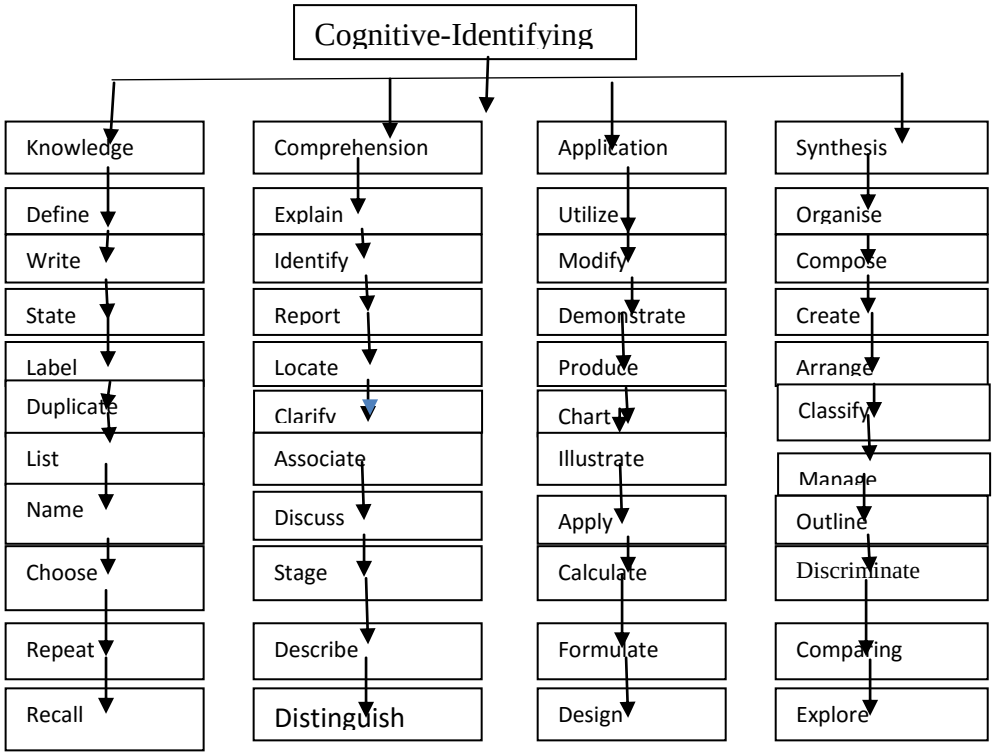


Fig. 91: Flowchart to show how to write Learning Objectives using the Cognitive Domain

3.6.12 Draw a flowchart to show what learning should look like in an Electronic Classroom

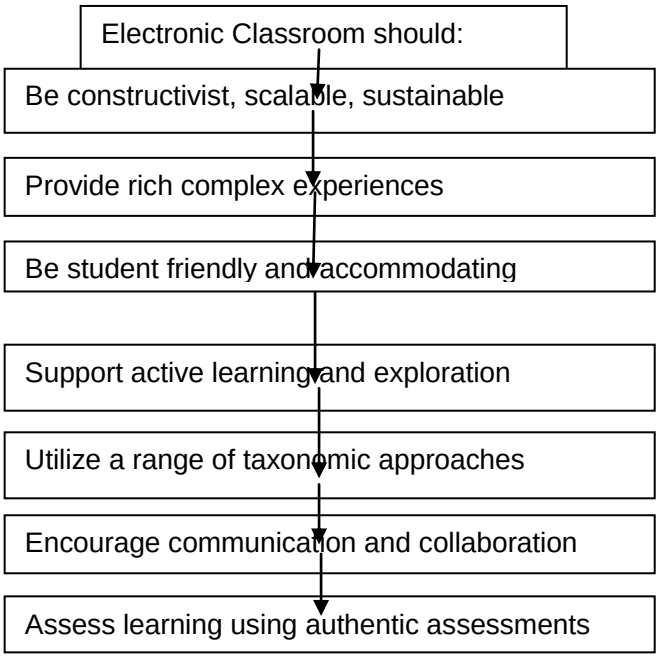


Fig. 92: Flowchart to show what learning should look like in an Electronic Classroom

4.0 Conclusion

Flowcharts, decision tables, pseudo codes and algorithms are essential ingredients to the writing of good programs. If they are done properly they lead to reduction in errors in programs. They help minimize the time spent in debugging. In addition, they make logic errors easier to trace and discovered.

5.0 Summary

In this unit we have learnt that:

a. A Flowchart is a graphical representation of the major steps of work in process. It displays in separate boxes the essential steps of the program and shows by means of arrows the directions of information flow.
b. ii. Decision tables are used to analyze a problem. The conditions applying in the problem are set out and the actions to be taken, as a result of any combination of the conditions arising are shown.
c. iii. Pseudo code is a program design aid that serves the function of a flowchart in expressing the detailed logic of a program.
d. An algorithm is a set of rules for carrying out calculation either by hand or a machine.

6.0 Tutor-Marked Assignment

Explain any five advantages of flowcharts

7.0 References/Further Reading

More recent editions of these books are recommended for further reading.

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MODULE 4: AREAS OF APPLICATION OF COMPUTERS

In this module, we shall discuss the application of computers in the following areas:

a. Education
b. Agriculture
c. Science and Engineering
d. Health Care
e. Business and Industry
f. Transport and Communications
g. Recreation
h. Government
i. The Military etc.

UNIT 1: APPLICATION OF COMPUTERS IN EDUCATION

Contents

1.0 Introduction

Computer has become a universal tool of any modern man (or woman). Literacy, today is not defined only in terms of the ability to read and/or write but in addition, it includes the ability to use and communicate with the aid of computer. In the education sector, computers are being used to promote teaching and learning and research.

2.0 Objective

The main objective of this unit is to identify some areas of application of computer in the field of education.

3.0 Main Content

3.1 Application of ICT in Education

The field of education provides the most fascinating application of computing system. This has consequently attracted considerable attention from educationist and policymakers since the late 1960s, when computers were introduced into the classroom. The entry of the computer into the classroom has now offered opportunities and possibilities for students to develop their potentials with computer-aided instructions packages. A considerable number of fascinating and entertaining educational computer software packages are now available in almost every subject. These self-tutor instruction packages are well designed to enable the user to learn on his or her own time, speed and convenience. The role of the teacher here is that of a guide so that the student can think more logically and can gain meaningful experience in such structured situations, role playing and other well programmed exercise so that the student can have a better understanding of the interrelationships of variables to real life situations.

Apart from the use of computer as an instructional aid, it is also used in the execution of routine and administrative tasks such as the keeping of academic and administrative records on admissions, examinations, staffing and other routine functions.

The computer has also revolutionized the services rendered by libraries to readers. A computer based on-line public access catalogue system manages a search for materials using indices such as author's name, book title, subject and class mark. Readers using public terminals can go through a menu-driven programme to find specific books or periodicals, recall books on loans and also make requisition for short loan items.

Furthermore, optical character reading devices are used to scan the bar codes on readers' library cards to offer a computer based issuing of books to readers. A computer based security system is used to maintain security services in libraries as well.

3.1.1 Advantages of using ICT in Education

In educational institutions such as nursery schools, primary schools, secondary schools, polytechnics, colleges of education and universities, computer can be used for the following:

- Computer aided self-tutored application packages.
- Computer instructional aids e.g. digital projectors.
- Microsoft PowerPoint application software for preparing slide shows, speeches, seminars, workshop, lectures etc.
- Computer simulated graded exercises, group work.
- Computer-aided laboratory experiments and investigations.
- Computer-aided software packages for special students e.g. the mentally/physically disable (the blinds, deaf etc), adults, KGs, teenagers etc.
- Distant learning programmes e.g. sandwich programmes, through the Virtual Library Technology.
- Teleconferencing technology.
- Placing and sourcing of educational materials/resources e.g. papers, journals, newsletters, magazines, textbooks, films, on the internet.
- Computerization of Library Services to make cataloguing indexing, retrieval, borrowing, return and other library services easier and faster.
- Keeping the records of students, teachers and teaching facilities.

- Estimating the teachers-student ratio with a view to assessing the adequacy of teaching and learning.
- Estimating the ratio of students to teachers and teachers to teaching facilities witha view to assessing the adequacy of teaching and learning.
- Timely generation of students' examination results.
- Automatic generation of lecture and examination time tables.
- Aiding students to learn basic theoretical concepts. There are currently, some computer aided learning software packages and hardware devices that are readily available in the market.
- To broadcast material, online facility or CD-ROM can be used as sources of information in different subjects;
- To facilitate communication for pupils with special needs;
- To use electronic toys to develop spatial awareness and psycho-motor control;
- To use the online resource like, email, Chat, discussion forum to support collaborative writing and sharing of information.
- To facilitate video-conferencing or other form of Tele conferencing to involve wide range of students from distant Geographic areas.
- For Blended learning by combining conventional classroom learning with E-leaning learning systems
- To process administrative and assessment data.
- To exchange and share ideas -among teachers for the professional growth.
- To carry out Internet-based research to enhance , educational process

3.2 Use of Web-based training and its advantages

Advances in communication technology since the mid-1990s have made e-learning (sometimes known as "virtual learning" or "distance education") a feasible educational option. The idea is that a teacher can reach students in remote locations, which enables students to learn subjects to which they wouldn't otherwise have access. Web based learning is a system where anything that is done in the classroom is replaced with work that is done online. Lectures are published online, then downloaded and even printed out to be read by the students. Web based learning is often referred to as e-learning. The approaches to this vary, depending on the type of studies pursued. However, the following are advantages of using Web-Based Training as outlined by James (2010):

- Extendibility, Accessibility, and Suitability - Users can proceed through a training program at their own pace and at their own place. They can also access the training at any time, receiving only as much as they need...
- Quicker (and cheaper) turnaround of finished product.
- Collaborative and exploratory learning environments.
- Easy and affordable training delivery - ...Validate what browser(s) your audience has and what version(s)...
- Cross Platform - ...you can deliver your training course to any machine over the Internet or company intranet without having to develop a different course for each unique platform.
- Inexpensive worldwide distribution - No separate or distinct distribution mechanism is needed (i.e., distributing CD-ROMs for CBT training). WBT can be accessed from any computer anywhere in the world while at the same time keeping delivery costs down.
- Reduced technical support...

- Ease of content update - The changes you make to any of your content are immediately available to your learning audience across the world.
- Installation options on private networks for security or greater bandwidth. If you opt for intranet delivery, you have more control over plug-ins and bandwidth...
- Travel cost and time savings - Learning is delivered directly to the learner...
- Web browsers and Internet connections are widely available...
- WBT-based development is easier to learn and pick up th[a]n CBT [computer]-based development...
- Vast, untapped market for training...
- Access is controllable - You can direct and monitor who receives web training - when, how many times, and in what sequence.
- Billing options - You can bill - and collect on that bill - through Net distribution, billing by user ID, number of accesses, date/time of access, or any other means by which you want to assess usage.
- Direct access to many other training resources...

3.2.1 Disadvantages of Web-Based Training:

James (2010) has outlined the following as disadvantages of Web-based Training:

- Limited formatting of content in current browsers - The WBT you create will not resemble the CBT you might be familiar with because of Net bandwidth constraints. So if your content relies on a lot of media "bells and whistles," or particular formatting, the Net might not be the best delivery medium.
- Bandwidth/browser limitations may restrict instructional methodologies -...If your content relies on a lot of video, audio, or intense graphics, and your audience isn't on a T1 line, Net delivery will only frustrate your learners.
- Limited bandwidth means slower performance for sound, video, and large graphics...
- Someone must provide web server access, control usage, and bill users (if applicable)...
- Time required for downloading applications...
- Student assessment and feedback is limited...
- Many, if not most, of today's web-based training programs are too static, with little if any interactivity...
- Cannot design and develop robust multimedia courses - The bandwidth limitations of the Net constrain what can be delivered effectively.
- Are computers replacing human contact? - The Net is not right for all training.
- Newness - ...new technologies always require time, experience, and money in order to take full advantage of its capabilities...
- Web-based training has high-fixed costs..."

3.3 Electronic Learning

E-learning (electronic learning) is the delivery of learning content and materials to learners in digital form via a variety of technologies.

