

INTRODUCTION TO COMPUTER STUDIES

Computer studies is a subject that deals with the study of the features of computers and their applications plus the ways and methods of using computers to provide an ***understanding of the use of computers to individuals, organizations and society at large.***

Aims of learning Computer Studies

The subject aims at equipping the learner with computer information and communication technology skills in order to enhance one's productivity and development of creative skills for problem solving and efficiency.

Objectives (Importance) of learning Computers Studies

1. Computer studies helps us to demonstrate general knowledge and skills in using computers and related technologies
2. To use the knowledge acquired in computer studies to improve learning in other subjects.
3. To understand important issues in a technology based society and exhibit ethical behaviour in the use of computers and related technologies.
4. To exhibit basic computer skills required for employment
5. To acquire knowledge as a foundation for further studies in computer technology
6. To use a variety of computer technologies to access, analyze, interpret, apply and communicate information.

INTRODUCTION TO COMPUTERS AND ICT

What is a Computer?

A **computer** is an electronic device operating under a set of instructions (programs or software) that can accept data, process it, output the information, and store the results for future use. A working computer system is made up of hardware and software. Computer systems can be categorized according to their processing speed, size, purpose and power.

Computer Literacy

Computer literacy refers to having the knowledge and understanding of computers and their uses.

Characteristics of Computers:

Input, processing, output and storage may seem to be simple processes for a computer. The computer's ability to perform the above processes is because of the following;

a) **Speed:**

In computers, operations and processing are carried out at a very fast speed. The computer performs millions and billions of instructions per second. The speed of a computer is determined by the kind of processor/microchip installed and the speed of that particular processor. The speed of a microchip is represented as cycles that are performed by a processor in a second. A single cycle of processing is called a **Hertz**. Therefore when millions or billions of cycles are performed then we have a **Megahertz** (MHZ) or **Gigahertz** (GHZ) respectively. Examples of microprocessor invented to date include Intel chips, Cyrix chips, AMD Athlon chips, etc.

b) **Accuracy:**

Computers have the ability of processing data without making errors. Computer errors are usually made by the users or operators thereby a term GIGO (Garbage In Garbage Out) which means that when you feed data with errors into the computer you receive output with errors from the computer.

c) **Memory Storage:**

Computers can store large amounts of data before and after processing in their memory temporarily. This type of temporary memory is called Random Access Memory (RAM). RAM is a temporary storage location for data and instructions during processing. Data in memory is retrieved quickly for processing and stored back to memory after processing. Computers today have memory capacities ranging from 32 MB (Megabytes) to 1,024 GB (Gigabytes).

d) **Versatile:**

Computers are said to be versatile because they are used to perform a variety of tasks such as creating documents, billing customers, storing records, performing calculations, entertainment, etc. All these tasks can be performed provided the instructions (programs) to perform the tasks are installed in the computer.

e) **Diligence:**

Computers are diligent machines because they repeat processing cycles over and over again without making any errors or getting tired and bored. Once programmed, the computer automatically performs as many cycles as possible and produces error free output in a short period of time with less human intervention.

f) **Reliability:**

The electronic components inside modern computers are very reliable due to a low failure rate. The high reliability of the

components inside enables computers to produce accurate results on a consistent basis.

A computer's capacity to communicate with other computers increases its input, processing, output and storage capabilities. If a computer is able to communicate with a remote computer, then it can share any of the four information processing cycles (input, process, output and storage) with that remote computer. Communications capability is referred to as **Connectivity**.

FUNCTIONS OF COMPUTERS

Computers can carry out the following basic functions:

a) **Input:**

Inputs are the raw facts entered into the computer. Input could also mean the process of entering data into computer by a person, or another computer. Data can be entered using input devices such as keyboards, data terminals, etc. Examples of input activities include:

-) Recording
-) Scanning
-) Typing
-) Editing
-) Coding etc

b) **Output:**

Computers produce results or information after processing data. The output can either be displayed on screen (soft copy) or printed on paper (hard copy). Examples of output activities include:

-) Printing
-) Projecting
-) Reporting
-) Displaying etc

c) **Storing:**

Computers can be used to store data internally or externally. Internally the computer stores data in memory while externally it is used to make a permanent copy of information on storage media, either a magnetic disk (hard or floppy) or a magnetic tape for future use. Most computers can store data permanently in more than one media location.

d) **Processing:**

Processing is defined as the series of actions or events that convert data into information. Processing of data takes place in the Central Processing Unit (CPU). The CPU is "**the brain**" of the computer. Examples of processing activities include:

-) Calculations
-) Sorting

-) Comparing
-) Summarizing
-) Interpreting
-) Formatting etc

e) **Communication:**

Communications refers to one computer transferring data, instructions, and information to another computer or some other computers. For communication to take place, there must be a sending device (Computer A) that initiates an instruction to transmit data, instruction, or information and a receiving device (Computer B) that accepts the signals from Computer A through a **communications channel**, or path, over which the signals are sent e.g. a standard telephone line. The communication path could be through a Local Area Network (LAN) or Wide Area Network (WAN).

A LAN is a group of connected computers and devices within the same geographical area (same office, building) that share a common communications line or link for the purpose of communicating and sharing resources. The devices and computers share resources on a single processor or server.

A WAN is a computer network that covers a broad area whose communications links cross regional or national boundaries for the purpose of communicating and sharing resources. WANs are used to connect LANs and other types of networks together, so that users and computers in one location can communicate with users and computers in other locations. The largest and most well known example of a WAN is the **Internet**.

f) **Retrieving:**

Retrieving is the process of reading or opening data from magnetic disks, tapes or CDs into memory for processing. The information retrieved should be resident on the media where it had been stored.

INFORMATION and COMMUNICATIONS TECHNOLOGY (ICT)

Information Technology (IT) or Information and Communication Technology (ICT) deals with the use of electronic computers and computer software to convert, store, protect, process, transmit, and retrieve information from anywhere at anytime. Information technology (IT) or information and communication technology (ICT) is the combination of computer and communication technologies to process data into information.

Examples of IT or ICT devices include: computers, radios, televisions, digital cameras, video cameras, mobile phones, faxing machines, photocopiers, scanners, etc.

Today, the term IT or ICT includes many aspects of computing and technology, and the term is more recognizable than ever before. Information Technology covers many fields. IT professionals perform a variety of duties that range from installing applications to designing complex computer networks and information databases. A few of the duties that IT professionals perform include, but not limited to:

-) Data Management
-) Computer Networking
-) Database Systems Design
-) Software design
-) Management Information Systems

Examples of IT applications in everyday life include:

- Payment by phone services at home
- Payroll systems in a factory
- Report card systems in a school
- Billing system in the Town Gas Company
- Electronic funds transfer system in a bank
- Stock control system in a department store
- Ticket reservation system in a cinema
- Traffic control system in transportation

IT today is used in school settings to perform a variety of tasks. Some of the common IT applications applied in schools include:

- a) **Computer based training, which** includes:
 - i) **Computer Assisted Instruction (CAI)**, where teachers can use computers and other IT equipment to present teaching materials in a more interesting way.
 - ii) **Computer Assisted Learning (CAL)**, where students can use computers and appropriate software to learn at their own pace
 - iii) **Computer Assisted Assessment (CAA)**, which may reduce the time and labour to mark the answer scripts
- b) **Distance learning** through computer based training and web based training.
- c) **Simulations** of experiments or real life situations that may be hazardous
- d) **Electronic Library system** for searching, borrowing and returning books.
- e) The **School Administration and Management System (SAMS)** for keeping records of students and producing report cards or other related documents
- f) **Edutainment**, which is a type of educational software that combines education with entertainment.

Advantages of using ICT/IT in learning and teaching include

-) CAI and CAL packages that usually contain multimedia effects make learning more interesting and interactive.
-) Students can learn by themselves when the teacher is not available.
-) Students can learn and proceed at their own pace.
-) Students can usually get their results or feedback immediately after they have answered the question or taken an action.
-) There are rich educational resources on CD-ROMs and the Internet.
-) Teachers can present subject matter and explain abstract concepts more clearly with multimedia.
-) Teachers can show experiments that are difficult to perform or dangerous in nature through simulations software.
-) Advanced instructions can be given to students in areas where the teacher may not be qualified.

Disadvantages of using IT in teaching and learning include

-) Face to face interaction between students and teachers may be reduced.
-) Students can only follow what the CAL packages are predefined to offer.
-) Computers are costly to acquire for the CAL process.
-) Students may fail to understand some concepts using CAL & CAI without proper explanations.
-) Some of the educational programs are not easy to acquire.

Exercise: Think of the various ways in which ICT can be applied at home and list them down in your book

DATA AND INFORMATION

Data is a collection of raw and unprocessed facts, figures, and symbols obtained relating to an activity in a given environment.

Information is organized, meaningful, and useful results or output obtained after processing data useful in making a decision.

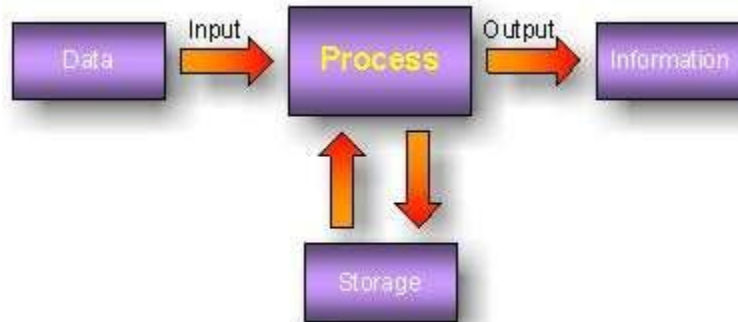
An example of data and information is listed below:

Data	Information
letters (e.g., a, b, c, ...)	words (e.g., apple, boy, cat)
words and symbols	a report, a letter, an essay
numbers	a mathematical formula
examination scores	comments, grades
musical notes	a piece of music, a song

Data and Information Processing

Information processing involves a series of **input**, **process**, **output**, and **storage** activities. These series of activities are often called the **information processing cycle**.

Below is a diagram illustrating the information processing cycle



Stages of Data Processing

The five basic stages of information processing are

1. **Data Collection** - capturing data from their sources and recording it onto some media (e.g., paper).
2. **Data Preparation** - copying, grouping, or arranging data in a more convenient way for input.
3. **Input of Data** -- entering the data or sending the stored data into the processing system.
4. **Data Processing** - calculating or manipulating the input data and even storing the results for future use.
5. **Output of Information** - giving out the processed results in a readable form (e.g., a report).

Methods of Data and Information Processing

There are many ways of processing information but the three basic ways include:

Manual Information Processing

When manual devices and human labour are used to process data into information, then this is called Manual Information Processing or Manual Data Processing (MDP). The tools used include pens, pencils, papers, etc. Transactions are recorded on source documents such as files, ledger cards and stored in filing cabinets or drawers.

Advantages of manual information processing

- Initial investment costs are not high. The tools used are cheap to acquire.
- Manual data processing methods are easy to apply since there are no complications in carrying out tasks.
- Skilled labour is not in high demand

- There are no health risks associated with manual data processing such as eyestrains and backaches.
- The equipments used in manual data processing are portable that is easy to move with.
- Many people are employed to perform various tasks.

Disadvantages of manual information processing

- Tasks cannot be completed because of the slow speed at which man processes data.
- Small amounts of data are processed and with errors.
- Small amounts of data are stored in files and drawers.
- Inefficiency and less productivity are experienced.
- Running cost becomes higher in the long term.
- Tasks cannot be completed without human intervention.
- There is lack of proper security for the data stored because it's easily accessible to everyone.
- There is lack of communicating ability for data and information with other employees.
- Manual data processing can lead to boredom and tiredness while processing large amounts of data
- Data can be easily lost in case of natural disasters such as fire, floods, etc.

Mechanical Information Processing

Mechanical information processing involves the use of human labour and human operated devices such as the typewriters, calculators, cash registers, accounting machines to convert data into information. Data is input by the machine operator who manipulates a machine and output is obtained in form of a printed material on paper or display on small screens such as what is seen on calculators and cash registers.

Electronic Information Processing

When an electronic device (e.g., a computer) is used to process data into information, this is called **electronic information processing**.

Advantages of using computers for information processing include

- Tasks can be completed faster because computers work at amazing speed.
- Computers can process large amounts of data and generate error-free results, provided that the data is entered correctly.
- Computers can store enormous amounts of data for future use.
- The high reliability of components inside modern computers enables computers to produce consistent results.
- Efficiency and productivity can be raised.
- Running cost becomes lower in the long term.
- Tasks can be completed with little human intervention (i.e., automatic).
- Overall, security can be raised due to less human intervention.

- The management can observe new information and new trends more quickly.
- Customer services can be improved due to more efficient management and operations.
- Computers with communicating capability can share data and information with other computers.

Disadvantages of using computers for information processing include

- Initial investment costs can be high.
- Extra cost is required to employ specialized staff to operate and design the data processing system.
- Some jobs may be lost due to computerization and thus lower the morale of staff members.
- Some staff has to be trained or retrained.
- Face-to-face interactions among staff may be reduced.
- Due to the rapid changes in information technology, computers and related equipment become outdated within a short period of time.
- In case of computer breakdown, data can be easily lost.

COMPONENTS, CLASSIFICATION AND CATEGORIES OF COMPUTERS

A Computer System

A computer system is a combination of hardware and software that functions together to process data. The computer system includes not only the computer, but also the peripheral devices like monitors, keyboards, mice, printers, scanners, etc, that are necessary to make the computer function.

A Peripheral Device:

A peripheral device is any device attached to a computer in order to expand on the computer's processing ability. Some of the more common peripheral devices are printers, scanners, disk drives, tape drives, microphones, speakers, and cameras.

The components of a computer system include:

a) Hardware:

Hardware includes the physical parts that make up a computer. These are the devices that are used to input, output, process, store and communicate data.

b) Software:

These are sets of instructions that direct hardware to perform tasks necessary to process data into meaningful information.

c) Human ware:

These are the trained users who operate the computers. They bring hardware and software into interaction as well as develop instructions (software) for different computer applications. Examples of jobs carried out in the ICT field include:

- i) Data entry clerks
- ii) Software developers
- iii) Hardware engineers
- iv) Network Engineers
- v) Computer Technicians
- vi) Network Administrators
- vii) Database Administrators
- viii) System Administrators
- ix) Website Developers etc

CLASSIFICATION OF COMPUTERS

Computers can be classified as follows:

a) According to Brand:

There are different manufacturers of computers producing different brands of computers namely:

- i) HP (Hewlett Packard) Compaq
- ii) IBM (International Business Machines)
- iii) Sony
- iv) Gateway
- v) Dell
- vi) Acer
- vii) Toshiba

b) According to Purpose

Computers can as well be classified according to the purpose they perform namely:

- i) Special Purpose Computers
These computers carry out specific processing tasks. They are also referred to as **dedicated computers**.
- ii) General Purpose Computers
These computers are designed to perform a variety of tasks. For such computers to perform many tasks the necessary programs have to be installed in the computer. Examples are the microcomputers.

c) According to Size

Computers can be classified according to their size namely:

i) Micro Computers:

Microcomputers are small computer systems basically found in homes, offices, schools and small businesses. They are single-user computers. They are also referred to as Personal Computers (PC).

The characteristics of microcomputers include:

-) They are designed to be operated by an individual (single-user)
-) Input of data is through one keyboard, mouse, scanner, etc
-) Output of data is through one monitor
-) Storage of data takes place on the disks (hard, floppy and compact) as well as in memory found on the system unit.
-) Processing of data takes place using one microprocessor or microchip found in the central processing unit (CPU).
-) They support one processing task at a time.
-) They can be used to perform a variety of tasks
-) They are further broken down into these categories

Desktop Computers:

Desktop Computers are small microcomputers that have their system units lying horizontally on the desk with a monitor placed on top of the system unit

Tower/Mini Tower Computers:

Tower computers are microcomputers that have their system units lying vertically on the desk with the monitor placed beside the system unit.

Laptop Computers:

Laptop computers are small microcomputers that are portable. They are carried in small lightweight carrying cases. They can be used to run general purpose applications packages. They are run with the help of rechargeable batteries in case of power failure.

Notebook Computers:

Notebook computers are smaller versions of laptops that are portable as well. They are carried in small lightweight carrying cases. They can be used to run general purpose applications packages. They are run with the help of rechargeable batteries in case of power failure.

Personal Digital Assistants (PDA):

PDAs are hand held devices designed for individuals who move around and have built in communications capabilities that allow the PDAs to use voice, fax, Internet, contact address books, appointments, etc.

Handheld/Palmtop Computers:

These computers usually have several built in personal information management functions such as calendar, phone book, address book, a task of things to do, etc. Some palmtops also have limited capabilities for typing notes. Handheld computers are basically used to perform meter readings and other mobile tasks by users.

ii) Mini and Mainframe Computers:

A mini computer is a medium sized computer larger than a microcomputer and is used in situations where a microcomputer is not powerful enough. It can handle hundreds of users connected at the same time. Mini computers are sometimes referred to as mid-range servers.

A mainframe computer is a large, powerful and expensive computer that is used in large organizations where sophisticated computers systems are run. They can handle thousands of users connected at the same time. Typical organizations that use mainframes include telecommunication companies, International Non Governmental Organizations, big industrial complexes, etc.

Users through a personal computer or **terminal** typically access both computers. A **terminal** is a device that has a keyboard and monitor. Terminals send and receive computer data. Different types of terminals exist including:

- i) **Dumb terminal** has no processing power, cannot act as a stand-alone computer, and must be connected to a server to operate.
- ii) **An intelligent terminal** has memory and a processor so that it can perform some functions independent of the host computer.
- ii) An **EPOS (Electronic Point of Sale) terminal** is used to record purchases at the point where the consumer purchases the product or services.
- iv) An **automated teller machine (ATM)** is a self-service banking machine attached to a host computer through a telephone network

Similarities between a mini and mainframe computer

- i) Both computers are very expensive to purchase and maintain
- ii) Both computers are extremely powerful and process data at a very fast speed
- iii) Both computers provide centralized processing, storage and management of large volumes of data
- iv) Both computers have more than one processing unit to perform the different internal processing of data
- v) Both computers handle a number of users connected at the same time during data processing using terminals
- vi) Both computers support a number of programs running at the same time using one central computer (a mini or mainframe)
- vii) Both computers are stored in special data processing rooms not easily accessible by all staff.
- viii) Special data processing staff are trained to manage these computers using special programs
- ix) Both computers require different operational environments unlike the personal computers such as dusts free environments, air conditioning systems, different power voltages, etc

Differences between the mini and mainframe computers

- i) A mini computer is smaller than a mainframe computer in terms of size. Therefore mainframes are large computers.
- ii) A mini computer will support hundreds of users connected while a mainframe computer will support thousands of users connected.
- iii) A mini computer is less expensive while a mainframe computer is more expensive than a mini.

iii) Super Computers

A **supercomputer** is the fastest, most powerful, and most expensive computer used for applications that require complex and sophisticated mathematical calculations. Super computers process billions of instructions in seconds and there processing is usually limited to one task.

Typical tasks carried out by supercomputers include weather forecasting, space exploration projects, weapons research and launching, etc

Other terms related to the classification of computers include:

i) Stand-alone Computer

A **stand-alone computer** is a computer that is not connected to a network, and is capable of performing the operations in the information processing cycle.

ii) Client Computer

A **client computer** is a computer that can access the resources on a network.

iii) Network Computer

A **network computer (NC)** is a computer designed specifically to connect to a network, especially the Internet.

iv) Server

A **server** is the **host** or **central computer** that manages the resources on a network. Examples of servers include:

-) File server
-) Print server
-) Database server
-) Network server

CATEGORIES OF COMPUTERS

There are basically two categories of computers or devices, **Digital and Analog**

a) Digital Computers (devices)

Computer equipment is designed to process data as digital signals. A **digital** device or computer is a tool that performs its operations or calculations using the binary system by sending digital signals. A digital signal consists of individual electrical pulses that represent the bits grouped together into bytes.

An electronic device is described as **digital** if data in it is represented as electrical '**off**' and '**on**' signals that correspond to the binary digits **0** and **1**. Data is represented as a series of 1s and 0s. Each 1 and 0 is called a bit an acronym for **Binary Digit**. A bit is the smallest unit of data handled by a computer. A group of 8 bits forms a **byte**. A byte is a unit of storage used to represent a character such as an alphabet (Aa..Zz) a digit (0..9) and special characters such as ?, %, #, &, \$, @, etc.

A digital device is more accurate than an analog device because it only needs to sense the difference between two clearly distinguishable states: **off** and **on**.

Advantages of digital signals include

-) Digital signals can be copied exactly without any loss of quality.
-) Computer can further process digital signals.

Examples of digital devices include:

Digital watches, digital cameras, printers, scanners, digital thermometers, digital speedometers, microwave ovens, etc

b) Analog Computers:

A device is described as **analog** if data is represented as **continuous signals** that vary within a predefined range. An **analog** signal consists of a continuous electrical wave. An example of analog data is **human speech**. Others include electrical voltages, pressure, temperature changes, time, speed, etc

Examples of analog devices include:

Analog thermometers, barometers, analog clocks and watches, analog speedometers, weighing scales, etc

CHAPTER THREE: HISTORY OF COMPUTING

THE EVOLUTION OF COMPUTERS

The History of computing begins with the early methods of counting and recording numbers that were devised by early man. Early man counted by means of matching one set of object with another set such as stones to sheep, etc. These methods of counting numbers were developed and used by the herdsmen who wanted to avoid animal loses. These simple methods were also used to count their possessions. Other methods of counting used included, use of sticks, writings and carving on walls, etc.

THE EARLY YEAR'S DEVICES:

Some of the devices that were developed in the early years include:

THE ABACUS

The abacus is a mechanized pebble counter invented around 500 BC as a traditional calculating aid. It is made of a frame and a string of wires with beads on the wires to perform calculations. The beads are slid along the wires to add and subtract. The abacus has been used for the last 2000 years and is still in use today in some parts of the world especially in Asia.

THE NAPIER BONES

In 1614, John Napier a Scottish mathematician invented logarithms and several machines as traditional aids for calculation. He invented as set of rods curved from bones printed with digits to be used as multiplication aids using the principles of logarithms. These rods were called the Napier Bones.

THE SLIDE RULE

In 1620, William Oughtred invented the slide rule. A slide rule was a calculating device that used the principles of logarithms to aid calculations. It had two scales one of which slides along the other

to perform calculations. It was possible to obtain products, quotients, and other functions.

PASCAL'S ARITHMETIC MACHINE

In 1642, Blaise Pascal, a French mathematician invented a mechanical adding machine with automatic carries from one column to another during calculations. The machine contained several dials that could be turned with the aid of a stylus to enter digits. Addition was performed by the gears turning as each digit was dialed in and the cumulative total was displayed in a window above the "keyboard". The machine was often called the **Pascaline**.

LEIBNIZ CALCULATING MACHINE

In 1671, Gottfried von Leibniz, a German mathematician invented a calculator. It used a stepped cylindrical gear to produce multiplication as numbers were repeatedly added and automatically fed into the accumulator. It used a series of sliders, which formed a shift mechanism where numbers were moved from one column to another in stages during calculations.

In the period 1800 to 1950 different developments took place, which contributed to one or more of the features found in computers built since 1950 as elaborated below.

THE LOOM

In France around 1801, Joseph Marie Jacquard invented an automatic loom that used punched cards to control the weaving patterns in cloth. The punched cards were strung tightly side by side in a long continuous form. The cards were automatically fed into the loom and were for the purpose of controlling the loom's weaving actions. The cards stored information about the patterns of the cloth. They had holes punched into them.

THE DIFFERENCE ENGINE

In 1822, Charles Babbage, a mathematics professor at Cambridge worked on a small mechanical computer which was called a difference engine. The machine was not completed because of mechanical and financial problems.