E-learning content can include:

- Text
- Images
- Animation
- Audio
- Video

Ways of delivering e-learning content include:

- Internet

- Intranet
- CD
- DVD
- USB

Ways of accessing e-learning content include:

- Personal computer
- Tablet computer
- Mobile phone or device
- Television
- DVD player
- CD player

3.3.1 Advantages of e-learning

a. Class work can be scheduled around personal and professional work
b. Reduces travel cost and time to and from school
c. Learners may have the option to select teaching material materials that meets their level of knowledge and interest
d. Learners can study wherever they have access to a computer and Internet
e. Self-paced learning modules allow learners to work at their own pace
f. Flexibility to join discussions in the bulletin board threaded discussion areas at any hour or visit with classmates and instructors remotely in chat rooms
g. Different learning styles are addressed and facilitation of learning occurs through varied activities.
h. Development of computer and Internet skills that are transferable to other facets of learners lives.
i. Successfully completing online or computer-based courses builds self-knowledge and self-confidence and encourages students to take responsibility for their learning

3.3.2 Disadvantages of e-learning

a. Unmotivated learners or those with poor study habits may fall behind
b. Lack of familiar structure and routine may take getting used to
c. Students may feel isolated or miss social interaction
d. Instructor may not always be available on demand
e. Slow or unreliable Internet connections can be frustrating
f. Managing learning software can involve a learning curve
g. Some courses such as traditional hands-on courses can be difficult to simulate

3.4 Distance Education

This is an education when teachers and students are separated by physical distance, and technology (i.e., voice, video, data, and print), often in concert with face-to-face communication. Distance education is also seen as the delivery of useful learning opportunities to learners at convenient places and time. Distance Education is therefore describe as the opposite of face-to-face education. Distance education involves interaction at a distance between instructor and learners, and enables timely instructor reaction to learners. Simply posting or broadcasting learning materials to learners is not distance learning. Instructors must be involved in receiving feedback from learners. It involves interaction between class members primarily at a distance, and enables the instructor to interact with learners. Distance learning is typically associated with televised broadcasts and correspondence courses, but it also applies to certain e-learning applications. On the Internet,

educational interaction primarily at a distance is required between instructor and students, or between students. Typical distance learning in this context includes Internet-based live instructor broadcasts, video-conferencing, chat and scheduled online conference discussions, and even e-mail courses or discussions. Web-based courses are akin to video broadcasts of educational materials. Many broadcasted educational materials are not distance learning since the "distant" instructor only produces the materials, and is not further involved in the education of the students.

Self-assessment Exercise

a. Discuss the advantages of ICT in general

3.5 Computer-Assisted Instruction Vs Computer Managed Instruction

Computer Assisted Instruction (CAI) is the use of the computer as an instructional tool that provide instructional information to a student, pose questions and react to the students' responses.It is also seen as the education that learner use computer for drill, practice, and revision, as well as testing and diagnosis which may be linear or branching, or extended to thinking and problem solving through simulation.

3.5.1 Advantages of CAI

- It enhances graded learner instruction
- It can tirelessly repeat material
- It can be self-sufficient allowing teacher to concentrate on other problems
- It can randomly generate questions or order of questions within certain limitations, so program can be used more than once by a pupil

3.5.2 Disadvantages of CAI

- It cannot be adapted easily
- It requires one computer per pupil which is a luxury for few pupils have at present
- It is only suitable for topics that can be structured into clear-cut stages
- Sills taught may not be transferable outside the instructional program

3.5.3 Computer Managed Instruction

- Computer Managed Instruction (CMI) is a computerized, record-keeping system that diagnoses a student's progress, provides instruction and analyzes progress. It is also seen as the use of computer to manage a student's progress through a course of instruction.

3.5.4 Advantages of CMI

- It frees teacher to teach
- It allows for more objective assessment
- It gives teacher time to be constructive rather than looking for errors
- It is potentially give faster feedback
- It allows more detailed assessment
- It automatically keep records of documents

3.5.5 Disadvantages of CMI

- It requires a great deal of time and effort to set up the course.

- Once it is set up it can be difficult to modify, and may also require such hardware as card-readers, printers, CD-ROMs, USB and large memory.
- It requires highly structured tests. The creations of such tests are time consuming, if they neither do nor already exist.
- Its program must include answers and comments on each topic.
- Machine needs a large memory
- Its input media may be hard for pupils to use, hence it may detract them from learning process.

3.6 Computer-Based Testing

This is a system where examinations are delivered via Computer-Based Testing (CBT) at local testing centers worldwide. This testing method provides candidates with top-of-the-line security measures and a comfortable testing environment. Further, candidates are able to take their examination at conveniently located centers.

3.6.1 Advantages of CBT

1. Improvement of the Board's service delivery.
2. Reduction of incidences of breaches of examination security.
3. Making Nigeria operate global best practices.
4. Lower long-term costs.
5. Instant feedback to students.
6. Greater flexibility with respect to locations and timing.
7. Improved reliability.
8. Improved impartiality.
9. Greater storage efficiency.
10. Enhanced question styles which incorporate interactivity and multimedia.
11. Enhanced presentation of items.
12. Unrestricted by the physical limitations of test booklets, computer administered test.
13. Allows subsequent changes to an answer without the uncertainty of knowing whether a poorly erased answer might invalidate the new selection.
14. Immediate score reporting
15. Ability to track and display the time remaining on the examination.
16. Opportunity to review any questions on the examination. You can change answers, mark or skip questions. Should your time expire while taking the examination, all answers, regardless of how they are marked, will be calculated into your score.
17. Computer Based Testing (CBT) has emerged as one of the recent innovative approaches to assessments by Examination Bodies.
18. New and more complex item formats can be administered (ICILS).
19. Adaptive (targeted) testing can be used to get more precise measures in shorter testing time (ETLS).
20. Skills needed to act efficiently in technology rich environments can only be assessed through CBT.
21. No cost for printing and data entry.
22. It reduces Paper.
23. It reduces printing transportation.
24. Reduces administration costs
25. Improves security of the testing enterprise.
26. Immediate test scoring (Poggio, Glasnapp, yang and Poggio, 2005).
27. It is reliable, Robust, flexible.

28. Time analysis of responses to the question level to better discriminate between candidates.
29. Item banks and randomization of items and response orders to reduce cheating.
30. Automated analysis of results of entire candidates.
31. Improved Security.
32. Access to interactive item formats.

3.6.2 Advantages to the students

- Instant results are available
- Testing centers conveniently located around the world
- Top-of-the line security measures:
  - Extensive encryption
  - No outside materials allowed inside testing rooms
  - Strict candidate identification standards
- A comfortable and consistent testing environment in all examination centers
- Images on the computer screen provide maximum readability
- Answers are recorded directly into the computer, therefore eliminating possible transcription errors from scanning format answer sheets

3.7 Use of ICT for Teaching

The use of ICT for teaching includes preparation for lessons, teaching and learning resources and for examination as well as access to different information for teaching. Some teachers use ICT to solve immediate problems related to teaching and learning as the following extract illustrates. I teach both undergraduate and postgraduate students the application of ICT in Education. When I get difficult questions from my students, I do simple go online and get good and enough satisfactory answers. My students praise me by calling me all sorts of names: a computer teacher, Computer expert, ICT Guru, Computer Wizard, the Bill Gate of Computer Science Education etc. However, the use of ICT helps teachers to simplify their teaching profession, manage their time and enrich their teaching-learning tasks(Gusen, 2010). Essentially, a good teacher should use the ICT to capture students interest and to be motivated to use the technology, ensure that concentration is either focused on the technology or on the teacher at a given time in the classroom.

3.7.1 General benefits of ICT

- Greater efficiency throughout the school (Greene et al, 2002)
- Communication channels are increased through email, discussion groups and chat rooms
- Regular use of ICT across different curriculum subjects can have a beneficial motivational influence on students' learning (Cox 1997)

3.7.2 Benefits of ICT for teachers

- ICT facilitates sharing of resources, expertise and advice
- Greater flexibility in when and where tasks are carried out
- Gains in ICT literacy skills, confidence and enthusiasm
- Easier planning and preparation of lessons and designing materials
- Access to up-to-date pupil and school data, anytime and anywhere
- Enhancement of professional image projected to colleagues
- Students are generally more 'on task' and express more positive feelings when they use computers than when they are given other tasks to do

- Computer use during lessons motivated students to continue using learning outside school hours

3.7.3 Benefits of ICT for students

- ♦ Higher quality lessons through greater collaboration between teachers in planning and preparing resources
- ♦ More focused teaching, tailored to students' strengths and weaknesses, through better analysis of attainment data
- ♦ Improved pastoral care and behaviour management through better tracking of students
- ♦ Gains in understanding and analytical skills, including improvements in reading comprehension
- ♦ Development of writing skills (including spelling, grammar, punctuation, editing and re-drafting), also fluency, originality and elaboration
- ♦ Encouragement of independent and active learning, and self-responsibility for learning Flexibility of 'anytime, anywhere' access
- ♦ Development of higher level learning styles
- ♦ Students who used educational technology in school felt more successful in school, were more motivated to learn and have increased self-confidence and self-esteem
- ♦ Students found learning in a technology-enhanced setting more stimulating and student-centred than in a traditional classroom
- ♦ Broadband technology supports the reliable and uninterrupted downloading of web-hosted educational multimedia resources
- ♦ Opportunities to address their work to an external audience
- ♦ Opportunities to collaborate on assignments with people outside or inside school

3.7.4 Benefits for parents

- ♦ Easier communication with teachers
- ♦ Higher quality student reports – more legible, more detailed, better presented
- ♦ Greater access to more accurate attendance and attainment information
- ♦ Increased involvement in education for parents and, in some cases, improved self-esteem
- ♦ Increased knowledge of children's learning and capabilities, owing to increase in learning activity being situated in the home
- ♦ Parents are more likely to be engaged in the school community

3.8 Use of ICT for Administration

Administratively, ICT is used for preparing school announcement, reports, writing of letters to students, teachers, parents, registration of students and employees and keeping various records in schools(Gusen, 2010).The uses of ICT are encouraging, contrary to what has been reported in some schools where such resources are available but not used at all. It seems in some schools there is the culture of looking at ICT resources as sacred objects. It is beyond human comprehension to learn, hence, ICT resources are not used at all despite their proliferation in the market and in schools, the availability of users and the need to use them. Gusen 2013 confirmed that many innovations are not implemented for the fear of changing the status quo of teachers. Such uses of ICT are likely to make work of administrators or school heads easy and manageable. They could use the ICT resources to store their document which saves a lot of space as physical files are replaced with electronic files. These are the common administrative ways of using ICT, but the worry is whether the schools and

institutions of learning in Nigeria have the right type of computer application software for the right tasks.

3.9 Use of ICT for educational Research

The following numerous advantages of using ICT for education research.

3.9.2 Advantages of ICT for Education Research

- Collaboration within higher education benefits not just the higher education community but also the information and communications technology community.
- Virtual environments can extend the reach of research collaborations internationally while stimulating developments in ICT infrastructure.
- Cloud computing offers opportunities to rethink how technology is provided and exploited within research, learning and teaching, and the management of colleges and universities.
- Support collaborative research
- Identify generic approaches to collaborative research
- Provide training for researchers
- Maintain and enhance appropriate technical infrastructures beyond the existing network communication tools
- *Motivating Factor*. The use of ICT is so interesting, exciting and enthusiastic enabling students to access learning materials not readily available in the classroom
- The Internet promotes fast communication across geographical barriers
- The use of Internet facilitates cooperative learning and encourages dialogue and creates more engaging classroom
- The use of Internet enhances faster location of research materials and their accessibility than school library can provide
- The use of Internet encourages the development of hypertext skills and other writing skills if they are to publish their work on the Internet

3.9.2 Disadvantages of Using ICT for Education Research

a. The use of Internet encourages plagiarism when students download research materials without referencing. However, there is an online service, Plagiarism.org at http://www.plagiarism.org/, which can assist us in minimizing cases of plagiarism in the class.
b. Student privacy. Criminals, marketers, and other persons can easily get information from students when they are online. These could post danger to students' lives or may even lead to litigation against the school. To avoid this problem, students should be educated on the dangers of giving information to people online. Parents and teachers need to supervise students' online activities.
c. The Low income groups may not have computers at home or may have computers at home with no access to the Internet
d. Preparation time on the effective use of the Net for education and research may be hampered for lack of time to surf the Internet to download lesson plans and adapt them to support the curriculum objectives
e. The new administrative responsibilities which involve teaching using Internet that brings to bear on a new set of administrative demands on the teacher and the school administration. This include development and implementation of acceptable use policy, training, developing new evaluation criteria as needed, and addressing parents' concerns.

4.0 Conclusion

Computers have been applied in virtually all fields of human endeavour. This unit presents an overview of the application of ICT in teaching, administration, research, and for examinations. The applications of computers in education are discussed in details.