THE ANALYTICAL ENGINE

In 1834, Charles Babbage drew up further plans for a steam powered calculating device, which was called the analytical engine, considered the mechanical precursor of the modern computer. It was automatic and could perform all arithmetic operations efficiently with less human operation. It included a processing unit called a "**mill**" which could add, subtract, multiply and divide. It had an input mechanism to read instructions and data was fed into the device using punched cards. It had an output mechanism to display results after calculations. It also had a simple memory device for storing data and instructions. In 1842, Augusta Ada

King, a student of Babbage produced extensive notes and programs for Babbage's machine. As a result of the programs, one programming language **ADA** was named in her honor. Although the Analytical Engine was never built fully, its key concepts, such as the capacity to store instructions, the use of punched cards as a primitive memory, and the ability to print, can be found in many modern computers.

THE EARLY ELECTRONIC CALCULATORS

THE TABULATOR

Dr. Herman Hollerith, a census statistician in the United States of America, invented a tabulator that was used for the 1890 census. It combined the use of punched cards and other devices to create and electronically read the cards. The devices were able to process data by reading the holes on the card. The tabulator made the computational time three to four times shorter than the time previously needed for hand counts. Hollerith set up his company, Hollerith Tabulating Company that combined with two other companies to create the **Computing Tabulating Recording** (CTR) company, later renamed **International Business Machines** (IBM) in 1924.

THE ABC (ATANOSOFF BERRY COMPUTER)

John Vincent Atanosoff and Clifford Berry developed the ABC between 1936 and 1939 at Iowa State University in the USA. It was a special purpose machine built to solve equations in physics. Atanosoff built the machine to demonstrate his concepts of digital computation. It had some features that would later appear in modern computers such as the **Arithmetic Unit** and **Memory**.

Z COMPUTERS

Konrad Zuse developed the Z computer between 1935 and 1938, which used binary arithmetic. He continued with the Z2 in 1938 with the assistance of Helmut Schreyer. Later he introduced the electronic valve based calculating machines in Germany around 1941 and called them Z3 and Z4. The machines used stored programs to perform calculations.

THE COLOSSUS

Alan Turing, a British and other experts produced the Colossus at the British Intelligence Centre in Bletchly Park around 1943. It was developed to decode (interpret) intercepted messages of the Germany forces. It became operational in 1954.

THE ENIAC

John Presper Eckert and John Mauchly started working on the ENIAC I in 1943 under the guidance of John Brainerd, a Dean at the Moore School of Electrical Engineering in the University of Pennsylvania started working on the **Electronic Numerical**

Integrator and Computer (ENIAC). It was believed to be the first true general-purpose electronic computer. It was completed in 1946. The U.S. military sponsored their research since they needed a calculating device for writing artillery-firing tables (the settings used for different weapons under varied conditions for target accuracy). The ENIAC contained 17,468 vacuum tubes, along with 70,000 resistors, 10,000 capacitors, 1,500 relays, 6,000 manual switches and 5 million soldered joints. It covered 1800 square feet (167 square meters) of floor space, weighed 30 tons, and consumed 160 kilowatts of electrical power. In one second, the ENIAC could perform 5,000 additions, 357 multiplications or 38 divisions.

THE EDVAC

This was the successor of the ENIAC. In August 1944, Mauchly and Eckert proposed the building of a new machine called the ***Electronic Discrete Variable Automatic Computer*** (EDVAC). Unfortunately, the machine did not become fully operational until 1952. When it was finally completed, the EDVAC contained approximately 4,000 vacuum tubes and 10,000 crystal diodes. It was believed to be the first stored programmable computer because it had internal memory for storing programs. Their idea was to have the program for the computer stored inside the computer. This would be possible because EDVAC was going to have more internal memory than any other computing device then.

THE ASCC

In 1937, Howard H. Aiken started working on the ***Automatic Sequence Controlled Calculator*** (ASCC), which became known more popularly as the "Harvard Mark I" at Harvard, with the help of IBM during World War II. It brought Babbage's principles of the analytical engine almost to full realization, while adding important new features.

It was 51 feet long, eight feet high and weighed nearly five tons. Consisting of 78 adding machines and calculators linked together, the ASCC had 765,000 parts, 3,300 relays, over 500 miles of wire and more than 175,000 connections. It was the largest electromechanical calculator ever built. Used by the Navy during the war to run repetitive calculations for the production of mathematical tables, the Mark I operated at Harvard for 15 years while assisting in the solution of complex problems in various disciplines.

It was difficult to identify the device that should be called the first digital computer or the first electronic computer. Therefore, different developments in computer history were broken down into **Computer Generations**.

THE COMPUTER GENERATIONS

Computer generations are gradual developments detailing advancements in computer technology grouped in different years. Each generation of computer is characterized by a major technological development that fundamentally changed the way computers operate, resulting in increasingly smaller, cheaper, more powerful and more efficient and reliable devices. The generations include:

FIRST GENERATION COMPUTERS (1946-1956)

The first generation computers used **vacuum tubes** as their processors instead of the mechanical switches to perform calculations. They were very big taking up entire rooms. They were very expensive to operate, unreliable and in addition to using a great deal of electricity, generated a lot of heat, which was often the cause of malfunctions. They had limited internal memory store in magnetic drums leading to slow processing. They could only solve one problem at a time. First generation computers relied on machine language to perform operations. The programs used on these computers were machine dependent. This means that programmers had to be design all computer instructions in machine language. Input was based on punched cards and paper tape, and output was displayed on printouts.

The EDSAC (***Electronic Delay Storage Automatic Calculator***), UNIVAC (***Universal Automatic Computer***) and ENIAC computers are examples of first-generation computing devices.

The **UNIVAC** was the first commercial computer delivered to a business client, the U.S. Census Bureau in 1951. It was designed by J. Presper Eckert and John Mauchly. Although manufactured by Remington Rand, the machine often was mistakenly referred to as the "IBM UNIVAC." The machine could run speed of 1,905 operations per second. Input and output was through a magnetic tape and unityper printer. It had a memory size of 1,000 12 digit words in delay lines and used delay lines as well as magnetic tapes for memory. It occupied 943 cubic feet of floor space. It cost \$750,000 dollars to purchase it.

SECOND GENERATION COMPUTERS (1956-1963)

Second generation computers used **transistors** instead of vacuum tubes and ushered in another generation of computers. The transistor was invented in 1947 by John Bardeen, William Shockley and Walter Brattain, but did not see widespread use in computers until the late 50s. The transistor was less expensive, far superior to the vacuum tube, allowing computers to become smaller, faster, cheaper, more energy-efficient and more reliable than their first-generation predecessors. Though the transistor still generated a great deal of heat that subjected the computer to damage, it was a vast improvement over the vacuum tube. Second-generation computers still relied on punched cards for input and printouts for output.

Second-generation computers moved from binary machine language to symbolic, or assembly, languages, using mnemonic codes that allowed programmers to specify instructions in words. High-level programming languages were also being developed at this time, such as early versions of COBOL and FORTRAN. These were also the first computers that stored their instructions in their memory, which moved from a magnetic drum to magnetic core technology. Magnetic tape storage was introduced which greatly increased storage capacity.

Examples of second-generation computers include, the ATLAS computers, IBM 300, IBM 700, IBM 7030 and IBM 7090.

THIRD GENERATION COMPUTERS (1964-1971)

The development of the integrated circuit was the hallmark of the third generation of computers. Transistors were miniaturized and placed on silicon chips, called semiconductors, which drastically increased the speed and efficiency of computers.

Instead of punched cards and printouts, users interacted with third generation computers through keyboards and monitors and interfaced with an operating system, which allowed the device to run many different applications at one time with a central program that monitored the memory. Computers for the first time became accessible to a mass audience because they were smaller and cheaper than their predecessors.

FOURTH GENERATION COMPUTERS (1971-PRESENT)

The microprocessor brought the fourth generation of computers, as thousands of integrated circuits were built onto a single silicon chip. What in the first generation filled an entire room could now fit in the palm of the hand. The Intel 4004 chip, developed in 1971, located all the components of the computer - from the central processing unit and memory to input/output controls - on a single chip.

In 1981 IBM introduced its first computer for the home user, and in 1984 Apple introduced the Macintosh. Microprocessors also moved out of the realm of desktop computers and into many areas of life as more and more everyday products began to use microprocessors.

As these small computers became more powerful, 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 GUIs, the mouse and handheld devices.

FIFTH GENERATION COMPUTERS (PRESENT AND BEYOND)

Fifth generation computing devices, based on **artificial intelligence**, are still in development, though there are some applications, such as **voice recognition**, that are being used today. The use of parallel processing and superconductors is

helping to make artificial intelligence a reality. The goal of fifth-generation computing is to develop devices that respond to natural language input and are capable of learning and self-organization.

Artificial intelligence is the application of human intelligence to computers i.e. speech recognition.

USES OF COMPUTERS TODAY

CARE AND MAINTENANCE OF COMPUTERS

COMPUTER HARDWARE

Computer Hardware are the physical components (devices) or tangible parts that make up a computer. Data is input, processed, output and stored using computer hardware. The hardware components are broken down into the following categories:

- Input devices
- Processing device (System unit)
- Output devices
- Storage devices
- Communication devices

Examples of hardware devices include:

Keyboard, mouse, scanners, printers, plotters, speakers, joystick, monitors, projectors disk drives (hard, floppy, compact), etc.

INPUT DEVICES:

What is Input?

Input refers to the process of entering data, programs, commands and user responses into memory for processing. Input also refers to the data entered into the computer through the keyboard, mouse, microphone and other devices.

An input device is hardware used to enter data into the computer. A variety of input devices exist including:

a) **Keyboard:**

The keyboard is the primary input device and most commonly used input device. Data is input by pressing the keys etched with characters on the keyboard. The characters include alphabetical, numerical, and special characters as well as keys with special words on them.

Data entered through the keyboard is temporarily stored in the computer's memory and displayed on the screen of the monitor. The keyboard is basically divided into the following divisions:

- i) **Alphanumeric key area:** This area contains alphabetic keys, numbers and special characters. They are arranged like those of a typewriter.
- ii) **Numeric keypad area:** Located on the right hand side of most keyboards has numeric keys arranged in a calculator format to allow you to enter numeric data rapidly.
- iii) **Arrow Keys:** These keys are used to position the insertion point, or cursor on the screen in the direction indicated on the arrow key. An insertion point is a blinking vertical bar while a cursor is a blinking underline character that indicates where the next

character entered will appear on screen. Arrow keys are also called **directional keys** or **navigation keys**.

- iv) **Function keys:** These keys are located at the top of most keyboards. They perform specific tasks in different programs. They are used alone or in conjunction with other keys i.e. **CTRL+F6**. They are labeled F1 - F12.

Functions of different keys on the keyboard

Alphabetical and Numeric Keys

The alphabetical keys (Aa..Zz) and numeric keys (0..9) work the same way as they do on a typewriter. When pressed alone they produce lowercase letters. When pressed with the shift key they produce UPPERCASE LETTERS.

Backspace key:

The backspace key moves the insertion point or cursor one character to the left while erasing the character to the left of the insertion point or cursor.

Spacebar:

The space bar inserts blank characters or spaces between any characters or words that you type.

Enter key:

The enter key is used to perform the following function:

- It is used to end a line of text when a user is typing and places the cursor or insertion point on the next line.
- It is used to start the processing of some commands in the computer e.g. when saving a document, printing, opening documents, starting programs, etc

Shift key:

The shift key enables you to type uppercase letters and special characters shown at the top of some keys where two characters exist on one key. For example when you press the key indicated with 5 and % symbol on it, it will produce figure 5 when pressed alone. When you press the same key while holding down the shift key, it will produce a % symbol.

Tab key:

The tab key moves the cursor on the screen while jumping 0.5 inches whenever it is pressed to the right. When pressed with the shift key, it jumps the cursor 0.5 inches backwards to the left.

Escape key:

The escape key terminates (stops) an activity or task currently being performed and returns the user to the previous activity or task. It is used to cancel a task when working with a computer.

Delete key:

The delete key erases data from the screen to the right of the cursor or insertion point whenever it is pressed.

Insert key:

The insert key enables a user to switch between the insert mode and overwrite mode. In the insert mode any new text that is added pushes existing text to the left of the screen to while when in overwrite mode, any new text added writes over or replaces the existing text at the cursor position. The insert key is a toggle key.

NumLock Key:

The NumLock key is used to switch the task of the numeric keypad area between two modes. When it is pressed, the characters produced from the numeric keypad will be digits only whereas when the NumLock is off any key pressed can either produce digits or the other function of that key.

The Insert, NumLock and CapsLock keys are all toggle keys. A toggle key changes the status of some keys and functions of the keyboard when pressed.

Home key:

The home key moves the cursor to the beginning of the current line or page. Its exact use varies from one program to another.

End key:

The end key is used to move the cursor to the end of the current line or current page. Its exact use varies from one program to another.

Cursor movement keys:

These are also called arrow keys, direction keys or navigation keys. They move the cursor or insertion point one position in the direction indicated on the key.

Control (Ctrl) and Alternate (Alt) keys:

These keys are used in conjunction with another key to perform some function in some programs. By itself when pressed alone, it performs no action.

Page Up (PgUp) and Page Down (PgDn):

The Page Up keys moves the cursor one screenful of information to a previous page depending on the application program being used.

The Page Down key moves the cursor or insertion point one screenful of information depending on the application program being used.

b) THE MOUSE:

A mouse is a pointing input device used to select items on the screen such as icons, text, images, menus and buttons. A mouse is a small palm sized input device that you move across a flat surface to control the movement of the pointer on screen. Pointing devices allow you to control a screen symbol called a pointer that is usually represented by an arrow shaped head mark.

The mouse moves the insertion point to a particular location on the screen. The top of the mouse contains one or more buttons that are used to perform the following operations:

- i) **Clicking:** This is the action of pressing the mouse button. There are two types of clicks:
Single click: This is when a mouse button is pressed once for example to select a menu, item or icon.
Double click: This is when a mouse button is pressed twice for example to start a program, open a document, etc.
- ii) **Dragging:** This is the process of moving data, images, text and icons from one location of the screen to another.
- iii) **Pointing:** This is when a pointer is positioned over text, an icon, image, button or menus on screen.

c) SCANNERS:

Scanners are input devices that electronically capture an entire page of text or images such as photographs or artworks. The scanner converts the text or image from the source document (original document) into digital data that can be stored on a disc and processed by a computer. The digitized data can be printed, displayed or merged with another document.

There are two types of scanners:

- i) **Hand held scanners:**
These enter text or graphics less than a page wide. The software then allows you to join separately scanned items to make up a complete page.
- ii) **Flatbed scanners:**
These enter entire pages of text in a computer system. The document to be scanned is placed on a glass window above the scanning mechanism. A bright light moves underneath the scanned document and the image of the document is sent to the computer by the software used to scan the page.

d) DIGITAL CAMERAS:

A **digital camera** is an electronic device used to capture and store photographs electronically instead of using photographic film like conventional cameras. Modern compact digital cameras are typically multifunctional, with some devices capable of recording sound and/or video as well as photographs.

Digital cameras can be classified into several groups:

a) Video cameras such as

- i. Professional video cameras such as those used in television and movie production.
- ii. Camcorders used by amateurs. They generally include a microphone to record sound, and feature a small LCD to watch the video during taping and playback.
- iii. Webcams are digital cameras attached to computers, used for video conferencing or other purposes. Webcams can capture full-motion video as well, and some models include microphones or zoom ability.

b) Still cameras

Digital still cameras are cameras whose primary purpose is to capture photography in a digital format. Initially, a digital camera was characterized by the use of flash memory and USB or FireWire for storage and transfer of still photographs. Among digital still cameras, most have a rear LCD for reviewing photographs. They are rated in megapixels; that is, the product of their maximum resolution dimensions in millions. They typically save pictures in only the JPEG file format.

OUTPUT DEVICES:

What is output?

Output is the result obtained from the computer after a processing task. Output could either be in form of a hard copy (printed material) or a soft copy (a display on the monitor). The type of output generated from the computer depends on the needs of a user, the hardware used plus the software used. Examples of output include: reports, images/graphics, audio output and video output.

Output devices:

Output devices are tools or machines that enable computer users to convert the results of processing into a form either displayed or printed that is readable by the user. There are basically two types of output devices:

- Display devices
- Printing Devices

a) Display Devices:

A display device is a visual output device of a computer. They include the monitors and flat panel displays

i) **The Monitor**

A monitor also called a visual display unit (VDU) has a display surface called a screen and a plastic casing to protect the electrical components inside. A monitor also has a swivel base that allows the user to adjust the angle of the screen display. An older term used to define a monitor is a Cathode Ray Tube (CRT).

Today monitors are manufactured in a variety of sizes i.e. 14 inch, 15 inch, 17 inch, 19 inch, etc. There are two categories of monitors:

1. **Cathode Ray Tube Monitors:** These monitors use a Cathode tube to display text and graphics on the surface of the screen. The cathode tube has electronic guns at the back of the tube that generates an electronic beam towards the surface of the screen.

2. **Flat Panel Displays:** A flat panel display monitor is a thin display surface, which uses the liquid crystal display technology to display data and images on the screen.

The liquid display technology uses two sheets of plastic or glass material with a liquid crystal solution deposited between them. An electric current passes through the liquid crystal solution causing the crystals to align (position in line with each other) so that light cannot pass through the crystals. Liquid crystal displays are used in digital watches, calculators, portable computers and other devices.

Monitors can either display text and graphics in one colour or a variety of colours. The monitors that display text and graphics in one colour such as white/green on a black background or black characters on a white background are called **Monochrome monitors.**

Monitors which display text and graphics in a variety of colours i.e. 16 colours, 256 colours, and more than a million colours are called **Colour Monitors**

Monitor Resolution:

Text and images are displayed on the monitor using patterns of lighted dots. Each dot that is lighted is called a **picture element** or **pixel**. The **resolution** of a monitor is the number of pixels the monitor can display and the distance between each pixel. The greater the number of pixels and the smaller the distance between

the pixels, the better the monitor resolution because it means more pixels can be displayed.

The number of pixels displayed by a monitor is expressed as the number of pixels horizontally and lines vertically on the screen i.e. **640 x 480** means 640 horizontal pixels by 480 vertical lines. The number of pixels displayed is determined by:

- The software program
- The capability of the video adapter card
- The monitor itself

Today monitors are identified by the highest graphics display standards they support. These include:

- **VGA (Video Graphics Array)** devices which display a resolution of 640 x 480 pixels
- **SVGA (Super Video Graphics Array)** devices which display a resolution of 800 x 600 pixels and 1024 x 768 pixels.
- **EGA (Enhanced Graphics Adapter)**- 640 x 350
- **CGA (Color Graphics Adapter)** device which display a resolution of 300 x 200 pixels
- **XGA (Extended Graphics Array)** devices which display a resolution of 1024 x 768 pixels
- **SXGA (Super XGA)** devices which display a resolution of 1280 x 1024 pixels

Advantages of Flat panel displays over Cathode Ray Tube

- i) Flat panel displays are smaller in size as compared to the Cathode ray tube that occupies a large space.
- ii) Flat panel displays use less power as compared to CRT tubes that use too much power.
- iii) Flat panel displays are more portable while CRTs are bulky.

b) Printing Devices:

i) The Printers:

Printers are output devices that produce a hard copy of text and graphical images on a piece of paper as output. The output is permanent and can be maintained for future use and conveniently distributed to many users and organizations.

Different types of printers exist based on their printing speed, output quality and what they can print. Printers can be classified into two categories:

1. Impact Printers:

Impact printers use a print mechanism whereby the print head comes into contact with the print ribbon and the paper to form characters. Impact printers are relatively cheap and

the cost of printing is low because the ink ribbons are not expensive. Impact printers use a continuous form paper for printing purposes. The speed of impact printers is too low and is measured in characters per second (cps) or lines per minute (lpm). Examples of impact printers include: Dot matrix printers, Daisy wheel printers, drum printers, chain printers, etc.

2. Non-impact printers:

Non-impact printers transfer text and images without making any contact on the paper and use one of the following printing methods:

- Ink is released from an ink cartridge by heat or pressure through ink nozzles and spread onto a paper as fine ink droplets forming character prints. Examples of printers that use ink are: Inkjet printers and DeskJet printers.
- Toner or fine black powder is released from a toner cartridge by heat or pressure through a drum and is fused onto a piece of paper to form characters. **Laser printers** are the most widely toner printers. They use a laser beam to print data onto a paper.

Inkjet and DeskJet as well as laser printers today can print both black and white as well as different shades of colour prints. Examples of laser printers include the LaserJet printers.

THE SYSTEM UNIT

The term a computer usually means a combination of hardware devices and software that manages information and processes data. This term most specifically describes the system unit because this is where computing actually takes place. In the system unit program instructions are performed (executed) and data is processed.

COMPONENTS OF THE SYSTEM UNIT

The system unit is made up of very many parts called components that are covered in the plastic/metallic casing (the box) some of the components found in the system unit include:-

1. Power Supply Unit
2. Mother Board
3. Memory slots and chips
4. Micro-processor/central processing unit
5. Data buses
6. Ports and connectors
7. Expansion slots etc.

MOTHER BOARD

The motherboard is sometimes called the main board, system board or circuit board. It is where all other electronic components in the system unit are connect/attached. Some of the components found on the motherboard include, processor, memory slots expansion slots etc.

THE POWER SUPPLY UNIT

The power supply unit converts electricity coming from the wall outlets to a lower voltage that the computer uses. The power supply unit also has the fan that provides the cooling system for the components inside the system unit.

DATA BUSES

Data is transported and processed as a series of electronic bits. These bits are moved internally within the system units' circuitry along a path that is called the **Bus**. Buses transfer data from the input devices to memory, from memory to the central processing unit from the central processing unit back to the memory and from memory to the output or storage devices.

EXPANSION SLOTS

These are sockets designed on circuit boards for other devices such as video cards; network interface cards (NIC) sound cards that add more capabilities to the computer system. The card that is added into the expansion slot is sometimes referred to as an adapter card, interface card or expansion cards.

BAYS

A bay is an open area inside the system unit used to install additional equipment such as disk drives.

PORTS AND CONNECTORS

A port is a socket used to connect a peripheral device e.g. keyboard, monitor to a system unit. Most of the ports are found at the back of the system unit although today's computers have ports at the front. There are three types of ports.

a) Parallel ports

Parallel ports are used to connect devices that send/receive large amounts of data such as the printers and tape devices. They transfer bits of data using a cable that has eight data lines.

b) Serial ports

These transfer small amounts of data and are used to connect devices such as keyboards, mice, etc. A serial port transmits one bit at a time.

c) Universal serial bus (USB) ports

These ports send and receive very large amounts of data. A USB port connects any device that has a USB interface on it. USB ports can transfer up to 12 MB (mega bytes) of data at a time.

Devices have different types of connectors attached to the cable that is used to connect the device to the system unit. There are basically two types of connectors. The connectors are generally categorized as follows:

- i) Male connectors
They have one or more exposed pins at the back of the system unit or on the cable connector
- ii) Female connectors
Have matching receptive holes to accept the pins from the male connectors.