5.0 Summary

In this unit we have learnt that computer could, among others, be applied in the following fields of human endeavour:

a. Education
b. Agriculture
c. Science and Engineering
d. Health Care
e. Business and Industry
f. Transport and Communications
g. Recreation
h. Government
i. The Military

6.0 Tutor Marked Assignment

1. Explain five advantages of CBT to students

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UNIT 2: COMPUTER APPLICATIONS IN AGRICULTURE

Content

1.0 Introduction

Computers play an important role in record keeping in the agriculture field. Both small-scale farmers and large-scale farmers use computers to keep track of information such as budget records, animal health and tracking forms, equipment inventories, and maps of land.

2.0 Objectives

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

a. become familiar with the application of computer in Agriculture
b. explain the advantages of using computer in agriculture

3.0 Main Content

3.1 Use of Computer in Agriculture

Uses of Computer in Agriculture - 7 Ways ...(2013) and Computers in Agriculture (2014) made the following as their contributions to the uses of computer in Agriculture:

- **Weather Prediction.** Weather forecasting has come into play, predicting the weather has obviously become exponentially easier for farmers.
- **Records keeping.** Farmers use computers to keep track of information such as budget records, animal health and tracking forms.
- Livestock farmers use computer to track the health and status of each of their animals.
- **Farm Software(herd recording).**Livestock farmers use ready-made computer applications to track individual animals, storing and evaluating information such as age, health records, milk production, offspring productivity, and reproductive cycle status.
- Farmers use computer to keep detail and accurate compilation of records of their farm produce in order for their business to operate smoothly.
- Farmers use computers to organize and present their records which is easily accessed and presented to audience in a clear and organized manner.
- Farmers use double-entry-computer-accounting systems to coordinate information such as taxes, money management, and plant details.
- **Geography.** Farmers use Global positioning system (GPS)to plot areas of land with certain characteristics that might affect crop yield.
- Farmers GPS receivers to electronically map factors and areas that might affect crop yield, such as wet spots and weed patches.
- Computers are extremely important and a conducive tool to farmers which aid them in the process of running their farms more efficiently and therefore making their products more assessable to consumers.
- **Farmer communication.** Farmers use computer to share knowledge about everything from growing strategies to market prices such as Pest epidemics, droughts, and other farming issues which are bound to arise and advice from other farmers which help with handling these problems

- Farmers use computer to quickly communicate questions about adapting to sudden weather changes or other concerns
- The use of computers is a fast and convenient tool in improving the accuracy of research related to the supply chain, item tracking and increasing yields of their farmers produces.
- With the rising Global Food Market, Information and Communication Technology (ICT) has become increasingly important for agriculture.
- Farmers use ICT tool (mobile phones, or nanotechnology) for food safety, or even satellite imagery to exchange data through transmission.
- Small-scale farmers use ICT to understand global developments in agriculture.
- Industrial-scale producers use utilize digital tools and technologies, as well as small-scale farmers to rely primarily on experience and word-of-mouth in tracking their produces.
- Both small-scale and large-scale farmers use computer to seek information in the following areas:
  - Markets & Pricing
  - Plant Varieties
  - Farm & Production Techniques
  - Processing & Distribution
  - Advancements in Tools & Equipment
- ICTs are extremely accessible and have the potential to protect small-scale farmers from falling behind the "technology curve," while increasing their incomes and protecting their livelihoods.
- **Farmland Assessment.** Farmers use GIS to develop ranking systems that evaluate land and provide a site assessment to aid in precision agriculture
- Farmers use hi-tech, interactive systems to provide information based on a variety of factors such as soil conditions, drainage and slope conditions, soil pH and nutrient status.
- Precision agriculture provides farmers with control by predicting vital information including fertilizer application and problems with drainage, insects, and weeds
- The use of GIS allows farmers to map, model, query, and analyze large quantities of data within a single database.
- Computer equips farmers with enough information to increase crop yield in a manner that is consistent with the best environmental practices for sustainable agriculture
- GIS allows both small-scale and large scale farmers to:
  - Construct maps
  - Combine information
  - Make scenarios
  - Make scenarios
  - Present ideas
  - Develop solutions
- **GIS is money saver and increases efficiency.** GIS is used in a ranking system called precision agriculture, which evaluates and assesses land. It is therefore a kind of information stored in this system which can be useful as follows:
  - Soil conditions
  - Drainage conditions
  - Slope conditions
  - Soil pH

- Nutrient status

- ♦ The use of computer leads to better decision making about where and when to produce crops.
- ♦ GIS greatly improves communication as farmers can access the vital information and use it to their advantage and produce a higher yield of healthier crops.
- ♦ GIS helps improve agricultural record keeping. It does this by compiling various data in an easily assessable system that farmers can look at.
- ♦ GIS helps farmers tremendously in the upkeep and functions of their land and crops.
- ♦ **Automated farm equipment** brings combines technology and farming into another dimension.
- ♦ With technology, the farming industry can go to new heights.
- ♦ Using automated farming equipment help farmers to boost their numbers of final products.
- ♦ Companies use affordable automated farming machines which can help them to be a successful farmer.
- ♦ Farmers take advantage of technology to do the hard work, and consequently, hold less appreciation for the finished product such as appreciation in great numbers and size of fruits and vegetables.
- ♦ **E-agriculture.** E-Agriculture is a community of people devoted to the exchange of information and ideas to work towards rural and agricultural development.
- ♦ Farmers can use E-Agriculture website to serve as a catalyst for institutions and individuals in agriculture and rural development to share knowledge, learn from others, and improve decision making about the vital role of ICTs to empower rural communities, improve rural livelihoods, and build sustainable agriculture and food security.
- ♦ A farmer is an entrepreneur who wants to export crops, but is unsure of the market standards regarding sustainability. He can use computer forums, online programs or e-mail to make his transaction better.
- ♦ **Effects of computer**. Farm implements such as tractors, fertilizers sprayers have computers that farmers can program to automatically adjust the amount of fertilizers according to the requirements of soil and crops which help in improving soil and higher crop yield.
- ♦ Farmers can use computer systems to guide the steering on their farm equipment during planting or harvesting; if the system experiences problems, technicians can diagnose and fix the issues remotely from another computer.
- ♦ **Internet forums, social networking and online knowledge base.** Farmers use internet forums, social networking sites and online knowledge bases to get lot of information on farming around the world.
- ♦ Farmers use social media to contact other farmers and experts and exchange know-how. There are many online databases, articles, newspapers in which there is lot of information available for farmers which help them in increasing productivity.

Self-Assessment Exercise

a. discuss the use of computer to small and large scale farmers

3.2 Challenges of using computer in agriculture

a. Climate change can have negative effect on agricultural produces if not immediately addressed.

b. The challenges posed by the unique features of Nigerian agriculture, characterized by fragmented farms, weak infrastructure and the involvement of numerous intermediaries, among others
c. The challenges brought forth by ecological factors affecting the environment need to be a major consideration for any kind of farming activity
d. The challenges of using ICT to disseminate agricultural information to farmers in Nigeria using mobile phones and minority of farmers live in the village where there are limited usages of the internet. A small percentage of researchers are using other methods including field days, farmers' school, seminars, training, workshops, meetings, extension convoys and personal contact.
e. Socio-economic factors that are perceived to influence the use of ICT, which include gender, education level, income and farm size. The most prevalent socio-economic factor that is perceived to affect use of ICT by farmers is difficulty in reading and writing represented by their low educational level
f. The lack of opportunities for farmers to acquire appropriate knowledge as well as availability and accessibility to ICT devices.
g. Lack of awareness of the use of ICT for agriculture because in most cases ICT programmes tend to focus on political and other government-related messages and lack sufficient focus on technology transfer in agriculture.
h. Lack of powerful legislation to enforce and implement the use of ICT in agriculture

4.0 Conclusion

In this unit, we have learnt that computers have been applied to the field agriculture for years. This unit presents an overview of the application of computer to the field of agriculture.

5.0 Summary

Computers are useful to agriculture in the following ways:

a. For Weather Prediction..
b. For Records keeping.
c. **To** track individual animals, storing and evaluating information such as age, health records, milk production, offspring productivity, and reproductive cycle status.
d. to keep detail and accurate compilation of records of their farm produce.
e. to organize and present their records.
f. to coordinate information such as taxes, money management, and plant details.
g. to plot areas of land with certain characteristics that might affect crop yield.
h. to electronically map factors and areas that might affect crop yield.
i. Aid farmers in the process of running their farms more efficiently.
j. to share knowledge about everything from growing strategies to market prices
k. to quickly communicate questions about adapting to sudden weather changes
l. as a fast and convenient tool in improving the accuracy of research related to the supply chain, item tracking and increasing yields of their farmers produces.
m. for food safety
n. to understand global developments in agriculture.

6.0 Tutor-Marked Assignment

a. explain the advantages of computer with respect to record keeping and communication

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In addition to the above, books, you can browse on the Internet to get additional materials on the topics covered in this course.

UNIT 3: COMPUTER APPLICATIONS IN THE BUSINESS ANDINDUSTRY

Content

1.0 Introduction

In the early days of computing, computers were originally meant to assist in scientificand engineering applications. Today, computers are widely used to perform wide rangingtasks from routine accounting operations to management decision making. Corporateoperations are becoming more complex and competitive thus increasing the need toproduce and process more accurate and timely data both in quantity and quality. Moreaccurate, reliable and timely data are needed for corporate planning, policy formulationand decision making

2.0 Objectives

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

a. Exposed to the area of application of computers in business and industry
b. Explain five application of computer in business and industry
c. Discuss five disadvantages of using computer in business and industry

3.0 Main Content

3.1 Payroll

Payroll preparation is essentially a repetitive and a routine task which has to be done periodically for every single employee in an organization at particular points in time weekly, fortnightly or monthly. Payroll preparation is a work schedule which demands speed, accuracy, carefulness and honesty. It involves making references to a number of source documents which by their nature also require constant and periodical dating. These attributes obviously lend themselves to the use of computers which have the capabilities to meet the challenging demands in payroll preparation. These include the capability of the computer to:

a. Handle the enormous amount of information required in payroll preparation.
b. Store information and make the information available as at when it is needed.
c. Handled repetitive recurring tasks and check on its own work as a way of controlling human errors.
d. Provide a much better and reliable procedure for the necessary security checks to monitor and detect fraud and other malpractices.

Computer application in payroll preparation involves a number of procedures which include the following:

a. Updating the personal records of employees whenever new appointments, resignations, terminations, dismissals and other changes are made within a period of time.
b. Computing wages and salaries for each individual workers based on regular and overtime hours worked.
c. Making deductions for income tax and for other payments such as union dues and repayment of loans.
d. Preparation of pay advice slips and cheques to employees and banks.

e. Updating the master payroll file based on the records received from the personnel department.
f. Preparation of summary report and analysis for management.

In addition to payroll preparation, the computer is also used for other routine and repetitive book keeping and accounting operations involving recording, classifying and summarizing accounting data. This may involve preparing and updating ledger and journal accounts, invoicing, accounts receivable and payable. Other operations may also include updating and preparing accounts on sales, purchases and inventory. The computer is also used for the preparation and evaluation of the balance sheet and statements of accounts, preparation of dividends and summary accounts for shareholders and management.

3.2 Inventory Control

An equally important business application of the computer is seen in the execution of the important business function involved in maintaining a desirable level of inventory in a business organisation. This is to ensure that working capital is not unduly tied in stocks while at the same time available stocks can meet the demands of continued production process. In this direction, the computer is used as a tool in updating records of inventory and also in the preparation of forecasts and demand predictions based on economic order quantity analysis and other forecasting techniques.

3.3 Auditing Operations

The computer is used as a tool by auditors to report accurately on the transaction register which constitutes the most crucial aspect in the audit trail. With the aid of the computer, it is easier for auditors, in their examination of the accounting records of a business, to trace routine business operations so that variances can be detected and verified accurately using various computer audit packages.

3.4 Management Information System

An equally challenging and revolutionary application of the computer in business is the important role the computer-based Management Information System (MIS) is playing in management decision making. The computer is used as a tool for the online storage, retrieval, processing and maintenance of corporate data meant to be shared by all the users' departments. A management Information System involves a computerized system of data processing procedures which are integrated in an organisation to provide accurate, complete, concise, timely and effective data which management can use at various level of decision making for planning, organizing, directing, controlling and monitoring procedures.