MICRO PROCESSOR/PROCESSOR

In personal computers, the processor is contained on a single integrated circuit called a micro-chip or an integrated circuit (IC). Micro chips are fixed on a thin slice of material made out of silicon hence the term a silicon chip. In the microprocessor, we have a Central Processing Unit (CPU). The Central processing unit is a circuit board where all arithmetic and logical decisions are performed. In this unit is where processing actually takes place. The central processing unit retrieves instructions and data from memory, processes and stores the results back in memory for display or storage. The central processing unit contains two other components. The control unit and arithmetic and logic unit (ALU)

a) Control unit

The control unit directs and controls all the operations in the computer. It coordinates the processing tasks in the system unit. The control unit operates by repeating four basic operating activities called the **machine cycle**. These operations include:

- **Fetching**
Fetching is the process of obtaining the next program instruction from memory for processing.
- **Decoding**
Decoding is the process of translating and interpreting the program instructions into commands a computer can process.
- **Executing:**
Executing is the actual processing of the computer commands.
- **Storing:**
After executing, the results of the instructions are written back to memory, thus storing.

b) The Arithmetic and Logic Unit (ALU):

It contains electronic circuits necessary to perform arithmetic and logical operations on data. The arithmetical operations performed include, multiplication, division, subtraction and addition while the logical operations performed compare one data item against another to determine if the data item is greater than, less than or equal to another.

Both the control unit and arithmetic and logic unit contain storage locations called **Registers**.

What is a Register?

A register is a temporary storage location for specific types of data in the system unit during processing. There are different types of registers but they mainly store

- Current program instructions
- The address of the next program instruction
- The values of the data being processed.

MEMORY

Memory are small chips that temporarily store program instructions and data during processing. Memory chips are basically installed on the motherboard and today many devices such as printers, monitors have small circuit boards with memory installed on them.

The basic unit of measuring memory is a **byte**. Each byte in memory has an address called a memory address.

What is a memory address?

A memory address is a number that identifies a location of a byte in memory. Today, memory is measured in kilobytes, megabytes, and gigabytes.

Today some of the common memory chips have the following capacities: 64 megabytes, 128 megabytes, 256 megabytes, 512 megabytes, 1 gigabyte. There are three types of memory:

a) Random Access Memory (RAM)

RAM is an integrated circuit or chip that can be read and written by the microprocessor or other computer devices. RAM chips temporarily store data and program instructions during and after processing. RAM is the working memory in any computer system. RAM chips store the following during and after processing:

- Operating system instructions (Windows, Linux, DOS)
- Application program instructions (Word, Excel, games)
- Data currently being processed

RAM is volatile. This means memory can lose data and programs stored in it when power to the computer is turned off.

b) Read-Only Memory (ROM)

ROM chips store information or instructions that don't change. ROM chips store the start up instructions when the computer is turned on. Therefore it can be read as many times as possible but not written to or erased from, hence the term **Read-Only**.

The instructions in ROM are recorded permanently in memory when it is manufactured. ROM is non-volatile. This means memory retains its contents when power to the computer is turned off.

c) Complementary Metal Oxide Semi-conductor (CMOS) Memory

These memory chips store information about the computer system such as:

- the type of keyboard used
- the type of mouse used
- the type of monitor used
- date and time in the computer system
- the amount of RAM installed
- the type and capacity of disk drives, etc

A small battery installed on the motherboard maintains the contents in CMOS memory.

COMPUTER STORAGE

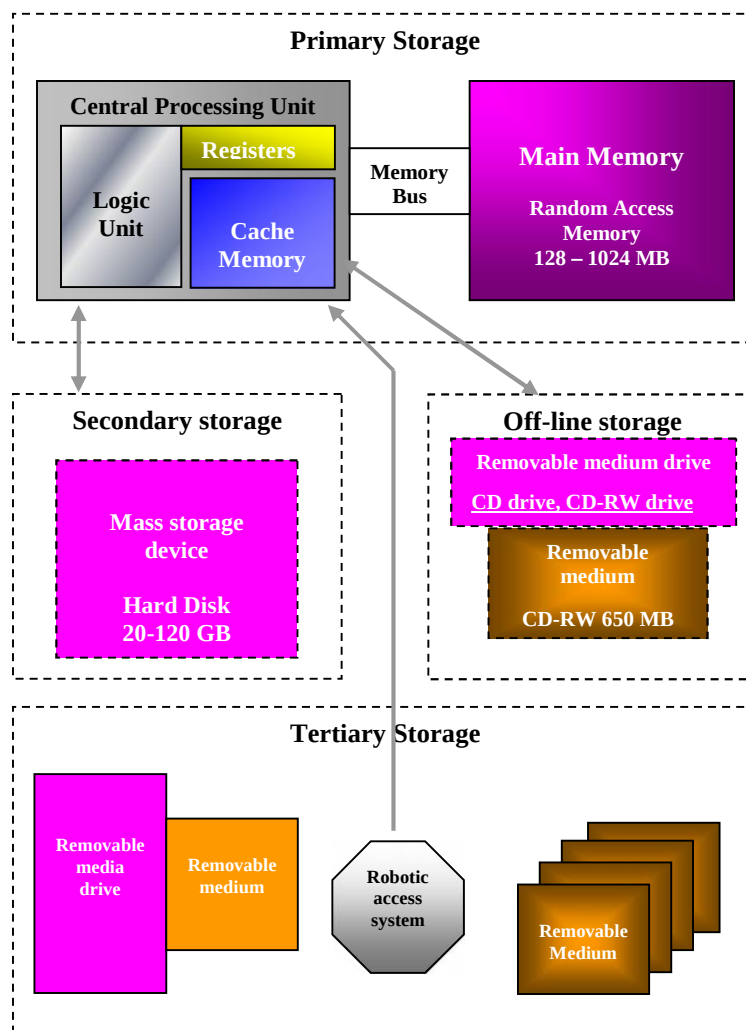
Computer storage refers to computer components, devices and recording media that retain data for some interval of time. Computer storage provides one of the core functions of the modern computer that is of information retention.

There are two forms of storage in computers

- i) **Primary storage:** This is storage that takes place in the computers memory, which is temporary. It is directly linked to the central processing unit of a computer.
- ii) **Secondary storage:** This is storage that takes place outside the computer's memory, which is permanent.

Storage, also called **secondary storage**, **backing storage** or **auxiliary storage** stores data and programs when they are not being processed. The process of storing data is called writing or recording data because the storage device records the data on the storage medium to save it for later use. The process of retrieving data is called reading data, because the storage device reads the data and transfers it to memory for processing.

Various forms of storage, divided according to their distance from the central processing unit are illustrated in the diagram below:



STORAGE TECHNOLOGIES

Storage technologies refer to the storage devices and their respective storage media used in storing data in a computer system. There are a variety of storage devices and storage media such as disk drives and tape drives, as well as disks, tapes, microfilms, PC Cards, Smart Cards, etc.

Secondary Storage Devices:

A storage device is a tool used to write and read data to and from a storage media when not being processed. It records (stores or saves) and retrieves (opens, loads or reads) data from storage media.

There are a variety of storage devices that are used to store data such as the floppy disc drive, hard disk drive, magnetic tape drives and others.

Most computers have more than one storage device. The most common storage devices are the disk drives and tape drives. A drive letter and a colon identify each storage device in the computer system as outlined in the following table:

Drive Letter	Storage device
A: or B:	Floppy disk drives
C:	Hard disk drive
D:	CD-ROM/DVD-ROM /CD-RW Drive
E: - Z:	Any other storage device attached

Storage devices are rated by the speed at which they transfer data and programs in the computer system. This speed is defined as **Access time**.

Access Time is the average amount of time a device takes to locate a single piece of information and avail it to the computer for processing. Access time of PC storage devices is measured in **milliseconds**. For example the access time of a hard disk drive is nine to fifteen milliseconds.

The common types of storage devices include:

i) **Floppy disk drive (FDD)**

A floppy disk drive records and retrieves data to and from floppy disks. There are basically two sizes of floppy drives although one is outdated. They include:

- a) $5\frac{1}{4}$ floppy disk drive (outdated)
- b) $3\frac{1}{2}$ floppy disk drive

Floppy disk drives access data slower than say hard disks because they are in motion or spin only when they are selected for data retrieval. A read-write head performs the process of reading (retrieving) and storing (saving) data. A **Read-write head** is a recording mechanism in each drive that rests on the top and bottom surface of media to record and retrieve data from the media.

ii) **Optical Disk Drives (Compact Disk Drives)**

Compact disks drives record and retrieve data on compact disks using laser light technology. An optical read-write head burns and retrieves the data from the compact disk. Today modern compact disk drives can perform both the writing and reading functions on compact disks. Compact disk drives are broken down into the following categories:

- a) **Compact Disk Read Only Memory (CD-ROM) drives:**
This type of drive can only read or retrieve data from a compact disk to memory for processing. It can read data from **CD-ROM** and **CD-R** disks as well as audio disks.
- b) **Compact Disk Rewritable (CD-RW) drives:**
This type of drive can read and write data from and to a compact disk during processing. It can read data from **CD-ROM**, **CD-R** and **CD-RW** disks as well as audio disks. It can write data to both **CD-R** and **CD-RW** disks.
- c) **Digital Video (Versatile) Disk-ROM Drive:**
This type of drive can only read or retrieve data from a compact disk to memory for processing. It can read data from **CD-ROM**, **CD-R**, **CD-RW** and **DVD-ROM** disks as well as audio disks.
- d) **Digital Video (Versatile) Disk-RW Drive:**
This type of drive can read and write data from and to a compact disk during processing. It can read data from **CD-ROM**, **CD-R**, **CD-RW** and **DVD-ROM** disks as well as audio disks. It can write data to **CD-R**, **CD-RW**, **DVD-R**, **DVD-RW** and **DVD-RAM** disks.
- e) **Combo Drives:**
This type of drive combines both the DVD-ROM and CD-RW abilities during processing. It can read data from **CD-ROM**, **CD-R**, **CD-RW** and **DVD-ROM** disks as well as audio disks. It can write data to **CD-R**, and **CD-RW** disks.

Compact disk drives are the second fastest secondary storage devices after the hard disk drives in accessing data off the storage media. This is because they use laser light to retrieve data from the compact disks.

iii) **Hard disk drives (HDD)**

A hard disk drive records and retrieves data to and from a hard disk. Hard disk drives access data faster than any

other storage device on personal computers. This is because it is always spinning right from the time the personal computer is turned on. A hard disk drive is a non-removable disk drive from a personal computer. Therefore it is also called a **fixed disk drive**. A hard disk drive is also known as a **Hard Disk**. A hard disk drive is needed for any stand-alone computer to function.

iv) **Magnetic Tape Drives**

Magnetic tape drives record and retrieve data on magnetic tapes. Magnetic tape drives are slow in accessing data because they read or write one record at a time in sequence on the magnetic tape.

v) **Zip Drive**

The zip drive records and retrieves data from a zip disk. Zip drives offer faster storage and retrieval of data from zip disks.

vi) **Flash Disk Drive**

These drives record and retrieve data from flash disks. They are portable, easy to use, and inexpensive and offer faster storage and retrieval of data.

The hard, floppy, optical, zip and flash disk drives are **random access** storage devices. A random access storage device has the ability to read or write data to any sector of the storage surface on a disk in any order.

The tape drives are **sequential access** storage devices. A sequential access storage device has the ability to read or write data to the storage surface one record after another in sequence.

Secondary Storage Media

Storage media are the physical materials or apparatus where data is stored in computer systems. They include the disks (hard, floppy, and optical) and tapes. The most commonly used type of media today is the magnetic storage media such as the magnetic disks and magnetic tapes.

With magnetic storage media, the storage device records data by magnetizing small microscopic particles on the storage surface of a disk or tape. Data on magnetic storage media can be recorded and erased as many times as possible.

Today, optical storage media such as the compact and digital versatile disks are also being used to store large quantities of data in computer systems. The optical media uses laser light technology to **burn** (store) data.

The common types of storage media include:

i) **Hard disks (HDD)**

Hard disks are magnetic storage media that contains one or more platters coated (covered) with a magnetic oxide material where data is recorded magnetically on the surface of the platters. The platters are made of aluminium but newer hard disks use glass or ceramic material for the platters. Storage on the hard disk is on both sides of the platters and the more platters the disk has the more data it can store. Each platter has a read-write head to read data from it and these are sealed in an airtight case to prevent dust and other particles from getting into contact with the storage surface.

Hard disks are permanently fixed inside the system unit and are not removable hence the term a fixed disk. For a computer to function, it requires a hard disk to store programs and data. Storage capacity of a hard disk is measured in megabytes and gigabytes. Today common hard disk capacities range from 500 MB to 400 GB of data storage.

Hard disk drives are of two categories:

- a) **Internal hard disks** that are mounted inside the computer system
- b) **External hard disks (Removable hard disks)** that are connected at the back or front USB ports on the system unit of a computer.

Advantages of Hard disks

- a) Hard disks provide for larger storage capacities than floppy disks and other media
- b) Hard disks provide for faster access times than floppy disks and other media
- c) A hard disk is cheaper than a floppy disk per Megabyte stored
- d) Hard disk is usually more reliable than floppy disk (a better protection against dust and dirt).

Disadvantages of Hard disks

- a) Hard disks are not portable (except removable hard disks) which is usually more expensive
- b) Data becomes more less secure if left on a hard disk
- c) Head crush might occur due to extreme shock or contaminants

ii) **Magnetic Tapes**

Magnetic tapes are magnetic storage media that contain a thin ribbon of plastic coated with a magnetic oxide material that can be used to record and retrieve large amounts of

data. Another term used to classify magnetic tapes today is **data cartridge**.

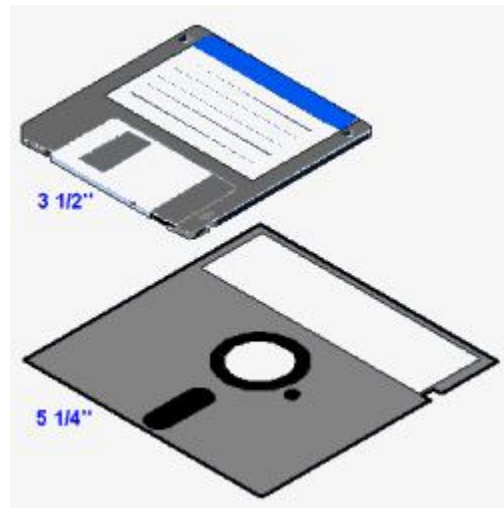
Today magnetic tapes are basically used for long-term storage and backup data. Backing up data means the process of creating an extra copy of information on another storage medium. Magnetic tapes are **sequential access** storage media. This means that they read or write data to the tracks and sectors consecutively or in order. Magnetic tapes were used in the late 1950's to early 1960's as the primary means of storing data.

iii) **Zip Disks**

Zip Disks are magnetic storage media that contain a plastic surface coated with a magnetic oxide material that can be used to record and retrieve large amounts of data. Zip disks are portable storage media connected at the back of the system unit on USB ports for reading and writing data. Zip disks transfer data between the port and computer's memory at a very fast speed. The storage capacity zip disk ranges between 100–250 MB of data.

iv) **Floppy Disks**

Floppy disks are magnetic storage media that consist of a thin, circular flexible plastic mylar surface coated (covered) with a magnetic oxide material where data is recorded magnetically on the surface of storage enclosed in a plastic shell. IBM introduced floppy disks as storage media in 1970 with an 8 inch wide floppy disk, called floppies because of being thin and flexible. Later the 5¼ inch wide disks were introduced in the 80s and early 90s. Today the 3½ inch wide disks are mainly used with personal computers.



The storage capacity of a floppy disk today is 1.44 megabytes (1,474,560 bytes) because storage takes place on both sides of the mylar surface hence the term a double sided (DS or 2S) disk. Storage capacity depends on two factors:

- a) Tracks on the disk: The number of tracks on the recording surface measured as tracks per inch (tpi) determines the amount of data floppies store.

- b) Density of the disk: Density refers to the number of bits recorded in a track inch. Two types of disk densities include:
- Double Density (DD) or low density with a storage capacity of 360 KB – 720 KB for both 5¼ and 3½ disks
 - High Density (HD) with a storage capacity of 720 KB – 1.44 MB for both 5¼ and 3½ disks.

Uses of Floppy Disk Storage

Today floppy disks are basically used for:

- a) Distributing software: When a new device is purchased a set of floppy disks containing device drivers is included in the package for purposes of installing new hardware in the computer system
- b) Sharing data: Documents, images, etc can be shared among computer users on diskettes by creating massive copies on many diskettes.
- c) Backing up data: Diskettes can be used to create duplicate copies of documents, images from another storage medium such as a hard disk. The duplicate copy that is created is called a **Backup**. The process of creating a duplicate copy is called **Backing up**.
- d) Floppy disks are also used to store data for individuals who don't have their own computers to work from i.e. such as in a school or university where computers are used by many students

Precautions for handling Floppy Disks

Users in handling floppy disks should take the following precautionary measures

- a) Do not touch the mylar surface because it can easily get contaminated with dirty particles
- b) Do not place or put heavy objects on top of disks
- c) A disk shouldn't be put near magnetic particles such as telephones. Data can be easily lost if exposed to the magnetic fields.
- d) Floppy disks should be kept away from dust and smoke. These can easily contaminate the storage surface.
- e) Floppy disks shouldn't be exposed to excessive sunlight, heat and cold conditions.
- f) Keep disks away from food and drinks. Once they get into contact with the storage surface, it is easily contaminated.
- g) Handle floppy disks by the edges while inserting it into the floppy drive.

- h) Do not eject the floppy from the drive when the drive in use indicator light is glowing. This can easily damage the mylar surface thereby creating bad sectors, regions where data cannot be stored.
- i) In case of movement over a long distance, floppies should be kept in plastic floppy boxes and not in papers, envelopes or pockets.
- j) Keep floppy disks in a floppy disk storage bank to prevent contaminants from accessing the mylar surface when the disk is not in use.
- k) To prevent data loss from diskettes through malicious or accidental erasure, always write protect your diskette using the **write protect notch** found within the write protect window.

Advantages of Floppy Disks

- A floppy disk is portable and inexpensive
- Data on a floppy disk can be accessed randomly
- Data on a floppy disk can be write protected from being changed accidentally
- Floppy disks can be used to transfer data from one computer to another

Disadvantages of Floppy Disks

- A floppy disk is not durable (due to dust and dirt) and can be destroyed by magnetic fields.
- Access time of a floppy disk is slow (about 84 ms).
- Storage capacity of a floppy disk is limited (only 1.44 MB).

iv) **Optical Disks**

An optical disk commonly called a **compact disc (CD)** is a flat, round, portable, storage medium that is usually 4.75 inches in diameter and less than one-twentieth of an inch thick that stores data by using microscopic pits and land (flat areas) that are in the middle layer of the disc.

A compact disc stores items in a single track, which is also divided into evenly sized sectors, that spirals from the center of the disc to the edge of the disc. The data is recording by use of a laser beam, which burns the data in the pits. A high-powered laser creates the pits while a low powered laser beam retrieves (reads) the data by reflecting light through the bottom of a disk. The reflected light is converted into a series of bits that the computer can process.

Variations of compact discs designed for use with computers include:

A **CD-ROM (Compact Disc Read-Only Memory)** is a compact disc that uses the same laser technology as audio CDs for recording music. A CD-ROM, however, can contain text, graphics, video, and sound. The contents of standard CD-ROMs are written, or recorded, by the manufacturer, and cannot be modified by the user. A **CD-ROM drive** or **CD-ROM player** is required to read items on a CD-ROM. A CD-ROM can hold up to 650 MB of data, instructions, and information. Most standard CD-ROMs are single session which means that all items are written at the time the CD-ROM is manufactured and no data or instructions can be added to the disc later while some are multisession which means that additional data, instructions, and information can be written to the CD-ROM disc at a later time.

CD-R (Compact Disc-Recordable) is a technology that allows a user to write on a compact disc using his or her own computer. CD-R is a “**write once, read many**” technology. A user can write on the disc in stages – writing on part of it one time and writing on another part at a later time. However, the user can write on each part only once and cannot erase it.

A **CD-RW (Compact Disc-Rewritable)** is an erasable compact disc that can be written on multiple times. CD-RW acts like a floppy disk or hard disk, allowing data, instructions, and information to be written and rewritten onto it multiple times. **CD-RW software** and a CD-RW drive are required in order to write and rewrite on a CD-RW. One problem with CD-RW is that they **cannot** be read by all CD-ROM drives.

A **DVD-ROM (Digital Video Disc-ROM)** is an extremely high capacity compact disc capable of storing from 4.7 GB to 17 GB. A **DVD-ROM drive** or **DVD player** is required to read a DVD-ROM. Although the size and shape of a DVD-ROM and a CD-ROM are similar, a DVD-ROM uses one of the following three storage techniques to increase its storage capacity:

- The first technique involves making the disc denser by packing the pits closer together.
- A second technique involves using two layers of pits, which doubles the capacity of the disc.
- Finally, some DVD-ROMs are double-sided, which means that they can be removed and turned over to read the other side

DVD-RAM is the recordable and rewritable versions of DVD-ROM, which allows items to be erased and recorded on it multiple times.

DVD-R is the recordable and rewritable versions of DVD-ROM, which can be written once and read (played) for many times.

DVD+RW is the recordable and rewritable versions of DVD-ROM, which can be written and read (play) for many times. A **DVD+RW** is similar to a CD-RW, except it has storage capacities up to 4.7 GB.

Advantages of compact disc include

- A compact disc is more portable than a hard disk.
- The storage capacity of a compact disc is very much larger than that of a floppy disk.
- The average access time of a compact disc is faster than that of a floppy disk.

Disadvantages of compact discs include

- Some kinds of compact discs are read only (CD-ROM and DVD-ROM).
- The average access time of a compact disc is slower than that of a hard disk.

Precautions for handling compact disks

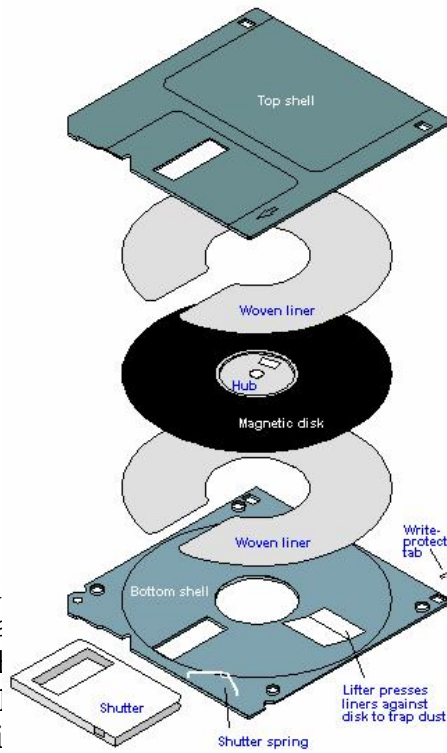
- Handle the compact disk by the edges only or through the hole in the middle of the disk
- Never touch the storage surface because it contaminates easily
- Do not write on compact disks except with a felt tipped marker or simply paste labels on them
- Do not store disks in dirty, dusty or humid locations because they easily get contaminants
- Do not expose compact disks to direct sunlight or near heat generating devices
- Avoid spilling liquids on the disk
- To protect important data, always keep disks in their protective plastics cases, compact disk wallets or compact disk storage boxes

A diagram showing components of a floppy disk

v)

Flash Disks

Flash disks are storage media that use flash memory to store large volumes of data. They are typically small, lightweight, removable and rewritable. They hold between 32 MB to 64 GB of data. Flash disks are the latest storage media technology today. To access data on a flash disk, it must be connected to a USB port (front or back) on the system unit or through a USB hub.



Flash disks are small mass storage devices that use a USB interface (computer memory) to store data. They consist of a small plastic or metal casing.

Uses of Flash Disk Storage

- Personal data transport of documents, image and video files
- Used for computer repair to transfer recovery and antivirus software
- System administration where system and network administrators load them with software for configuration information, system maintenance and troubleshooting.
- Application carriers where they are used to carry programs to run on a computer that do not require installing.
- Audio players- some are designed with sound output to hold and play music files
- To boot an operating system- Bootable Flash drives are used to start operating systems on a computer. They are called **LiveUSBs**.