Included in Management Information System to be used for the various decision making procedures are a number of systems comprising.

a. Controlling and operational planning support systems to deal with day-to-day decisions involving routine processing and transaction procedures.
b. Tactical support systems to deal with short-run and middle level management decisions.
c. Strategic support systems to deal with corporate strategic and top level management decisions.

With the aid of these support systems, data can be retrieved and analyzed on a continuous and timely basis to aid management decision making and other management functions about sales, finances, purchases, acquisition of plant and equipment, research, market analysis and so on.

3.5 Personnel Record Keeping

One of the important functions of the personnel department is to maintain and continually update a master file and other records in the personnel department in an organisation. The computer facilitates the effective keeping of a comprehensive and upto date record of each employee by providing a comprehensive database involving names, addresses, ages, qualifications, marital status, salaries, dates of promotion and soon. By keeping such an up-to-date record, a steady flow of various reports can be prepared at the appropriate time to provide the necessary data to aid management decision making in areas such as appointments, promotions, awards of incremental credits, leave periods, staff training, staff development and so on. Furthermore, management can provide the necessary accurate and up-to-date reports on a timely and continual basis to facilitate payroll preparation and also to satisfy other mandatory data requirements from data users such as governments, trade unions, banks, credit unions and tax collectors.

3.6 Preparation of Customers Utility Bills

The routine and periodic preparation of customers utility bills particularly those based on meter readings for such utility services as water, electricity, telephone, gas, demands accuracy and speed in which the computer has proved very effective and efficient. With the aid of the computer, accurate and up-to-date customer's bills can be sent to them periodically and in good time to enable settlement to be made. Computers can be used to generate notices of defaulters. Equally important is the use of the computer to calculate dividend, pension and other periodic payments as and when they become due.

3.7 High Quality Production Controls

Another important application of the computer which has proved very beneficial in the world of business is the monitoring of production processes so that high quality products and services are provided to customers. Computer Aided Designs (CAD) devices are used in the design of products while computer monitored quality control procedures are used in production process to detect items that fail to meet the approved quality standards and specifications. Such automated devices are used in car assembly plants, oil refineries, manufacturing of drugs and so on. Computer aided quality control devices are also used to monitor weight, size, quantity, contents and other standard specifications in the course of a manufacturing process.

3.8 Point of Sale Services

Check-out points in supermarkets and departmental stores are now highly computerized to detect the prices of items. Magnetic Character Readers are used to scan Universal Product Codes on items to provide fast, efficient and satisfactory services to customers in commercial transaction in retail outlets, departmental stores, libraries and other point of sale service.

3.9 Financial Market Transactions

Computer application in the financial market is manifested in its use to monitor financial market operations and to disseminate timely and up-to-date information which are announced daily on the radio, television or consumers magazines. Stock exchange centres are highly computerized to provide accurate and up-to-date prices of stock and shares and also to execute the buying and selling transactions that take place in the markets. The computer has long been used to assess, evaluate and monitor stock market prices. With the aid of the computer, market trends are predicted with accuracy and inventors are provided with the appropriate and up-to-date data to enable them make intelligent decisions and also to guide them to manage their portfolios effectively. Furthermore, the computer is used to calculate the foreign exchange rates of major currencies as well as the prices of major commodities

such as gold, crude oil, cocoa, coffee, and other commodities that enter into international trade. Computer is also used to provide accurate and up-to-date information on interest rates, gilts and bonds to reflect market trends. The computer application in business is further seen in its use in discounting bills and bonds and other financial market instruments to their present values. Closely related to this is the use of the computer to carefully monitor the movement of a basket of goods and services which measures the rate of inflation in an economy and which further provides a barometer of the standard of living in a country. Most banking operations are now highly computerized as a move to provide fast, effective and efficient services to customers. These include the use of Magnetic Ink Character Readers to process cheques and the provision of Magnetic Credit Cards to customers to have access to funds twenty-four hours a day at unattended automatic teller machines. Customers also use their credit cards to open doors to some banking houses to transact business. There are other Electronic Funds Transfer terminals to perform automatic financial transactions at checkout counters in hotels, stores, airlines, railways and other terminals. In the banking industry, computer can also be used to:

a. Keep the records of customers or clients' accounts.
b. Monitor, control and evaluate the transactions of the customers and clients on their accounts.
c. Reconcile accounts and assist in producing cashbook balance.
d. Monitor, control and evaluate the bank or insurance company's revenue and expenditure.
e. Automate the production of statement of accounts and assist in generating the accurate the correct addresses to which the statement of account should be sent.

3.10 Publishing industry

In the publishing industry, computer is used in the following ways:

a. Creative writing
b. Typesetting manuscript
c. Drawing illustrations.
d. Generating the table of contents and the index of a book automatically.
e. Generating the page size of a book and cut and paste illustrations automatically.
f. Processing images such as the scanning of pictures and recording them automatically in the computer store for future retrieval or printing.
g. Verification and validation of spellings.
h. Assisting the writer of an article to identify the words that have similar meaning.

Self-assessment Exercise

a. explain five uses of computer in Nigeria banking industry.
b. explain five advantages of computer in inventory control

3.11 Challenges of ICT in business and industry

a. Security & Safety
b. data management**.** Large scale data deployment can lead to users becoming confused between data ownership and copyrights
c. Thee battery life may not last for long with you want to continuing working for a long time
d. Multiple connection may course loss of phone and Internet lost when everything is happening in an age where everything you use daily needs connectivity to function
e. The challenges of multiple viruses affecting the computer
f. The challenges of technical know-how

g. The challenges of hackers cracking and surfing your money in the bank

4.0 Conclusion

Computer technology has changed the face of business and industry through its various applications. Information and knowledge replace capital and energy as the primary wealth-creating assets. Information technology transforms the way that business is conducted, and the way the commodities of trade are transformed. Discussions presented in this unit has brought to the fore some of the areas of application of computer in business and industry.

5.0 Summary

In this unit, the following areas of application of computer technology in business will be were discussed in details:

a. Payroll.
b. Inventory Control.
c. Auditing Operations.
d. Personnel Record Keeping.
e. Preparation of Customer Utility Bills and Payment Orders.
f. Management Information System.
g. High Quality Production Controls.
h. Point of Sale Service.
i. Financial Market Transactions.
j. Publishing Industry.

6.0 Tutor-Marked Assignment

a. Discuss any five advantages of a computerized payroll system

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UNIT 4: Computer Applications in Science and Engineering, Health Care, Transport, Communications, Recreation, government and the Military.

1.0 Introduction

This unit discusses in greater details the application of computers in the following fields: science and engineering, health care, transport and communication, recreation, government and the military.

2.0 Objectives

The objective of this unit is to further introduce students to the application of computers in more areas of the society.

3.0 Main Content

3.1 Use of computer in science and engineering

Computer is commonly used to find the accurate solutions to both scientific and engineering problems. Weather forecasting has now become a daily activity to which the computer has proved very useful in providing information on the kind of weather we are likely to expect over a period of time. Such accurate predictions help the farmers, airline operators, navigators and other activities which depend on the weather for their operations. Computer aided critical path study is used to monitor the optimum and efficient use to time, money, material and human resource in the execution and implementation of projects. Such critical path study is used successfully on various projects, for example, the construction of roads, bridges, buildings, manufacturing, the conduct of election and sales campaigns.

Another scientific application of the computer is the monitoring, simulation modeling techniques to provide indicators as to how systems such as the human body, economy, weather, demographic variables and so on react to changes in situations. The application of simulation techniques helps in taking decision and precautions in advance should incase such repercussions happen when the desired changes are introduced in practical situations. Computers are also to design buildings, roads, bridges, vehicles, aero planes, ships and complex architectural, ships and complex works and so on. Prototyping is increasingly being used to minimize the financial commitment to the real life construction of these systems.

The computer is used to find solution to very complex mathematical and statistical computations at incredible speed and accuracy. Furthermore, various software packages are now increasingly being developed to analyse surveyed data, construct life tables, perform mortality demographic and other multivariate data analysis designed to revolutionize

scientific research and to find practical solutions to complex, challenging and everyday life situations. We now outline the use of computer in the following specific areas among others.

(i) Research Institutions

a. Evaluating, monitoring and controlling laboratory experiments.
b. Storing the readings obtained in laboratory experiments.
c. Standardizing the reading obtained in laboratory experiments.
d. Tabulating or plotting the graph of the results obtained from laboratory experiments.
e. Interpreting the results obtained from laboratory experiments.
f. Modeling and simulating systems.
g. Developing the prototypes of systems.

(ii) Engineering and Architecture

a. Designing and drawing with very high precision, accuracy and at minimum cost.
b. Modeling and simulating the behaviour of engineering or architectural systems.
c. Developing the prototype of say, an aircraft, a motor car, assembly plant and soon. It is possible to test and monitor the performance of these systems without serious financial commitments.
d. Fabricating, constructing and assembling the component parts of machines such as motor car, aircraft and engineering plants without any hazards.

3.2 Marketing Department

a. Comparative analysis of products of two or more companies with a view to predicting some areas of improvement.
b. Market survey, statistical analysis of proportional market gains and prediction of new market areas.
c. Creation of the awareness and appreciation of products.

3.3 Agriculture

a. Keep records of soil, rainfall, weather conditions, land size, crops, chemicals and ultimately process the records to estimate the soil fertility and yield per hectare over a number of years.
b. Keep records, of poultry and animal husbandry farm with a view to estimating the feed mix, environmental condition desirable for optimal yield.
c. Assess the behaviour patterns of farmers in a cooperative venture and assist in matching the farmers that have identical behaviour with a view to optimizing their productivity.

3.4 Law and Justice

a. Modeling and simulating legislative procedures.
b. Indexing, storage and retrieval of law reports.
c. Indexing, storage and retrieval of court proceedings.
d. Assisting the human experts in crime investigation.
e. Statistical analysis of criminal and civil cases in the law court and estimating the rate of growth.
f. Assisting the court registrar in the allocation of cases to courts.
g. Monitoring and evaluating congestion in police custody and prisons.
h. Identifying the causes of crime and assisting with the provision of preventive and curative measures.

3.5 Health Care

The delivery of health care facilities has been one of the notable areas in which computer applications have proved most beneficial to mankind. The computer is used to conduct fast and accurate laboratory tests for blood, urine, stool and so on. The computer is used in the diagnosis and physiological monitoring of patients life during surgical operation and intensive care programme. There is also a wide range of application packages for the scientific preparation and administration of drugs, x-ray techniques, blood bank management and so on. An equally important application of the computer is the computer simulation provided in the training of medical and paramedical staff and students.

Computers are being used to perform routine clerical functions in hospitals such as keeping records of hospital admission and discharges, administration of drugs and prescriptions and other hospital administrative functions. Furthermore, the computer is used to provide data banks of medical history to meet the data needs of health insurance schemes and vital health care statistical reports. The summary that can be drawn about the use of computers in the hospitals are as follows:

a. Keeping and reviewing in a timely, effective and efficient manner the records of patients, staff, drugs and equipment.
b. Monitoring the temperature, blood pressure, heart beat and a host of other parameters of patients and raising an alarm when abnormal situation is about to occur.
c. Assisting medical practitioners in the diagnosis of patient disease.
d. Assisting the medical practitioners in the prescription of drugs to patients and ultimately the treatment of patients.
e. Assisting the medical practitioners in the monitoring, controlling and reviewing basic health services, birth rate, death rate, outbreak of disease and a host of others.

3.6 Transport and Communications

The most dramatic computer application is witnessed in the transport and communications sectors with increased sophistication but geared towards making life easier and safer for mankind. Today, mankind world-wide is linked by computer controlled orbiting communications satellite. Telecommunications and computing are today electronically linked together. As a result, information can now be transmitted around the globe on the radio, television, telex, facsimile and so on through microwave communication satellites. Man's advancement in information technology has led to the development of the popular computer controlled electronic mail service which provides a more effective and efficient method of disseminating information to users in a computer network environment. The electronic mail service now provides faster, more convenient and cheaper electronic flow of information than the telephone, fax and telex transmission.

Computer application in communications has led to the use of computer terminals at home. This development enable viewers to read electronic newspapers on the television while the tele text provides computerized information to viewers on events around the globe in the field of politics, business, transport, sports, airline, hotel reservations and many others. The Cabled Network News (CNN) is a practical example.

Computer application is now felt in traffic control and vehicle maintenance. Traffic congestion is cities are monitored by computer controlled traffic switching system which controls traffic flows. Computer aided input devices in a form of rail cards or tickets are used to operate automatic gates in underground railway lines. When a ticket coated with magnetic stripes is slotted down wards into a device, the gate automatically opens for you to enter while you take your ticket. The device will return your ticket if it is valid for another journey; if not, it will keep the ticket and allow you to go. A passenger with an invalid ticket is given a red message and there is no way he or she can enter through the gate In the delivery of postal

services, the computer is used to sort letters according to post codes. In the field of aeronautics, computer simulations are used to train pilots while air traffic movements are monitored by computer controlled radars. The scheduling of trains, subways, and by real-time sophisticated computer systems. Another important computer application is the introduction of computer devices to improve personal safety on aircrafts and vehicles and also to detect engine faults and help in the maintenance of aircrafts and vehicles.

3.7 Government

The business of governance is a serious business. In a multi-cultural, multilingual, multiethnic, setting such as Nigeria, a lot of complex and often conflicting variable inter play or are taken into consideration before a broad-based decision can be taken. Computers can assist government business in the following ways:

a. Planning
b. Decision marking
c. Policy formulating
d. Monitoring and control of operations

The availability of data, timely access to the data and timely reporting on the data are very crucial to the above listed business of government. Computers can be used to:

a. Keep accurate records of government assets and periodically estimates the market value and insurance value.
b. Keep accurate records of the population, behaviour patterns, consumption patterns of utilities and estimates the distribution of basic needs such as electricity, water, telephone and postal services.
c. Keep records of government revenue and expenditure and assist government in monitoring, controlling and evaluating the revenue and expenditure(d) Keep records of government employees with a view to:
    - Preventing ghost workers
    - Estimating the strength of the human resources of government
    - Producing statistical data on employees
d. Computers can be used in the issuance of identity cards to the citizens.
e. Compilation of a broad-based and accurate voters register. This will check the incidence of ghost voting, multiple voting and other electoral malpractices which has bedeviled the electoral processes and stable polity in the third world countries.
f. Computers are used to keep track of crime in the society thereby helping the government security agencies to check crime in the society.
g. Computers can be used to build and to main the database of the mineral resources and other resources of the nation.

Self-Assessment Exercise

a. Discuss the roles of computer in ensuring food security in Nigeria.

3.8 The Military

One of the areas in which computer has been applied intensively and extensively is in the military. The first generation of the modern computers were designed and used during the first and the second world wars. The use of computer for processing data became more popular during these periods due to the need to procure, store and process large volume of data. Over the years, the use of computer have transcend the traditional role of crunching numbers" to sophisticated applications. Specifically, computers are being used in the following ways, in the military operations:

a. Training the personnel through the use of simulated war situations.

b. Reconnaissance surveys.
c. Automatic detection of mines.
d. Monitoring and tracking of planes with a view to crash landing any un-authorised plane flying in the nations airspace.
e. Monitoring operations in the military base.
f. Launching of missiles from distant military base to the enemy territory. Such missiles are programmed to ensure that only the desired targets are hit.
g. Manufacture of state-of-the-art military hardware and consumables.
h. Communications and transmission of highly coded classified military information.
i. Military games, adventures and expeditions.
j. Keeping records of military personnel and logistics.
k. Keeping records of military assets – hardware
l. Management of military stock with a view to maintaining war-ready stock of materials, ammunitions and assets at any point in time.
m. Monitoring the environmental and storage conditions of leather weapons in order to prevent accidents like sudden explosions caused by improper storage.
n. Generation and maintenance of necessary data that would enhance planning, policy formulation, decision making and forecast.

3.9 Recreation, Amusement and Gaming

One of the major areas in which computer has affected the society positively is in the area of recreation, amusement and gaming. "Work and no play make Jack a dull boy. With increasing civilization and urbanization, there is the need for people to relax and keep their mind off the tension that is associated with daily activities, some of which are tension soaked. Computer games helps one to learn in the private (even in the comfort of your own room or office), keeps you off the streets and arcades, reduces tension and boredom, engages the mind on constructive things and teaches you new skills. There are different kinds of games such as adventure games, business games, war games, traditional games, and simulation games.

4.0 Conclusion

Computer as a universal machine is being applied to almost every area of human society. The discussions in this unit clearly demonstrate this fact.

5.0 Summary

In this unit, we have discussed in details the application of computers in the following fields:

a. Science and Engineering
b. Health Care
c. Business and Industry
d. Transport and Communications
e. Recreation
f. Government
g. The Military

6.0 Tutor-Marked Assignment

a. Explain any five uses of computer in health care

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In addition to the above, books, you can browse on the internet to get additional materials on the topics covered in this course.

MODULE 5: THREATS TO THE COMPUTER

This module focuses on computer virus as a major threat to the smooth operations of the computer.

UNIT 1: COMPUTER VIRUS

Contents

1.0 Introduction

One of the biggest fears of having computers are viruses. Viruses are malicious programs designed entirely for destruction and havoc. Viruses are created by people who either know a lot about programming or know a lot about computers. Viruses are development for the purpose of

2.0 Objectives

The objective of this unit is to introduce students to the concept of computer virus, history, reasons for its creation, types of viruses, itsmode of transmission, detection, prevention and cure.

3.0 Main Content

3.1 Computer Virus. A computer virus is a software program written with malicious intentions. They are small software programs that are designed to spread from one computer to another and to interfere with computer operation They are malicious software (malwareprogram) that, when executed, replicates by inserting copies of itself (possibly modified) into other computer programs, data files, or the boot sector of the hard drive; when this replication succeeds, the affected areas are then said to be "infected. Therefore, computer virus is one of the greatest threats to computers and computer applications. Once the virus is made it will generally be distributed through shareware, pirated software, e-mail or other various ways of transporting data, once the virus infects someone's computer it will either start infecting other data, destroying data, over writing data, or corrupting software. The reason that these programs are called viruses is because it is spreads like a human virus, once you have become infected either by downloading something off of the Internet or sharing software any disks or write able media that you placed into the computer will then be

infected. When that disk is put into another computer their computer is then infected, and then if that person puts files on the internet and hundreds of people download that file they are all infected and then the process continues infecting thousands if not millions of people.

3.2 History of Computer Viruses

Devotta(2014), has classified the following as a history of some of the most famous viruses and malware ever:

1. **1949 – 1966 – Self-Reproducing Automata:** Self-replicating programs were established in 1949, to produce a large number of viruses, John von Neumann, whose known to be the "Father of Cybernetics", wrote an article on the "Theory of Self-Reproducing Automata" that was published in 1966.
2. **1959 – Core Wars:** A computer game was programmed in Bell Laboratory by Victor Vysottsky, H. Douglas McIlroy and Robert P Morris. They named it Core Wars. In this game, infectious programs named organisms competed with the processing time of PC.
3. **1971 – The Creeper:** Bob Thomas developed an experimental self-replicating program. It accessed through ARPANET (The Advanced Research Projects Agency Network) and copied to a remote host system with TENEX operating system. A message displayed that "I'm the creeper, catch me if you can!". Another program named Reaper was created to delete the existing harmful program the Creaper.
4. **1974 – Wabbit (Rabbit):** This infectious program was developed to make multiple copies of itself on a computer clogging the system reducing the performance of the computer.
5. **1974 – 1975 – ANIMAL:** John Walker developed a program called ANIMAL for the UNIVAC 1108. This was said to be a non-malicious Trojan that is known to spread through shared tapes.
6. **1981- Elk Cloner:** A program called the "Elk Cloner" was developed by Richard Skrenta for the Apple II Systems. This was created to infect Apple DOS 3.3. These programs started to spread through files and folders that are transferred to other computers by floppy disk.
7. **1983 –** This was the year when the term "Virus" was coined by Frederick Cohen for the computer programs that are infectious as it has the tendency to replicate.
8. **1986 – Brain:** This is a virus also known as the "Brain boot sector", that is compatible with IBM PC was programmed and developed by two Pakistani programmers Basit Farooq Alvi, and his brother, Amjad Farooq Alvi.
9. **1987- Lehigh:** This virus was programmed to infect command.com files from Yale University.
10. **Cascade:** This virus is a self-encrypted file virus which was the outcome of IBM's own antivirus product.
11. **Jerusalem Virus:** This type of virus was first detected in the city of Jerusalem. This was developed to destroy all files in an infected computer on the thirteenth day that falls on a Friday.
12. **1988 – The Morris Worm:** This type of worm was created by Robert Tappan Morris to infect DEC VAX and Sun machines running BSD UNIX through the Internet. This is best known for exploiting the computers that are prone to buffer overflow vulnerabilities.
13. **1990 –** Symantec launched one of the first antivirus programs called the Norton Antivirus, to fight against the infectious viruses. The first family of polymorphic virus called the Chameleon was developed by Ralf Burger.

14. **1995 – Concept:** This virus name Concept was created to spread and attack Microsoft Word documents.
15. **1996 –** A macro virus known as **Laroux** was developed to infect Microsoft Excel Documents, A virus named **Baza** was developed to infect Windows 95 and Virus named **Staog** was created to infect Linux.
16. **1998 – CIH Virus:** The release of the first version of CIH viruses developed by Chen Ing Hau from Taiwan.
17. **1999 – Happy99:** This type of worm was developed to attach itself to emails with a message Happy New Year. Outlook Express and Internet Explorer on Windows 95 and 98 were affected.
18. **2000 – ILOVEYOU:** The virus is capable of deleting files in JPEGs, MP2, or MP3 formats.
19. **2001 – Anna Kournikova:** This virus was spread by emails to the contacts in the compromised address book of Microsoft Outlook. The emails purported to contain pictures of the very attractive female tennis player, but in fact hid a malicious virus.
20. **2002 – LFM-926:** This virus was developed to infect Shock ware Flash files.
21. **Beast or RAT:** This is backdoor Trojan horse and is capable of infecting all versions of Windows OS.
22. **2004 – MyDoom:** This infectious worm also called the Novang. This was developed to share files and permits hackers to access to infected computers. It is known as the fastest mailer worm.
23. **2005 – Samy XXA:** This type of virus was developed to spread faster and it is known to infect the Windows family.
24. **2006 – OSX/Leap-A:** This was the first ever known malware discovered against Mac OS X.
25. **Nyxem:** This type of worm was created to spread by mass-mailing, destroying Microsoft Office files.
26. **2007 – Storm Worm:** This was a fast spreading email spamming threat against Microsoft systems that compromised millions of systems.
27. **Zeus:** This is a type of Trojan that infects used capture login credentials from banking web sites and commits financial fraud.
28. **2008 – Koobface:** This virus was developed and created to target Facebook and MySpace users.
29. **2010 – Kenzero:** This is a virus that spreads online between sites through browsing history.
30. **2013 – Cryptolocker:** This is trojan horse encrypts the files infected machine and demands a ransom to unlock the files.
31. **2014 – Backoff:** Malware designed to compromise Point-of-Sale (POS) systems to steal credit card data.

3.3 Reasons for Creating Computer Viruses

Most of the reasons people create viruses fall under the following:

a. To generate money. The motivation behind virus' is money
b. To take control of a computer and use it for specific tasks
c. To steal sensitive information (credit card numbers, passwords, personal details, data etc.)
d. To prove a point, to prove it can be done, to prove ones skill or for revenge purposes
e. To cripple a computer or network

3.4 Characteristics of Computer Viruses

The following are the characteristics of computer viruses:

1. The hardware troubles
2. The computer show no response
3. The computer show slow performance
4. The computer running too slow (Slow Startup)
5. The computer Crashed and got Burnt
6. There are lots of missing files
7. Disks, Disk Drives, CD-ROM, USB are not Accessible
8. Extract file, showing visually notice which is an extra pop ups and extra programs that seem to be running on your computer, especially on startup
9. Printer issues, if you cannot get your documents to print correctly, or cannot print at all, you may be dealing with a virus
10. Unusual error messages which are gibberish messages, messages you hadn't seem before, undesired ad messages and such
11. Procedural computer virus (enforceability. Computer viruses and other legal procedures, is a executable program, but it is not a complete program, but the parasite in other executable programs
12. Infectious virus. computer viruses will be through various channels from the infected computer to spread to uninfected computers, in some cases caused the infected computers or even paralyzed the work of disorders
13. The latent virus. The first performance of latent means, the virus program without specific testing procedures are not out of checks, so the virus can hide in silence the disk or tape to stay a few days or even years, when the time comes, get the opportunity to run , but also everywhere on the propagation, diffusion, continue to harm.
14. Computer viruses can be triggered. If we do not move, it has been latent virus infection also cannot be destroyed, they lost the lethality.
15. Destructive computer viruses. all the computer viruses are a common hazard exists, that reduce the efficiency of computer systems, taking up system resources, their invasion of the system depending on the virus program
16. Attack of the initiative. From a certain extent, the computer system regardless of how strict conservation measures taken cannot completely rule out the virus attacks the system, while the protection is at best a means to prevent it.
17. Targeted virus. Computer viruses are specific for a particular computer and operating system
18. Viruses and unauthorized. Virus unauthorized execution of which the purpose of the user is unknown, is without the user allowed
19. Hidden nature of the virus. The first infection of secrecy when the majority of the virus during transmission speed is very fast, usually does not have an external performance cannot easily be found. The existence of hidden virus programs, virus programs are generally caught in the normal procedure are difficult to discover
20. Virus derivative. When people master their own attempts to carry out any changes, which in turn derived from a different original version of the new computer virus (also called variants)
21. . Parasitic virus (dependent). Once the host program execution, the virus program is activated, which can still be self-replicate and reproduce.
22. Unpredictability of the virus. Different types of viruses, they code vary, but some operations are shared (such as in memory, change interrupt)
23. . Deceptive computer virus. Computer viruses secretive, unresponsive to their computer, often to the fact that the virus causing the error as accepted, so it is easy to be successful.

24. Persistent virus. Even after the virus program has been detected, data and programs as well as the operating system is very difficult to restore. Especially in network operating conditions, because the virus program from a copy of infection spread through the network repeatedly, making the virus removal process is very complex.

3.5 Types of Computer Viruses

The most common types of computer viruses and other malicious programs fall among the following:

1. **Resident Viruses.** This type of virus is a permanent which dwells in the RAM memory. From there it can overcome and interrupt all of the operations executed by the system: corrupting files and programs that are opened, closed, copied, renamed etc. Examples include: Randex, CMJ, Meve, and MrKlunky.
2. **Multipartite Viruses**. Multipartite viruses are distributed through infected media and usually hide in the memory. Gradually, the virus moves to the boot sector of the hard drive and infects executable files on the hard drive and later across the computer system.
3. **Direct Action Viruses.** The main purpose of this virus is to replicate and take action when it is executed. When a specific condition is met, the virus will go into action and infect files in the directory or folder that it is in and in directories that are specified in the AUTOEXEC.BAT file PATH. This batch file is always located in the root directory of the hard disk and carries out certain operations when the computer is booted.
4. **Overwrite Viruses.** Virus of this kind is characterized by the fact that it deletes the information contained in the files that it infects, rendering them partially or totally useless once they have been infected. The only way to clean a file infected by an overwrite virus is to delete the file completely, thus losing the original content. Examples of this virus include: Way, Trj. Reboot, Trivial.88.D.
5. **Boot Virus.** This type of virus affects the boot sector of a floppy or hard disk. This is a crucial part of a disk, in which information on the disk itself is stored together with a program that makes it possible to boot (start) the computer from the disk. The best way of avoiding boot viruses is to ensure that floppy disks are write-protected and never start your computer with an unknown floppy disk in the disk drive. Examples of boot viruses include: Polyboot.B, AntiEXE.
6. **Macro Virus.** Macro viruses infect files that are created using certain applications or programs that contain macros. These mini-programs make it possible to automate series of operations so that they are performed as a single action, thereby saving the user from having to carry them out one by one. Examples of macro viruses: Relax, Melissa. A, Bablas, O97M/Y2K.
7. **Directory Virus.** Directory viruses change the paths that indicate the location of a file. By executing a program (file with the extension .EXE or .COM) which has been infected by a virus, you are unknowingly running the virus program, while the original file and program have been previously moved by the virus. Once infected it becomes impossible to locate the original files.
8. **Polymorphic Virus.** Polymorphic viruses encrypt or encode themselves in a different way (using different algorithms and encryption keys) every time they infect a system. This makes it impossible for anti-viruses to find them using string or signature searches (because they are different in each encryption) and also enables them to create a large number of copies of themselves. Examples include: Elkern, Marburg, Satan Bug, and Tuareg.

9. **File Infectors.** This type of virus infects programs or executable files (files with an .EXE or .COM extension). When one of these programs is run, directly or indirectly, the virus is activated, producing the damaging effects it is programmed to carry out. The majority of existing viruses belongs to this category, and can be classified depending on the actions that they carry out.
10. **Encrypted Viruses.** This type of viruses consists of encrypted malicious code, decrypted module. The viruses use encrypted code technique which make antivirus software hardly to detect them. The antivirus program usually can detect this type of viruses when they try spread by decrypted themselves.
11. **Companion Viruses.** Companion viruses can be considered file infector viruses like resident or direct action types. They are known as companion viruses because once they get into the system they "accompany" the other files that already exist. In other words, in order to carry out their infection routines, companion viruses can wait in memory until a program is run (resident viruses) or act immediately by making copies of themselves (direct action viruses).Some examples include: Stator, Asimov.1539, and Terrax.1069.
12. **Network Virus.** Network viruses rapidly spread through a Local Network Area (LAN), and sometimes throughout the internet. Generally, network viruses multiply through hared resources, i.e., shared drives and folders. When the virus infects a computer, it searches through the network to attack its new potential prey. When the virus finishes infecting that computer, it moves on to the next and the cycle repeats itself. The most dangerous network viruses are Nimda and SQLSlammer.
13. **Nonresident Viruses.** This type of viruses is similar to Resident Viruses by using replication of module. Besides that, Nonresident Viruses role as finder module which can infect to files when it found one (it will select one or more files to infect each time the module is executed).
14. **Stealth Viruses.** Stealth Viruses is some sort of viruses which try to trick anti-virus software by intercepting its requests to the operating system. It has ability to hide itself from some antivirus software programs. Therefore, some antivirus program cannot detect them.
15. **Sparse Infectors.** In order to spread widely, a virus must attempt to avoid detection. To minimize the probability of its being discovered a virus could use any number of different techniques. It might, for example, only infect every 20th time a file is executed; it might only infect files whose lengths are within narrowly defined ranges or whose names begin with letters in a certain range of the alphabet. There are many other possibilities.
16. **Space filler (Cavity) Viruses.** Many viruses take the easy way out when infecting files; they simply attach themselves to the end of the file and then change the start of the program so that it first points to the virus and then to the actual program code. Many viruses that do this also implement some stealth techniques so you don't see the increase in file length when the virus is active in memory. A space filler (cavity) virus, on the other hand, attempts to be clever. Some program files, for a variety of reasons, have empty space inside of them. This empty space can be used to house virus code. A space filler virus attempts to install itself in this empty space while not damaging the actual program itself. An advantage of this is that the virus then does not increase the length of the program and can avoid the need for some stealth techniques. The Lehigh virus was an early example of a space filler virus.
17. **FAT Virus.** The file allocation table or FAT is the part of a disk used to connect information and is a vital part of the normal functioning of the computer. This type of virus attack can be especially dangerous, by preventing access to certain sections of

the disk where important files are stored. Damage caused can result in information losses from individual files or even entire directories.

18. **Worms.** A worm is technically not a virus, but a program very similar to a virus; it has the ability to self-replicate, and can lead to negative effects on your system and most importantly they are detected and eliminated by anti viruses. Examples of worms include: PSWBugbear.B, Lovgate.F, Trile.C, Sobig.D, Mapson.
19. **Trojans or Trojan Horses.** Another unsavory breed of malicious code (not a virus as well) are Trojans or Trojan horses, which unlike viruses do not reproduce by infecting other files, nor do they self-replicate like worms.
20. **Logic Bombs.** They are not considered viruses because they do not replicate. They are not even programs in their own right but rather camouflaged segments of other programs. Their objective is to destroy data on the computer once certain conditions have been met. Logic bombs go undetected until launched, and the results can be destructive.

Self-Assessment Exercise

a. What is a computer virus?

3.6 The Most Dangerous Computer Viruses

As dreadful as may sound, computer viruses can be a nightmare that might cause extensive damage to your innocent machine. It can significantly disrupt your system's performance and has the potential to wipe out everything on your hard disk. Like cancer, pneumonia and other deadly diseases are to humans, computer viruses are to computers. Agrawal (2014) and Jamaluddin (n.d) share the same ideas on the following as the most dangerous computer viruses:

1. My Doom explored its way to the malware world on 26th January 2004 and sent a shockwave around the world as it scattered exponentially via e-mail with random senders' addresses and subject lines. My Doom also known as "Novarg" is reported to be the most dangerous virus ever released, breaking the previous record set by the Sobig F worm. My Doom swiftly infected some two million computers and instigated a huge denial of service attack which smashed the cyber world for some time. It transmitted itself in a particularly deceitful manner through e-mail as what receiver would first reckon to be a bounced error message as it reads "Mail Transaction Failed."

2. ILOVEYOU. Back in 2000, one of the trickiest computer malware ever was detected on May 4 in Philippines. Around 10% of the internet users committed a huge mistake by going on the name of this hazardous worm. The virus played on a radical human emotion of the need to be loved because of which it became a global pandemic in only one night. The bug was transmitted via e-mail having a subject line "ILOVEYOU" – a notion appealing to many of us with an attached file to it which reads as – Love-Letter-For-You.TXT.vbs. As soon as the file was opened, the virus took the liberty of e-mailing itself to the first 50 contacts present in the Windows address book and also infected the multimedia files saved in the system causing damages that amounted to $5.5 billion.
3. Sobig F –August 2003 turned out to be the miserable month for corporate and domestic computer operators around the world as the sixth and most destructive deviant of Sobig series hit the internet. Sobig F infected host computers by fooling the users that the corrupt e-mail they received is from a legitimate source. If the user opens the attachment it exposes a security hole in the system allowing the intruder to send messages via the trapped user's e-mail address. Within 24 hours, Sobig F set a record

of replicating more than one million copies of itself which later was broken by yet another mass mailer worm – My Doom. However, Sobig F caused an extensive damage of $3 billion – $4 billion leaving infections in over 2 million PCs worldwide

4. Code Red. In the summer 2001, a computer worm most commonly referred to as "Code Red" was unleashed on the network servers on July 13. It was a very sneaky virus which took advantage of a flaw in Microsoft Internet Information Server. This virus was for the first time detected by two of the Eye Digital Security employees and at the time when they found out about the virus, they were drinking Code Red Mountain Dew; hence the name "Code Red." The interesting thing about this deadly virus is, it did not require you to open an e-mail attachment or run a file; it simply needed an active internet connection with which it defaces the webpage you open and display a text string "Hacked by Chinese!" In less than a week "Code Red" brought down more than 400,000 servers including the White House web server. It's estimated that the total damage was of approximately $2.6 billion dollars with as many as one million computers hit by the virus
5. SQL Slammer, a standalone malicious program also known as "Sapphire" appeared at the starting of the year 2003 and was the first fileless worm which rapidly infected more than 75000 vulnerable hosts within10 minutes on 25th January. Through a classic denial of service attack, it dramatically slowed down global internet traffic and brought down South Korea's online capacity on knees for 12 hours. Sapphire mainly targeted on the servers by generating random IP addresses and discharging the worm to those IP addresses. The abrupt release of infected network packets had a huge impact on the significant services provided by Bank of America's ATMs, Seattle's 911 emergency response systems and Continental airlines. All in all, the worm caused between $950 million and $1.2 billion in lost productivity which is not much compared to what would have happened if it erupted on a week day and not on a Saturday
6. Melissa was the first mass-mailing macro virus for the new age of e-mailing which became the breaking news across the world on March 26, 1999. The estimated damage accounted to 300 to 600 million dollars after which FBI launched the largest internet manhunt ever to catch the author of Melissa – David L. Smith which of-course they did and after the arrest, he was sentenced 20 months in federal prison and was ordered to pay a fine of $5000 for unleashing the fastest virus of its time. The virus was distributed as an e-mail attachment and when the attachment "list.doc" is clicked upon, the virus seeks for the Microsoft Outlook address book to e-mail itself to the first 50 names on the list with a message "Here is that document you asked for…don't show anyone else. ;-)"
7. CIH. A destructive parasitic virus CIH also known as "Chernobyl" was first emerged in the year 1998 in Taiwan and quickly became one of the most dangerous and destructive viruses to ever hit with a payload that corrupts data. The CIH virus infects Windows 95 and 98 executable file and after doing that it remains a resident in the machine's memory, where it infects other executables. Once activated, the virus annihilates the data on the hard disk and overwrites the computer's Flash BIOS chip, rendering it completely inoperable and unless the chip is reprogrammed the user will not be able to boot the machine at all. Although with increased awareness and advancement in technology the virus does not pose a serious threat today but we can never forget the $250 million worth of destruction it caused
8. The dreaded Storm Worm struck the cyber world as a malicious Trojan horse program in late 2006 when users began receiving e-mails with a subject line "230 dead as storm batters Europe." It was without a doubt one of the most sophisticated and greatest cyber fraud networks ever constructed. It tricked the victims into clicking the fake

links in an e-mail that was infected by the virus which could easily turn any Windows PC into a botnet, letting someone offsite operate it remotely for sending spam mails across the internet. In January 2007, it was estimated that out of all global malware infections, 8% is due to the Storm worm as the number of this dangerous malware infected PCs was close to 10 million.

9. In 2009, a new computer worm Conficker also known as Downup, Domnadup and Kido crawled its way into as many as fifteen million Microsoft Windows operating systems around the world without human intervention using a patched Windows flaw. Conficker virus is very difficult to detect without running an upgraded version of original anti-virus and malware scanner. It might spread via removable drives like hard disks, smart phones and other thumb drives adding a corrupt file to it so that when the device is attached to another computer, the AutoPlay dialog box display an additional option. Conficker has assembled an army of zombies which has the potential to steal financial data and other important information from your system
10. Nimda first surfaced in 2001 and hastily rosed to the top. The name of the virus is derived from the word “Admin” spelled backwards. It just took 22 minutes for this dangerous virus to propagate via four different ways – e-mail, server vulnerabilities, shared folders and file transfer. The worm was released on September 18, 2001, a week after the 9/11 attacks which forced many people to believe that Nimda is a Cyber Terror attack as it quickly captured almost all the sources via which the virus can infect maximum number of computers. Albeit, the primary purpose of this virus was to slow down the internet traffic considerably causing a denial-in-service attack
11. Jamaluddin (n.d.) via BBC.The virus was created by two Filipino programers, Reonel Ramones and Onel de Guzman. What it did was **use social engineering to get people to click on the attachment**; in this case, **a love confession**. The attachment was actually a script that poses as a TXT file, due to Windows at the time hiding the actual extension of the file. Once clicked, it will send itself to everyone in the user’s mailing list and proceed to overwrite files with itself, making the computer unbootable. The two were never charged, as there were no laws about malware. **This led to the enactment of the E-Commerce Law** to address the problem
12. via F-SecureIt will then launch a denial of service attack on several IP address, famous among them the website of the White House. It also allows backdoor access to the server, allowing for remote access to the machine. **The most memorable symptom is the message it leaves behind on affected web pages, "Hacked By Chinese!"**, which has become a meme itself. A patch was later released and it was estimate that it caused $2 billion in lost productivity. **A total of 1-2 million servers were affected**, which is amazing when you consider there were 6 million IIS servers at the time
13. via MSN Canada. Smith was eventually caught when they traced the Word document to him. The file was uploaded using a stolen AOL account and with their help, law enforcement was able to arrest him less than a week since the outbreak began. **He cooperated with the FBI in capturing other virus creators**, famous among them the creator of the Anna Kournikova virus. For his cooperation, he served only 20 months and paid a fine of $5000 of his 10 year sentence. The virus reportedly caused $80 million in damages
14. Sasser **A Windows worm first discovered in 2004**, it was created by computer science student Sven Jaschan, who also created the Netsky worm. While the payload itself may be seen as simply annoying (it slows down and crashes the computer, while making it hard to reset without cutting the power), t**he effects were incredibly disruptive, with millions of computers being infected, and important, critical infrastructure affected**. The worm took advantage of a buffer overflow vulnerability

in Local Security Authority Subsystem Service (LSASS), which controls the security policy of local accounts causing crashes to the computer. It will also use the system resources to propagate itself to other machines through the Internet and infect others automatically

15. via HPThe effects of the virus were widespread as while the exploit was already patched, many computers haven't updated. This **led to more than a million infections**, taking out critical infrastructures, such as airlines, news agencies, public transportation, hospitals, public transport, etc. Overall, the damage was estimated to have cost $18 billion. **Jaschen was tried as a minor** and received a 21 month suspended sentence.
16. Zeus Zeus is a Trojan horse made to infect Windows computers so that it will perform various criminal tasks. The most common of these tasks are usually **man-in-the-browser key logging and form grabbing**. The majority of computers were infected either through drive-by downloads or phishing scams. First identified in 2009, it managed to compromise thousands of FTP accounts and computers from **large multinational corporations and banks** such as Amazon, Oracle, Bank of America, Cisco, etc. Controllers of the Zeus botnet used it to steal the login credentials of social network, email and banking accounts.
17. via Abuse.ch. In the US alone, it was estimated that **more than 1 million computers were infected,** with 25% in the US. The entire operation was sophisticated, involving people from around the world to act as money mules to smuggle and transfer cash to the ringleaders in Eastern Europe. About $70 million were stolen and in possession of the ring. 100 people were arrested in connection of the operation. In late 2010, the creator of Zeus announced his retirement but many experts believe this to be false.
18. Conficker. Also known as **Downup** or **Downadup**, Conficker is a worm of unknown authorship for Windows that made its first appearance in 2008. The name comes from the English word, configure and a German pejorative.**It infects computers using flaws in the OS** to create a botnet. The malware was able to infect more than 9 million computers all around the world, affecting governments, businesses and individuals. It was **one of the largest known worm infections to ever surface** causing an estimate damage of $9 billion
19. via Wikipedia. The worm **works by exploiting a network service vulnerability** that was present and unpatched in Windows. Once infected, the worm will then reset account lockout policies, block access to Windows update and antivirus sites, turn off certain services and lock out user accounts among many. Then, it **proceeds to install software that will turn the computer into a botnet slave** and scare ware to scam money off the user. Microsoft later provided a fix and patch with many antivirus vendors providing updates to their definitions
20. Stuxnet. Believed to have been created by the Israeli Defence Force together with the American Government, Stuxnet is **an example of a virus created for the purpose of cyberwarfare**, as it was intended to disrupt the nuclear efforts of the Iranians. It was estimated that Stuxnet has managed to ruin one fifth of Iran's nuclear centrifuges and that nearly 60% of infections were concentrated in Iran
21. via IEEE. The computer worm was **designed to attack industrial Programmable Logic Controllers (PLC), which allows for automation of processes in machinery**. It specifically aimed at those created by Siemens and was spread through infected USB drives. If the infected computer didn't contain Siemens software, it would lay dormant and infect others in a limited fashion as to not give itself away. If the software is there, it will then proceed to alter the speed of the machinery, causing it to tear apart. Siemens eventually found a way to remove the malware from their software.

22. via Virus.Wikidot.com. **The worm spreads itself by appearing as an email transmission error and contains an attachment of itself**. Once executed, it will send itself to email addresses that are in a user's address book and copies itself to any P2P program's folder to propagate itself through that network. The payload itself is twofold: first it opens up a backdoor to allow remote access and second it launches a denial of service attack on the controversial SCO Group. It was believed that **the worm was created to disrupt SCO** due to conflict over ownership of some Linux code. It caused an estimate of $38.5 billion in damages and the worm is still active in some form today.
23. CryptoLocker. CryptoLocker is **a form of Trojan horse ransomware** targeted at computers running Windows. It **uses several methods to spread itself**, such as email, and once a computer is infected, it will proceed to encrypt certain files on the hard drive and any mounted storage connected to it with RSA public key cryptography. While it is easy enough to remove the malware from the computer, the files will still remain encrypted. **The only way to unlock the files is to pay a ransom by a deadline**. If the deadline is not met, the ransom will increase significantly or the decryption keys deleted. The ransom usually amount to $400 in prepaid cash or bitcoin
24. via Bleepingcomputer.com .The ransom operation was eventually stopped when **law enforcement agencies and security companies managed to take control part of the botnet operating CryptoLocker and Zeus**. Evgeniy Bogachev, the ring leader, was charged and the encryption keys were released to the affected computers. From data collected from the raid, the number of infections is estimated to be 500,000, with the number of those who paid the ransom to be at 1.3%, amounting to $3 million.
25. 10. Flashback. Though not as damaging as the rest of the malware on this list, this is **one of the few Mac malware to have gain notoriety** as it showed that Macs are not immune. The Trojan was first **discovered in 2011** by antivirus company Intego as a fake Flash install. In its newer incarnation, a user simply needs to have Java enabled (which is likely the majority of us). It propagates itself by using compromised websites containing JavaScript code that will download the payload. Once installed, the Mac becomes part of a botnet of other infected Macs.

3.7 Mode of Transmission of Computer Virus

Viruses and worms can infect network servers, desktop computers, laptops, tablets and mobile 'phones... they pose one of the most serious Internet security risks, reaching our PCs from email, web sites, downloaded files and loadable media, such as USBs, CD-ROMs and DVDs. Unfortunately, the effects of an infection are pretty unpleasant. The virus or worm can,

a. **Disable** the computer
b. Add, modify or delete files or reformat the hard disk. **A worm eats up storage space and slows down the computer**, but won't alter or delete files.
c. **Steal addresses** held in our computer to send on virus-infected emails to our friends, colleagues, clients or customers
d. **Send spam** (unsolicited, bulk email) to those in our mail address books and other users

The majorities of viruses are contract by USB, CD-ROMs by bringing information from one source and then put onto your computer. VIRUSES can infect USB and when that disk is put into your computer your computer will then become infected with that virus, a recent survey done in 1997 by NCSA given to 80 percent of PC users showed that 90% of PC users contract viruses by USB. In the survey done above it showed that the other 20% of viruses

were contracted by email attachments and over the Internet. This means that you received an email with an attached file and opened the file. Or downloaded a file over the Internet.

3.8 Virus Properties

Your computer can be infected even if files are just copied. Because some viruses are memory resident as soon as a diskette or program is loaded into memory the virus then attaches itself into memory.

Can be Polymorphic. Some viruses have the capability of modifying their code which means one virus could have various amounts of similar variants.

Can be memory / Non memory resident. Depending on the virus can be memory resident virus which first attaches itself into memory and then infects the computer. The virus can also be Non memory resident which means a program must be ran in order to infect the computer.

Can be a stealth virus. Stealth viruses will first attach itself to files on the computer and then attack the computer this causes the virus to spread more rapidly.

Viruses can carry other viruses and infect that system and also infect with the other virus as well. Because viruses are generally written by different individuals and do not infect the same locations of memory and or files this could mean multiple viruses can be stored in one file, diskette or computer.

Can make the system never show outward signs. Some viruses will hide changes made such as when infecting a file the file will stay the same size.

Can stay on the computer even if the computer is formatted. Viruses have the capability of infecting different portions of the computer such as the CMOS battery or master

How Viruses may Effect Files

Viruses can effect any files however usually attack .com, .exe, .sys, .bin, .pif or any data files. Viruses have the capability of infecting any file however will generally infect executable files or data files such as word or excel documents which are open frequently.

It can increase the files size, however this can be hidden. When infecting files virtues will generally increase the size of the file however with more sophisticated viruses these changes can be hidden.

It can delete files as the file is ran. Because most files are loaded into memory and then ran once the program is in memory the Virus can delete the file.

It can corrupt files randomly. Some destructive viruses are not designed to destroy random data but instead randomly delete or corrupt files.

It can cause write protect errors when executing .exe files from a write protected disk. Viruses may need to write themselves to files which are executed because of this if a diskette is write protected you may receive a write protection error.

It can convert .exe files to .com files. Viruses may use a separate file to run the program and rename the original file to another extension so the exe is ran before the com.

It can reboot the computer when a files is ran. Various computers may be designed to reboot the computer when ran.

3.9 What Viruses May Do

The following are possibilities you may experience when you are infected with a virus. Remember that you also may be experiencing any of the following issues and not have a virus. Once the hard drive is infected any disk that is non-write protected disk that is accessed can be infected.

- Deleted files
- Various messages in files or on programs.
- Changes volume label.
- Marks clusters as bad in the FAT.

- Randomly overwrites sectors on the hard disk.
- Replaces the MBR with own code.
- Create more than one partitions.
- Attempts to access the hard disk drive can result in error messages such as invalid drive specification.
- Causes cross linked files.
- Causes a "sector not found" error.
- Cause the system to run slow.
- Logical partitions created, partitions decrease in size.
- A directory may be displayed as garbage.
- Directory order may be modified so files such as COM files will start at the beginning of the directory.
- Cause Hardware problems such as keyboard keys not working, printer issues, modem issues etc.
- Disable ports such as LPT or COM ports
- Caused keyboard keys to be remapped
- Alter the system time / date
- Cause system to hang or freeze randomly.
- Cause activity on HDD or FDD randomly.
- Increase file size.
- Increase or decrease memory size.
- Randomly change file or memory size.
- Extended boot times
- Increase disk access times
- Cause computer to make strange noises, make music, clicking noises or beeps.
- Display pictures
- Different types of error messages

3.10 Detecting Viruses

The most commonly used method of protecting against and detecting viruses is to purchase a third party application designed to scan for all types of viruses. A list of theseprotection programs are listed above. Alternatively a user can look at various aspects of the computer and detect possible signs indicating a virus is on the computer. While this method can be used to determine some viruses it cannot clean or determine the exact virus you may or may not have.

3.11 Types of anti viruses

The following are the most common types of antivirus software produced by different companies in alphabetical order as indicated in Table 15**:**

Company	Windows	Apple	Linux	Mobile	Free?
ACD Systems	Yes	No	No	No	No
AntiVir	Yes	No	Yes	No	Yes
AVG	Yes	No	No	Yes	Yes
Avast	Yes	No	No	Yes	Yes
Avira	Yes	No	Yes	Yes	Yes
BitDefender	Yes	No	Yes	Yes	No
BullGuard	Yes	No	No	Yes	No

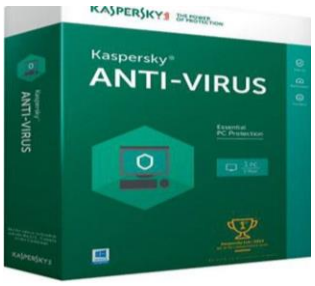
ClamWin	Yes	No	No	No	Yes
Comodo	Yes	Yes	Yes	No	Yes
ESET NOD32	Yes	Yes	Yes	Yes	No
F-Prot	Yes	No	Yes	No	No
Kaspersky	Yes	Yes	Yes	Yes	No
McAfee	Yes	Yes	Yes	Yes	No
MSE	Yes	No	No	No	Yes
Netlux	Yes	No	No	Yes	No
Network Associates	Yes	Yes	Yes	Yes	No
Panda Software	Yes	No	Yes	No	No
RAV	Yes	Yes	Yes	No	No
Sophos	Yes	Yes	Yes	No	No
Symantec (Norton)	Yes	Yes	Yes	Yes	No
Trend Micro	Yes	No	No	Yes	No
Vipre	Yes	No	No	No	No
Webroot	Yes	No	No	No	No

Table 15: Types of anti viruses

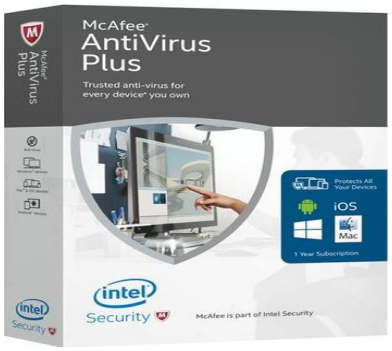
3.12 The Best Antivirus Software

The following are the best antivirus software based on review of research visually presented: Gold Award Bitdefender as in Fig. 93

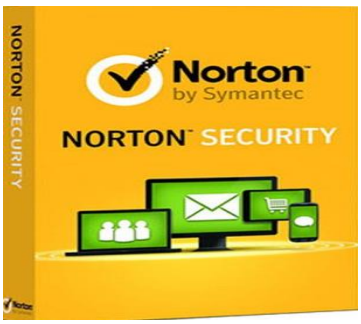
(1). Bitdefender Antivirus Plus



(2) . Kaspersky Anti-Virus

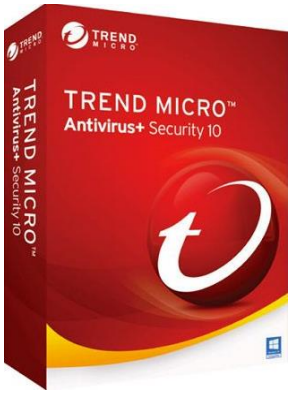


(3). McAfee AntiVirus Plus

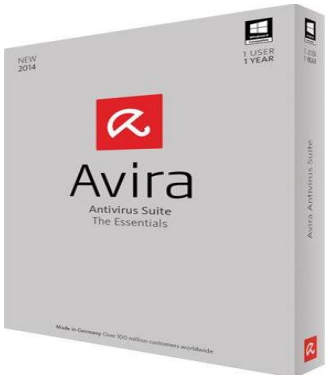


(4). Norton Security

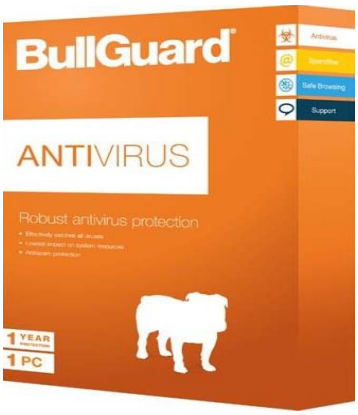
Fig. 93.1: The Best Antivirus Software



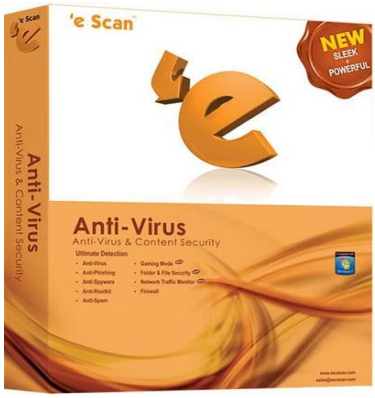
(5) Trend Micro Antivirus + Security



(6). Avira Antivirus Pro



(7).BullGuard Antivirus

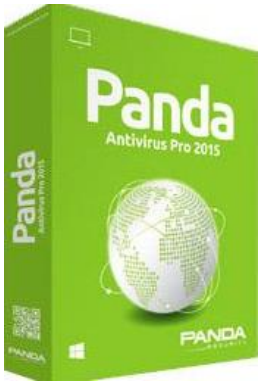


(8). eScan Anti-Virus

Fig. 93.2: The Best Antivirus Software

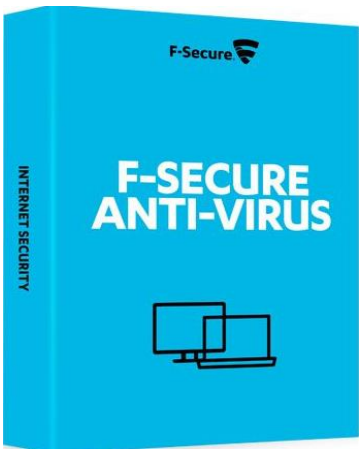
(9).ZoneAlarm Antivirus + Firewall

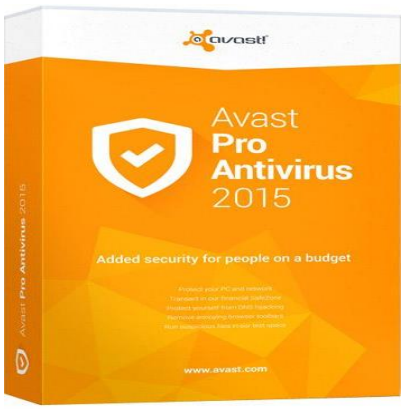
(10).G Data AntiVirus



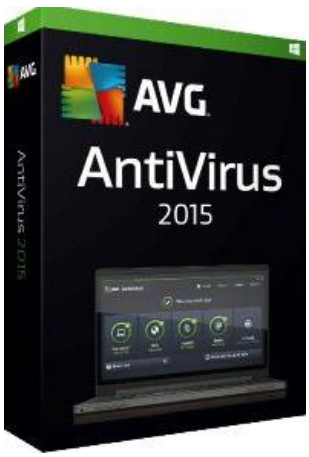
(11). ESET NOD32 Antivirus (12).Panda Antivirus Pro

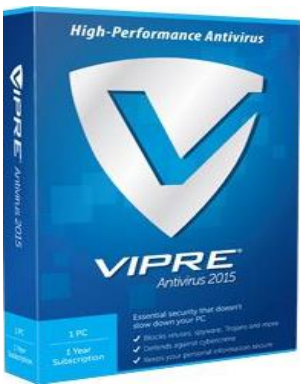
Fig. 93.3: The Best Antivirus Software





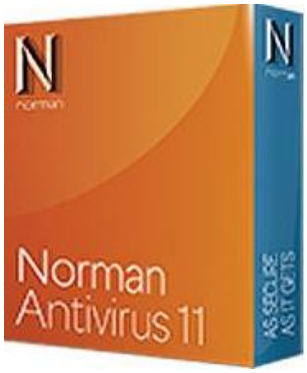
(13) F-Secure Anti-Virus (14). Avast! Pro Antivirus



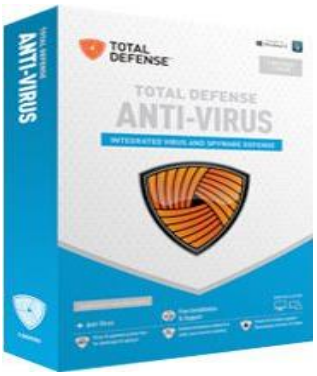


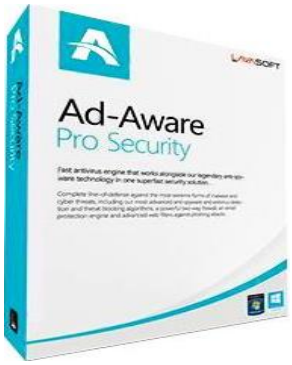
(15).AVG Anti-Virus (16). VIPRE Antivirus

Fig. 93.4: The Best Antivirus Software



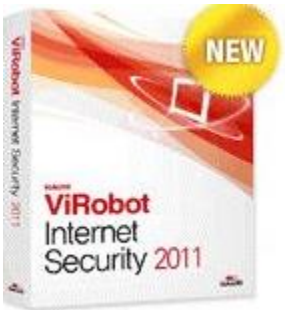
(17). Norman Antivirus (18). Webroot Secure Anywhere Antivirus

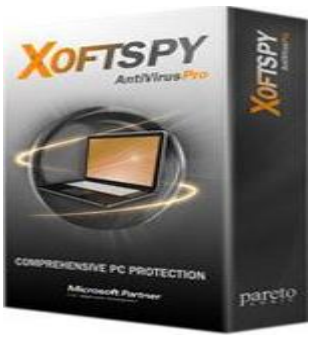




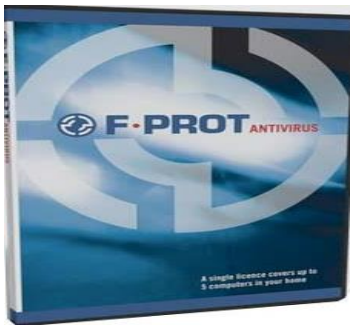
(19). Total Defense Anti-Virus (20). Lavasoft Ad-Aware Pro

Fig. 93.5: The Best Antivirus Software





(21) Hauri ViRobot Internet Security (22).ParetoLogic XoftSpy AntiVirus Pro



(23) F-Prot Antivirus (24) TrustPort Antivirus

Fig. 93.6: The Best Antivirus Software

4.0 Conclusion

Computer viruses are one of the greatest threats to the computer. If not detected and promptly cured, computer virus attack could lead to the total breakdown of computer installation. With the aid of our discussion in this unit, students should be able to identify and install antivirus software as a preventive measure.. So, here is what you can do to keep your computer system safe from viruses:

a. Have a **legitimate** antivirus program installed on your system as indicated above.
b. Remember to **renew** your antivirus software on time – if it isn't renewed, its not active.
c. Make sure you are always **up-to-date with latest virus definitions** – if it is not up-to-date, it is useless.
d. Ensure that your antivirus updates are running **automatically** – or as a minimum, make sure you install antivirus program updates as frequently as you can to make sure that your system has a defense line against most recent viruses, too.

5.0 Summary

In this unit we have learnt the following:

a. That computer viruses are programs written by programmers with the aim of getting money, causing havoc to the computer in order to gain control.
b. Computer viruses could lead to malfunctioning and total breakdown of the computer.
c. Computer viruses are transferred from one computer to another through the use of infested storage media such as flash drive, CDROM, or a cross a computer network.
d. There are different types of computer viruses and anti viruses
e. There are some dangerous computer viruses available
f. There are many characteristics of computer viruses
g. There are antivirus packages specially written to prevent, detect and clean viruses as indicated pictorially above.

6.0 Tutor-Marked Assignment

Explain five reasons for the development of computer viruses

7.0 References/ Further Reading

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