Advantages of Flash Disks

- They are more compact than floppy disks
- They are generally fast in accessing data
- They hold a lot of data
- They are more reliable due to their lack of moving parts and more durable design

Disadvantages of Flash Disks

- They are easy to misplace, leave behind or easy to lose
- They can sustain a limited number of write and erase cycles before failure.
- Most flash disks do not include a write protect mechanism
- Improperly wired USB ports can destroy the circuitry of a flash disk
- Some flash disks require a high-speed USB connection port that doesn't exist on old computers.

Formatting Disks:

Formatting is the process of preparing a storage media usually a disk for storage purposes. The formatting process creates tracks, sectors, clusters and cylinders on the storage surface.

A **track** is narrow recording band forming a concentric circle (a ring pattern) formed around the storage surface of the disk. Tracks are further divided into sectors.

A **sector** is a pie shaped segment of a track on the storage surface of the disk where data is stored. Each sector stores 512 bytes of data. A file that is 512 bytes or less fits in a single sector. Larger files are stored in more than one sector. Each sector is sequentially numbered. Sectors are further grouped into clusters. Any sector that cannot be used due to a physical flaw on the disk is called a **bad sector**.

A **cluster** is a group of two to eight sectors. The size of a cluster depends on the operating system that was used to format the disk. A cluster is the smallest unit of space used to store data.

A **cylinder** is a set of tracks that occupy the same position at the top and bottom surface of storage on a disk with the same track number.

When you format a disk, the operating system performs the following tasks.

- a) The storage surface is divided into tracks and sectors
- b) Any data on the disk surface is erased
- c) The storage surface is checked and marked where the bad sectors exist
- d) An internal address table called a **File Allocation Table** (FAT) is created on the surface of the disk and is used to locate files on a disk.

The File Allocation Table records the following:

- a) The name of the file stored on the disk
- b) The size of the file stored on the disk
- c) The tracks and sectors where the file is stored on the disk
- d) The date and time the file was created or last modified.

Storage Capacity:

Storage Capacity refers to the maximum amount of data that a storage media can store. Storage capacity is measured in kilobytes, megabytes or gigabytes. The amount of data a media will store depends on the way the disk was formatted. A double-sided disk that is formatted with 40 tracks per side and 9 sectors per track will have 720 sectors.

Media Failure

Media failure is a problem with the storage media that results in data loss. Magnetic media gradually lose their magnetic charge, hence data loss.

Device Failure:

A device failure is a problem with a mechanical device such as a disk drive. Storage devices fail as a result of power or circuitry problems.

A diagram showing a formatted disk surface



Qn: Find out about the characteristics of the following storage media:

-) Hard disk
-) Floppy disk
-) Magnetic tapes
-) Optical disks

COMMUNICATION DEVICES

Communications devices enable two or more computers to exchange items such as data, instructions, and information with each other. The primary function of a communications device (e.g., a modem) is to convert or format signals so that they become suitable for the communications channel or a receiving device.

A communication channel is the communications path between two devices.

Some of the more common types of communications devices are:

a) Modems:

A **modem** is a communications device that converts between analog and digital signals. The word modem is derived from a combination of the words **modulation** and **demodulation**.

-) **Modulation** is to convert digital signals into analog signals
-) **Demodulation** is to convert analog signals into digital signals.

A modem connected to a sending computer converts the computer's digital signals into analog signals (i.e., modulation), which can travel over a communications channel (e.g., a telephone line). Another modem at the receiving end converts the analog signals back into digital signals (i.e., demodulation) that can be understood by the receiving computer.

A modem can be **external** or **internal**. An external modem is a stand-alone device that attaches to a serial port on a computer with a cable and to a telephone outlet with a standard telephone cord. An **internal modem** is an expansion card that can be inserted into an expansion slot on a computer's motherboard; and the modem then attaches to a telephone outlet with a standard telephone cord.

Most personal computer modems transmit data between 28.8 Kbps and 56 Kbps. Many modems today are also fax modems because they can send computer prepared documents as faxes and also receive faxes.

Examples of modems include:

-) Dial-up modems
-) ISDN (**I**ntegrated **S**ervices **D**igital **N**etwork) modems
-) DSL (**D**igital **S**ubscriber **L**ine) modems
-) Cable modems

) Fax modems

b) Network Interface Card

A **network interface card (NIC)**, or **LAN adapter**, is an expansion card that enables a computer or device to connect to a network. Most network interface cards require a cable connection and have connectors on the card for different types of cables. The Ethernet card is the most common type of network interface card. The transfer rate on an Ethernet network can be 10 Mbps, 100 Mbps, or 1,000 Mbps. Some **NICs** are also a combination of Ethernet and dial-up modem card.

c) Hub:

A **hub**, also called a **concentrator** or **multistation access unit (MAU)** is a device that provides a central connecting point for cables that run to the server and each of the devices in a network. It allows devices such as computers, printers and storage devices to be connected to the server.

d) Gateway:

A **gateway** is a combination of hardware and software that allows users on one network to access resources on a different type of network. Gateways connect networks that use different protocols.

e) Bridges:

A bridge is a device that connects two LANs using the same protocol, such as the Ethernet. Sometimes, it is more efficient and economical to use a bridge to connect two separate LANs, instead of creating one large LAN that combines the two separate LANs.

f) Routers

A **router** is an intelligent communications device that sends (routes) communications traffic to the appropriate network using the fastest available path. A router is used to connect several networks.

COMPUTER SOFTWARE

Software is the series of instructions that tells the hardware how to work. Software is often called a **computer program**. Most software needs to be installed onto the hard disk before it can be used, but some can be loaded into memory directly from the storage media.

The two categories of software are system software and application software.

The various forms of software available are:

- i) **Packaged software** is commercial software, which is copyrighted and designed to meet the needs of a wide variety of users.
- ii) **Custom software** is tailor-made software, which is developed at a user's request to perform specific functions.
- iii) **Freeware** is copyrighted software provided at no cost to users.
- iv) **Shareware** is copyrighted software that is distributed free for a trial period, and payment is required for using the software beyond that trial period.
- v) **Public-domain software** is free software donated for public use and has no copyright restrictions.
- a) **APPLICATION SOFTWARE**

Application software refers to programs that perform specific tasks for users using a variety of application programs. Most application software is available as packaged software that can be purchased in retail stores or on the Web. Many application software packages are also available as shareware, freeware and public domain software. However, such packages usually have fewer capabilities than packaged software.

Various application software programs are used to design letters, posters, cards, produce budgets and financial statements, store records in a database etc. Application software is further broken down into the following:

- i) **Customized application software:**
These are specific software programs designed to perform specific tasks for users. For example a Payroll package to compute salaries of employees, an inventory program to control stock of assets, books, etc. Custom made software is designed to address specific processing needs of users and organizations. It is also referred to as **tailor made** software, **custom made** software.
- ii) **Off-shelf application software:**
These are programs designed to solve a variety of tasks. The common types of off-shelf application software include:

Word processing software, also known as a **word processor**, is used to create, edit, format, save, and print documents that contain text and graphics.

Examples of word processing documents include letters, memos, reports, mailing labels, and newsletters. Many word processing software is also capable of creating Web pages.

Popular word processing software includes **Microsoft Word**, **Lotus WordPro**, and **Corel WordPerfect**.

Advantages of word processing software over ordinary typewriter include

-) Easy and fast to make changes to the document.
-) Has many features to create documents that look professional and visually appealing.
-) Documents can normally be previewed before being printed.
-) Documents can be saved for future use and editing.
-) Convenient to create form letters and mailing labels.

Differences between operating a word processor and an ordinary typewriter include

-) A word processor prints the entire document at a time while an ordinary typewriter prints one character at a time.
-) A word processor automatically moves the cursor to the beginning of the next line when text extends beyond the right page margin while the user needs to advance the lever manually when using an ordinary typewriter.

Spreadsheet software is used to organize data in rows and columns, and perform calculations on the data. A spreadsheet document is often called a **worksheet**. On each worksheet, data is organized vertically in **columns** and horizontally in **rows**. Each column is identified by a **letter** (i.e., A, B, C, ...) and each row is identified by a **number** (i.e., 1, 2, 3, ...). A **cell** is the intersection of a column and a row. Each cell has a unique **cell address** (e.g., A1) to define its location on the worksheet. The **upper-leftmost cell** is generally identified as **A1**. A cell can be empty, or contain a label, a value (i.e., a number) or a formula.

Labels are text that identify the data and help organize the worksheet.

Values are numbers to be used for calculations.

A **formula** performs calculations on the data in the worksheet, and displays the resulting value in the cell that contains it.

Popular spreadsheet software includes **Microsoft Excel**, **Lotus 1-2-3**, and **Corel Quattro Pro**.

Advantages of spreadsheet software over manual worksheet include

-) Easy to make changes and corrections to data on the worksheet.
-) The rest of the worksheet is recalculated whenever data on a worksheet changes.
-) Operation is fast with the help of built-in functions and macros.
-) Calculation is always accurate, provided that data and formulae entered are correct.
-) Easy to create different kinds of charts, or to change chart types.

Presentation software is used to create **presentations**, which can communicate ideas and other information to a group of audience.

The presentation can be viewed as a **slide show**, which usually displays on a large monitor or on a projection screen. Some presentation software can convert an existing slide show into a format that can be accessed on the Web.

Popular presentation software includes **Microsoft PowerPoint**, **Corel Presentations**, and **Lotus Freelance Graphics**.

Advantages of presentation software include

-) Presentation software usually provides a wide variety of presentation formats and layouts for the slides.
-) Multimedia components such as clip art images, video clips, and audio clips can be incorporated into the slides.
-) The timing of the slides can be set so that the presentation automatically displays the next slide after a predetermined period of time.
-) Special transition effects can be applied between each slide.
-) The presentation can normally be viewed and printed in different formats.

Database Management Systems

A **database** is a collection of data organized in a way that allows access, retrieval, and use of the data. Common "paper

databases" include telephone books, dictionaries, recipe cards, and television guides. Computerized databases in Hong Kong include flight information phone inquiry system, and database system in the public libraries.

A **database software**, or a **database management system (DBMS)**, allows a user to create, access, and manage a database. Databases can be categorized into **flat file databases** and **relational database**.

A **flat file database** is made up of only one table.

A **relational database** can take information from two or more database tables and combine them into a new table or report.

Popular database software includes **Microsoft Access**, **Microsoft Visual FoxPro**, **Borland dBase**, **Lotus Approach**, **Corel Paradox**, and **Claris Filemaker Pro**.

Advantages and Disadvantages of Flat File Database and Relational Database

	Flat File Database	Relational Database
Advantages	▪ Easy to set up and use.	▪ Can access and combine information from more than one table. ▪ Changes made in one database table will be reflected in related tables without additional modifications.
Disadvantages	▪ Can only fulfill simple requirements. ▪ Information contained in one database table cannot be used in another database table.	▪ More complicated to set up and use.

Desktop publishing (DTP) software is used to design and produce complicated documents that contain text, graphics,

and brilliant colors. DTP software is ideal for the production of high-quality color documents such as newsletters, catalogs, textbooks, and annual reports.

Popular DTP software includes **Microsoft Publisher**, **Adobe PageMaker**, **Adobe In-Design**, etc

Advantages of DTP software over word processors include:

-) DTP software is specifically designed to support **page layout**, which is the process of arranging text and graphics in a document on a page-by-page basis.
-) DTP software includes **color libraries** to ensure that colors will print exactly as specified.
-) DTP software supports **colors separation** for producing the master copies used in the final presswork.

Web page authoring software is specially designed for creating Web pages that contain text and multimedia elements. Some Web page authoring software also includes the capabilities of organizing, managing, and maintaining Web sites.

Popular Web page authoring software includes **Microsoft FrontPage**, **Macromedia Dreamweaver**, **Adobe Go Live**, and **Adobe PageMill**.

Communications software consists of programs that help to establish a connection to another computer or network, and manage the transmission of data, instructions, and information between computers and other devices. Communications software usually includes one or more of the following features:

Dialing feature that allows a user to store, review, select, and dial telephone numbers to connect to another computer.

File transfer feature that allows a user to send one or more files from one computer to another.

Terminal emulation feature that allows a personal computer to act as a specific type of terminal, so that the user can connect to and access data and resources on a minicomputer or mainframe.

Internet access feature that allows a user to use the computer to connect to the Internet to send e-mail, participate in chat rooms, visit World Wide Web sites, and so on.

Software related to communications includes:

- a) **E-mail Software**

E-mail, or **electronic mail**, is the transmission of messages via a computer network such as a local area network or the Internet.

The message can be simple text, or can include an **attachment** such as a word processing document, a graphical image, an audio clip, or a video clip.

E-mail software creates, sends, receives, forwards, stores, prints, and deletes e-mail messages.

b) Web Browsers

A **Web browser** allows a user to access and view Web pages on the Internet. Most Web browsers also allow the use of other Internet services such as e-mail and chat rooms.

Two popular Web browsers are **Microsoft Internet Explorer** and **Netscape Navigator**. Others include **Opera**, **Mozilla Firefox**.

c) Instant Messaging Software

Instant messaging (IM) is a real-time communications service that notifies a user when one or more people are online and then allows the user to exchange messages or files with them.

An **instant messenger** program from an instant messaging service must be installed in order to use instant messaging. No standards exist currently for instant messaging. All those individuals involved, need to use the same instant messenger to guarantee successful communications.

Popular instant messengers include **Yahoo Messenger** and **MSN (Microsoft Network) Messenger**

d) Videoconferencing software

A **videoconference** is a meeting between two or more geographically separated people who use a network or the Internet to transmit audio and video data. A videoconference conducted over the Internet, using Web browsers and Web servers to deliver the service, is called a **Web conference**.

A videoconference allows participants to collaborate as if they were in the same room. Videoconferencing **software** along with a microphone, speakers, and a digital video camera attached to the computer are required to participate in a videoconference.

e) Chat room software

A **chat room** is a location on an Internet server that permits users to chat with each other by typing lines

of text on the computer. Some chat rooms support voice chats and video chats.

To start a chat session, a user must connect to a **chat server** through a **chat client** program on his or her computer. Most Web browsers also include a chat client.

Educational software is designed to teach a particular skill about any subject. Most educational software uses a computer-based training (CBT) approach, so that students learn by using and completing exercises with the software

Computer-aided designed (CAD) software is mainly used for creating engineering, architectural, and scientific drawings. Three-dimensional (3-D) CAD programs even allow users to rotate designs of 3-D objects in order to view them from different angles.

Popular CAD software includes **Autodesk AutoCAD** and **Microsoft Visio Technical**.

Accounting software is used to record and report financial transactions by companies. Accounting software can normally handle activities involved with the general ledger, accounts receivable, accounts payable, purchasing, invoicing, job costing, and payroll functions.

Popular accounting software includes **Intuit QuickBooks**, **Peachtree Complete Accounting**, **Pastel Accounting**, **Tally** and **Sage Accounting**

Multimedia authoring software combines text, graphics, animation, audio, and video into an application. Multimedia is widely used in video games, electronic newspapers and magazines, electronic books and references, simulations, virtual reality, and computer-based training.

Popular multimedia authoring software includes **Macromedia AuthorWare**, **Macromedia Director**, and **Macromedia Flash**.

Graphics and Image Editing Software is used to create and modify graphical and photo images.

Graphics software allows a user to draw pictures, shapes, and other graphical images using various tools such as pen, brush, and paint bucket, which come with the program.

Image editing software allows a user to retouch photographs, adjust or enhance image colors, and add

special effects like shadows and glows. Image editing software usually provides the capabilities of paint software as well as the capabilities to modify existing images.

Popular graphics and image editing software includes **Microsoft PhotoDraw**, **Paint Shop Pro**, **Adobe Photoshop**, **Corel Draw**, **Adobe Illustrator**, and **Macromedia Freehand**.

Besides the individual software application packages mentioned above, two approaches have been devised of sharing information among applications. They include:

Software Suites

A **software suite** is a collection of individual application software packages sold as a single package. A software suite usually includes application software: a word processor, a spreadsheet software, a database software, and a presentation software. Popular software suites include **Microsoft Office**, **Lotus SmartSuite**, and **Corel WordPerfect Suite**.

Advantages of software suites include:

- A software suite normally costs significantly less than purchasing each of the application packages separately.
- Ease of use because applications within a suite usually use a similar interface and share common features.
- Shorter development and training time for the applications

Integrated Software

Integrated software combines application programs such as word processing, spreadsheet, and database into a single, easy-to-use package. Like a software suite, the applications within the integrated software use a similar interface and share some common features. Unlike a software suite, the applications within the integrated software cannot be purchased individually.

The most popular integrated software is **Microsoft Works**.

Advantages of integrated software include

- Integrated software normally costs significantly less than a software suite, or purchasing each of the application packages separately.
- Ease of use because applications within a suite usually use a similar interface and share common features.

Disadvantages of integrated software include

- The applications within the integrated software normally do not have all the capabilities of stand-alone application software of the same kind.

SYSTEM SOFTWARE

System software consists of programs that control the operations of the computer and its devices. System software also serves as the interface between the user, the application software and hardware.

Some of the functions that system software performs are:

- Starting up the computer
- Loading, executing and storing application programs
- Storing and retrieving files
- Formatting disks
- Sorting data files, etc

Two types of system software are the operating system and utility programs.

UTILITY PROGRAMS

A **utility program** is a type of system software that performs a specific task, usually related to managing a computer, its devices, or its programs. Utility programs are also referred to as **service programs**.

Popular types of utility programs include:

- A **file viewer** is a utility that displays and copies the contents of a file. An operating system's file manager often includes a file viewer. File viewers list the names of files, sizes of files and date and time when the file was created as well as the folders. They can also be used to edit, copy, and move and delete files and folders. Examples include Windows Explorer, File manager, etc
- A **file compression utility** reduces, or compresses, the size of a file.
Compressed file takes up less storage space on a hard disk or floppy disk, which frees up room on the disk and improves system performance. Compressed files sometimes are called **zipped files** because they usually have a **.ZIP** extension. A compressed file must be **unzipped** or restored to its original form before being used.

A **file decompression utility** enlarges, or decompresses, the size of a file from the compressed state to a big size.

Two popular file compression and decompression utilities are **PKZIP** and **WinZip**; **PKUNZIP** respectively.

- A **disk defragmenter** is a utility that reorganizes the files and unused space on a computer's hard disk and floppy disk so data can be accessed more quickly and programs can run faster. When the contents of a file are scattered across two or more noncontiguous sectors, the file is **fragmented**.

The process of **defragmentation** is reorganizing the disk so the files are stored in contiguous sectors. Windows includes a disk defragmenter, called **Disk Defragmenter**

- An **uninstaller** is a utility that removes an application, as well as any associated files for that application from the computer system. One of the popular stand-alone uninstallers is **McAfee's Uninstaller**.
- A **backup utility** allows a user to copy, or backup, selected files or the entire hard disk onto another disk or tape. Backup files are usually not usable in their backup form because many backup programs will compress the files during the backup process. A restore program that is included with the backup utility reverses the process and returns the backed up files to their original form. Windows also includes a backup utility and a restore program.
- A **screen saver** is a utility that causes the monitor's screen to display a moving image or blank screen if no keyboard or mouse activity occurs for a specified time period.

Screen savers originally were developed to prevent a problem called **ghosting**, in which images could be permanently displayed on a monitor's screen. Screen savers can also be used for reasons of security, business, or entertainment.

OPERATING SYSTEMS

An **operating system (OS)** is a set of programs containing instructions that coordinate all the activities among computer hardware devices.

The operating system relies on device drivers to communicate with each device in the computer. The operating system also contains instructions to run application software.

Operating systems are usually stored on the hard disks of PCs. Therefore a computer cannot operate without an OS installed. Each time the computer is started, the most frequently used instructions (commands) in the operating system are transferred from the hard disk to memory.

Functions of an operating system include

a) Controlling Input and Output

Operating systems control the flow of data into and out of the computer system and to the peripheral devices. Input is directed to memory for processing while output is directed to the output and storage devices after processing.

b) Memory Management

The purpose of **memory management** is to optimize the use of RAM. The operating system has to allocate, or assign items to areas of memory, called buffers, while they are being processed; to monitor carefully the contents of these items in memory; and to clear these items from memory when they are no longer required by the CPU. Some operating systems use virtual memory to optimize RAM.

With **virtual memory (VM)**, the operating system allocates a portion of a storage medium, usually the hard disk, to function as additional RAM. The area of the hard disk used for virtual memory is called a **swap file**. The amount of data and program instructions swapped or exchanged at a given time is called a page.

c) Administering Security

Most multi-user operating systems require each user to log on. Both successful and unsuccessful log on attempts are often recorded in a file so the system administrator can review who is using or attempting to use the computer. Some operating systems also allow a user to assign **user ID (Identification) and passwords** to files so that only authorized users can open them.

A user ID is a unique set of letters and numbers that identifies a particular user on a PC. i.e. your initials, identity card number, employee registration number, etc.

A password is a unique set of letters and numbers known only to the PC and the user. Passwords are set by administrators of computer systems and later changed by individual users.

d) Managing Storage Media and Files

Most operating systems include a file manager program that performs functions related to storage and file management. A **file manager** is a program that performs functions related to storage and file management. The file manager arranges files on storage media in a File Allocation Table (**FAT**)

Functions performed by a file manager include:

- Formatting and copying disks.
- Displaying a list of files on a storage medium.
- Checking the amount of used or free space on a storage medium.
- Copying, renaming, deleting, moving, and sorting files.

e) Detects Equipment Failures

The OS monitors each hardware device and detects failures. During the booting process the OS detects any faults in each

device and displays error messages to the user such as keyboard failure, mouse not attached, Bad CMOS, to indicate a fault in the system. In other instances it produces sounds called beeps to indicate an error during booting.

f) Monitors system performance

The operating systems monitors the systems' performance using a program called a **performance monitor** to detect the status of each device and report failures and other information about various system resource and devices. The information in these reports can help users to identify system problems.

BOOTING A COMPUTER

Booting is the process of starting or resetting a computer, which involves loading an operating system into memory. Booting includes the sequence of events that occur between the time when you turn on a computer and the time when the computer is ready to accept instructions.

The two methods of booting are:

a) Cold Boot

A **cold boot** is the process of turning on a computer after it has been powered off completely. In the cold booting process all the devices are switched on. Cold booting usually happens at the beginning of the day or when power to the machine has been turned on.

b) Warm Boot

A **warm boot** is the process of restarting, or resetting, a computer that is already turned on. There are a number of reasons why computers are warm booted including:

-) A computer lacking enough memory and thereby using up all the available memory for programs and data during a processing task.
-) A program failing to run due to some missing files
-) A device failing to function when attached to a computer system.

Two methods of warm booting include:

- When using **Windows**, pressing the Ctrl+Alt+Del key combinations can perform a warm boot.
- Press the **RESET** button on the front of the system unit

The steps that occur during a cold boot using the Windows operating system are:

1. The power supply sends an electrical signal to the motherboard and other devices located in the system unit.
2. The CPU resets itself and looks for the ROM (Read Only Memory) that contains the **(BIOS) basic input/output system**, which is a sequence of instructions the computer follows to load the operating system and other files when the computer is turned on.
3. The BIOS executes the Power-On Self Test (POST) to make sure that the computer hardware is connected properly and operating correctly.
4. The results of the POST are compared with data in a CMOS chip on the motherboard.
5. If the POST is completed successfully, the BIOS looks for the boot program that loads the operating system.
6. Once located, the boot program is loaded into memory and executed, which then loads the kernel of the operating system into RAM.
7. The operating system loads system configuration information, and the remainder of the operating system is loaded into RAM, and the desktop and the icons display on the screen.

Popular operating systems for microcomputers include: