UNDERSTANDING COMPUTER THEORY BOOK FOR BOTH "O" AND "A" LEVELS

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TOPIC 1: INTRODUCTION TO COMPUTERS

Let us begin with the word **'compute'**. It means to '**calculate'.** Therefore, we may define computer as;

- **An electronic and a multipurpose machine which can accept data inputs, process data, output information and store information. Or**
- **It refers to an electronic device that processes a user's input usually referred to as data to a desired output also known as information. Or**
- **A computer is an electronic device that allows input of data, process that data, store and output results known as information to the user.**

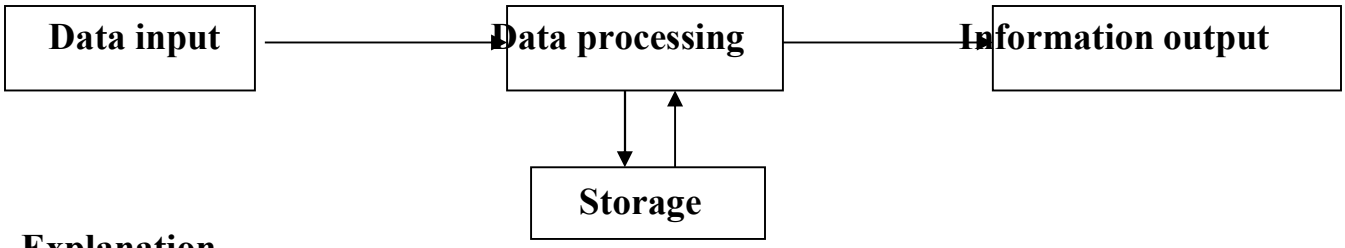
– **Data** can be defined as unprocessed facts (raw facts) or **data** refers to raw facts or figures that don't have much meaning to the user. And examples may include: **numbers, symbols, words or letters or text, images, music notes, student's score and sounds.**

– **Information** refers to the processed data that is meaningful to the user. **Or** The term information means organized and meaningful data

A computer like any machine or object has special tasks or functions to do which unifies it from others. It allows:-

- Data input
- Data processing
- Information output
- Storage.

All the above four tasks can be seen clearly in the **Information Processing Cycle** (I.P.C) which refers to the full set of operations that take place from the collection of data input to the availability of output (information) as shown below.



Explanation

Data is entered into a computer by use of input devices, the computer will process data or convert or manipulate our data into meaningful facts by use of processing devices and software.

After processing, we get information from computer (by using output devices) or store information (by using storage devices).

From the diagram above, you ask yourself one of the arrows from storage is facing up. This is because some of the storage devices can also be used to enter data into a computer for example **a digital camera.**

HISTORY AND EVOLUTION OF COMPUTERS

Before **computers** come into use, the ancient people had problems especially in counting the exact number of Cows, Goats, Sheep, Camels and Donkeys they had on farm. The only method that was available was the use of stones. If one had ten heads of cows or goats, he had to gather stones that were equivalent to the number of cattle. If a cow produced say two calves, he picked two stones and added on the heap. This was tiresome and storage of stones difficult. After a serious research, people invented some of the devices that could help them when making some simple calculations. These devices were mainly for calculations. The period when these devices were discovered and used is known as **the mechanical era or period.** A mechanical era **refers to a computer having moving parts.**

MECHANICAL ERA OR PERIOD (3000BC-1945)

Before electronic computers came into existence, several machines were used and developed by different people. These machines were made to solve some simple mathematical problems like addition, multiplication, subtraction and division. For example counting animals, years among others.

Some of the means of counting used before these devices were tiresome for example use of stones, sticks and small pieces of cloth. This made scientists to think of new simple means and devices which could simplify life. **The following were some of the machines developed during the mechanical era.**

- **Calculating Machines**

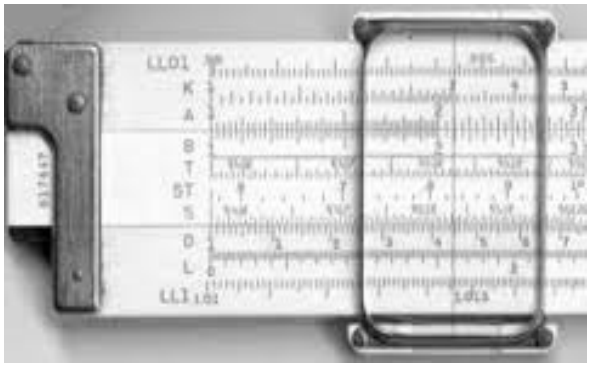
  It took over generations for early man to build mechanical devices for counting large numbers. The Egyptian and Chinese people developed the first calculating device called **ABACUS**. The word ABACUS means **calculating board.** The Abacus consisted of a rectangular wooden rack which had horizontal wires running from left to right. These wires had **beads** stuck on them. It is these beads that were used for simple addition and subtraction.

- **Napier's bones**

  English mathematician John Napier built a mechanical device for the purpose of multiplication in 1617 AD and used the principle of multiplication table we use today. The device was known as Napier's bones.

- **Slide Rule**

  In **1620**, a British mathematician called **William Oughtred** invented the first type of analog computer which was referred to as the **Slide Rule** this device was made up of **two** sets of scales. These scales were marked in logarithms. This Mechanical Computer could also solve mathematical problems involving multiplication, division, addition and subtraction. This could be done by sliding to and from.



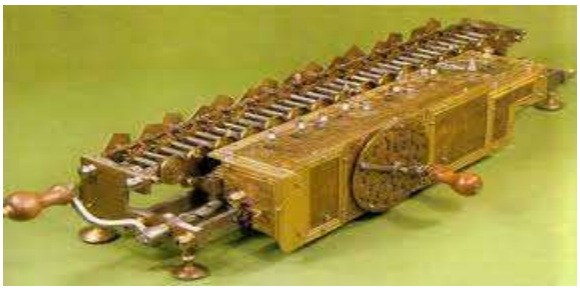
- **Mechanical Adding Machine/ Pascal's Adding Machine /Pascal's calculator**

  This Mechanical device was invented by Blaise Pascal; Pascal's father was a Tax Collector. Blaise Pascal had always wanted to come up with a more simplified way which his father would use to compute totals from taxes daily. In an effort to achieve this, Pascal invented the Mechanical Adding Machine. It consisted of toothed wheels which were numbered from 0-9. When one wheel moved past the notch of another wheel, it would cause it to automatically rotate

  You might have heard the name of Blaise Pascal. He developed a machine at the age of 19 that could add and subtract. The machine consisted of wheels, gears and cylinders.

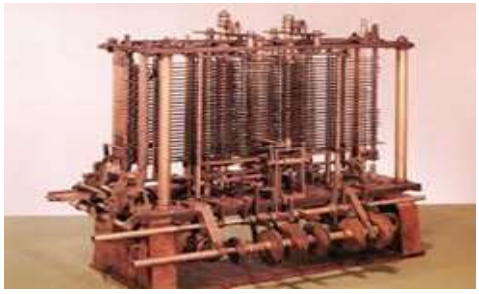
- **Stepped Reckoner (Leibniz's multiplier and dividing machine)**

  In 1672, the German philosopher and mathematician Gottfried Wilhelm Von Leibniz improved the Pascal's calculator by creating a machine that could multiply and divide. Like its predecessors, Stepped Reckoner worked by a system of gears and dials.



- **Analytical Engine**

  It was in the year 1837 that a famous English man Charles Babbage built a mechanical machine to do complex mathematical calculations. It was called **difference engine.** Later he developed a general-purpose calculating machine called **analytical engine.** You should know that Charles Babbage is called the **father of computer.**



- **The Jacquard loom**

  This was invented by Joseph Marie Jacquard French merchant and a weaver in the year 1801. This was developed for textile purposes since it could perform weaving (method used in textile industries to set threads at right angles and fix them to form a cloth). It used punched cards for storage of numbers of production.

- **Hollerith machine.**

  Herman Hollerith an American statistician used the concept of Jacquard loom and invented a machine which he named **Hollerith machine** in 1889. This machine used punched cards for data storage and was used during the United States census. Hollerith found a simplest way of carrying out the population census since the one carried out in 1880 spent almost seven years. The use of Hollerith machine simplified the process and the census took approximately 6 weeks. Due to his good achievement, Hollerith started a tabulating machine company (1896) that became an International Business Machine (IBM).

- **Electronic Computers (1945 to date)**

  The first computer on market was ENIAC by John W. Mauchly and J. Presper Eckert in 1946. ENIAC (Electronic Numeric Integrator and Calculator) is regarded as the first high speed electronic digital computer (EDC) and was between 1946 and 1956. It started due to the development of vacuum tubes.

COMPUTER GENERATION

This term is used to refer to the accumulation and advancement of computer technology over the years. **Or** the advancement of computer technology over different years is the one we call **computer generation or evolution. Or** this is the framework for the growth of computer industry.

There are four marked generations in computer development and a fifth one which was earlier writers/authors considered as the **future generation**. However, considering some of the characteristics and developments in computer technology which they had expected to occur in the fifth generation, looks like we are currently living in what was once thought of as the future generation of computers.

1. FIRST GENERATION COMPUTERS (1946-1956).

This major technological development of this generation was the **use of vacuum tubes**. Apart from the use of vacuum tubes for processing, **other characteristics of first generation computers included:-**

- They were very big in size hence consumed a lot of space.
- They consumed a lot of power (electricity) hence expensive.
- They generated or emitted or produced a lot of heat because of vacuum tubes.
- They were hard to maintain.
- Their processing speed was very slow because of having limited primary memory.
- They used punched cards to input data/instruction, output and store information.
- They used many wires.
- They produced a lot of noise during operation or working.
- Their hardware was centralized and had a fixed point (unmovable).
- They had a short life span.
- Their software was machine code language.

Some of the computers of the first generation included:-

- **The Electronic Numeric Integrator and Calculator (ENIAC)**

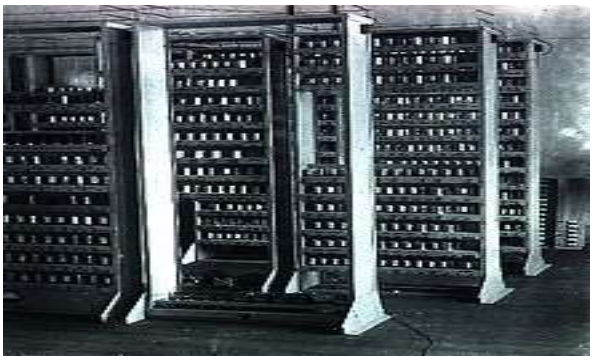
  In 1946, John W. Mauchly and J. Presper Eckert developed a high-speed computer, and named the Electronic Numeric Integrator and Calculator. The ENIAC laid a foundation for all the other computers of this generation.

- **The Electronic Discrete Variable Automatic Computer (EDVAC)**

  The improvements made on the ENIAC led to further advancement in computers hence the invention of the EDVAC by John Von Neumann. It was the first machine to have the instructions and data stored on the same unit. This was achieved by making both the instructions and the data reside in the memory unit.

- **The Electronic Delay Storage Automatic Calculator (EDSAC)**

  In1947, a British Professor Maurice Wilkes under the Mathematics Department at the University of Cambridge invented the EDSAC computer. It used a mercury delay line storage system to control its operations.



- **The Universal Automatic Computer (UNIVAC)**

  Due to its speed and processing power, the UNIVAC was ranked highest in the 1st Generation Computers. It was the first computer to be used commercially by the businesses and factories of the time. It was the first computer to carry out numeric and alpha-numeric data operations

2. SECOND GENERATION COMPUTERS (1956-1963).

The major technological development of this generation was the use **Transistors** by William Shockley, John Barden and Walter Brattain of Bell-Labs then the second computer generation begun. Their performance was a little bit better that that of the first generation.

They had the following characteristics:-

- They used transistors as their processors.
- Introduction of high-level programming languages e.g. COBOL (1960) and BASIC (assembly language).
- Increased processor speed compared to the first generation computers.
- Computers became less expensive because they were consuming less power.
- Computers gave off / produced / emitted / generated a lot of heat
- Computers were smaller in size
- Computers became more reliable compared to the first generation computers
- They consumed less power.
- The memory increased up to 32 kilobytes.

Some of the computers in the Second Generation include

- Livermore Automatic Research Computer
- IBM 7030

3. THIRD GENERATION COMPUTERS (1964-1971).

The major technological development was the **introduction of Integrated Circuits** (ICs) as their processors in order to solve the problems which were associated by transistors. This was invented by Jack Kirby together with Robert Noyce in 1965.

Other characteristics of this generation included:-

- Introduction of Operating Systems e.g. MULTICS
- Higher storage capacity than the previous generation
- Introduction of peripheral devices such as Optical Scanners
- Introduction of remote processing i.e. a user could access a computer which he/she is not physically seated at.
- Consumed less power compared to previous generation computers.
- They were smaller in size
- Development of the PASCAL Programming language (third generation language) by Nicholas Wirth
- Computers became cheaper.
- They were much reliable than the previous generation computers.
- They emitted less heat.
- They were much speedy than the previous computer generations.

4. Fourth Generation computers (1971 to 1990s)

The development of **Microprocessors** brought the fourth generation of computers as thousands of integrated circuits were onto a single silicon chip. The design produced what is called **large scale integration (LSI)** and **very large scale integration (VLSI)** circuits. Which were used in the innovation and technological development of the brain of the computer called the **microprocessor or Central Processing Unit (C.P.U).** Fourth generation also saw the development of **GUIs** (Graphical User Interface)

Other characteristics in this generation included:-

- Introduction of Large Scale Integration (LSI) and Very Large Integration (VLSI)
- Introduction of multi-media programs using sound and video devices appeared on the market.
- They much more portable and movable like Laptop computers were introduced around 1988.
- Introduction of the INTEL special purpose processor around 1997.
- Smaller in size
- Cheaper in cost
- Increased processor speed hence faster than previous generations.
- Computers can be linked together to form a network which led to the development of internet.
- There is development of graphical user interface operating system which supports the use of mouse and other hand held devices.
- Computers emit less heat compared to previous ones.
- They are easy to use and maintain.
- Limited artificial intelligence.

5. FIFTH GENERATION COMPUTERS (present and future/ beyond)

Fifth generation devices based on artificial intelligence are still under development. The major target of fifth generation is to develop devices which can respond to natural language input and are capable of learning and self organization.

Some of the expected characteristics of the future generation included:-

- More widespread use of the Internet
- Increased applicability of Artificial Intelligence
- They will use artificial intelligence
- They are and will be cheaper than the first four generations.
- Instructions to computers will reduce.
- Introduction of expert systems.
- Power consumption will reduce.
- Superior devices or hardware and software will be used.
- Will use natural languages which are spoken by humans.
- Will be very small in size.
- High storage capacities.

CHARACTERISTICS OF MODERN COMPUTERS

1. **Speed.** Computers are fast compared to man. They process a lot of data in micro seconds. They are composed of microprocessors that process data in **hertz** or **millions of instructions per second (MIPS).**
2. **Accurate.** Computers are known to accurate that they hardly make mistakes. In fact computers are capable of detecting and correcting any mistakes made. The computer will work on what has been given to it. It allows therefore that if wrong date is fed or entered into the computer, wrong results are expected out. That is where we get a saying **Garbage in Garbage out** (GIGO).
3. **Diligent (consistent).** Computers are said to be diligent simply because they can execute the same task over and over without getting tired or bored. There is no day a computer will show a message that it is tired. It can work for 24 hours without getting tired unlike human beings who work and get time to rest.

4. **Storage.** Computers have the capability to store what they have processed or what the user wants to keep. Computers have a storage space where data is stored temporarily for example **Random Access Memory** (RAM) which provides a work space before processing and permanently after processing for example **hard disk** (HDD).
5. **Automation.** A computer is known as an automatic machine which can do tasks on its own without close supervision but rather service when it breaks down. For example if you program a routine playing music by organizing a playlist.
6. **Versatility.** Computers are capable of accepting all kinds of data unlike calculators for instance work with only numbers but for the case of computers work with all kinds of numbers, but also with text, images or graphics, sound, video, audio etc. therefore, a technological term or concept that combines text, numbers, images or graphics, video, audio, sound and animation is the one we call **multimedia.**
7. **Artificial intelligence.** Computers are artificially intelligent because they can respond to requests given to them and provide solutions.

ADVANTAGES OF COMPUTERS IN OUR SOCIETY

- Computers are very fast in doing work and thus very good when carryout communication (sending e-mail, video conferencing etc).
- They are very good in the entertainment area since they can play all kinds of music.
- They are better in storing data because of big storage space and provision of data passwords.
- Browsing internet is simple and fast on computers.
- Computers are very good when carrying out medical operations and medicinal testing.
- They automatically do industrial work better than humans.

- Computers can o various functions in a home i.e. providing security, learning and killing boredom.
- Due to introduction of artificial intelligence, computers are used to operate in businesses, factories and hospitals.

DISADVANTAGES OF COMPUTERS IN OUR SOCIETY

- They have created unemployment by replacing human resource in workplaces.
- They are expansive in terms of costly devices, computer programs and computer knowledge or skill acquisition.
- They have lead to health hazards like eye defect, back pain, headache if you over use them.
- They lead to moral decay due to high spread of pornographic materials shown on the internet.
- Computers lead to high crime rate people use them to cheat others or for forgery of paper money, academic documents etc.
- They have increased dishonest among people. A lot of false communication.

CLASSIFICATION OF COMPUTERS

(Types of computers)

Classification of computers **refers to the consideration of computer depending on the size, generation and storage capacity.**

1. **Classification computers by processor power.** Computers defer in terms of speed which is derived from the power of microprocessor build inside and classified based on the speed of its microprocessor chip that has an operating clock speed that help it measure how fast the processor works. The higher the processor speed, the faster the computer in terms of processing data.

The commonly known processors are; Intel Pentium I, Intel Pentium II, Intel Pentium III, Intel Pentium IV, Intel Pentium M, Intel Pentium N, Duo core, Celeron processor, AMD etc. **other processors are;** 8086, 80286, 80486 developed in 1993.

2. **Classification by function.** Computers are also constructed on how they process their information. They are **digital, analog and hybrid computers.**
   a) **Digital computers.** Refer to computers that process data that is in form of digits or values. **Or** these are computers that process data that is discreet in nature e.g. (0, 1, 2……9). **Examples include;** digital watches, digital calculators, digital petro pump, all micro computers, digital video cameras etc.
   b) **Analog computers.** These are computers that process their data in a continuous form or measurable quantities. They are used in scientific research centers, measuring pressure, time, communication and broadcast transmission. **Examples include;** voltmeters, thermometers, speedometer, wall clocks, slide rule, galvanometers etc.
   c) **Hybrid computers.** These are computers that incorporate both digital and analog computer processes. **Or** hybrid computers are computers with a combination of both digital and analog computers.
3. **Classification of computers by purpose.**
   a) **Special purpose computers.** These are computers designed to perform or do specific task. You cannot use them to do other tasks because they are restricted by nature. **They include;** ATM (Automated Teller Machine), Traffic lights controls, missiles, Bombs, lifts etc.
   b) **General purpose computers.** These are multipurpose computers designed to do or perform all work or tasks given to them. But their functionality depends on the installed software. For example is you want a computer to write/ burn a compact disc, you need to install burning software like a shampoo burning studio.

Examples of general purpose computers include; **desktops, palmtops, laptops and others.**

4. **Classification of computers by size.**

- **Mainframe computers.** These are the biggest computers which can accommodate many users up to 1000 people. They are used by governmental organizations, large organizations and companies like **hospitals, banks, airports etc** for critical applications, bulk data processing such as census, industry and customer statistics, enterprise resource planning and transaction processing. They have large storage capacity and can support a variety of peripherals. They share one system unit or processor but operate with separate monitors, keyboards and mice. The challenge with mainframe computers is that they consume a lot of power, generate a lot of heat and noise in the working environment.

- **Mini computers.** They resemble mainframe but slightly smaller and less expensive. They accommodate up to a hundred (100) people or users at a time. Although they support fewer peripheral devices and are not as much powerful and fast as mainframe computers, they were designed as cheaper alternative to mainframes for smaller organizations. They are used mainly in scientific laboratories, research institutions and also commonly used in medium sized organizations like telecommunications companies, institutions for higher education, government ministries, banks and private industries.

- **Super computers.** They are very fast, expensive and most powerful computers and were introduced in 1960s (second generation). They are able to perform many complex operations in a fraction of a second. Because of their weight, they are kept in a special room. Due to their huge processing power, they generate a lot of heat. They are mainly used in scientific research which requires big calculations. They are commonly used in fields such as petroleum research, defense and weapon analysis.

- **Micro or stand alone computers.** These are sometimes called **personal computers** (PCs). They are the smallest, cheapest, relatively least powerful type of computers and allow one user at a time. They are called microcomputers because their CPU is a called **a microprocessor,** which is small, compared to that of mini, mainframe and super computers. The user has his or her system unit, keyboard, mouse and monitor and this implies that all the resources are allocated to a single user. Micro computers are commonly used in training and learning institutions, small business enterprise, communication centers etc. the first personal computer is **IBM (International Business Machine).**

There are many types of personal or micro computers on market today which includes;

- **Desktop computers.** They are commonly placed on top of the desk. The system unit placed on top of the desk and the monitor is placed on top of the system unit. **Or** a system unit besides the monitor.

- **Laptop computers.** These are portable and movable computers. They are called laptops because **they are normally placed on lap.**

- **Personal Digital Assistants (PDAs).** These are hand-held devices that allow for portable access to contacts, calendars, e-mail and other data that may be stored on desktop computers or on centralized information servers. PDA is a term for any small mobile hand-held device that provides computing and information.

- **Notebook computer.** This is a recent version of a laptop, small in size but having almost all the features of a laptop. The major difference is that notebook computers lack CD and DVD drives.

- **Palmtop computers.** These are smaller that laptop computers and can fit on a palm.

INFORMATION AND COMMUNICATION TECHNOLOGIES (ICTs)

This is the use of communication devices like radio, television, cellular phones, computers, network hardware and software to deliver information to the people. **Or**

ICT is the use of technological tools to create, modify and communicate information. **Or** ICT can also be defined as a set of technological gadgets which can be used to create, modify and communicate information.

Note that ICT does not concern about computers only but go beyond the use of computers and look at the use of radios, televisions, phones and internet.

The following are some of the communication tools;

- Computers
- Radios
- Televisions
- Cellular phones
- Internet

COMPUTER APPLICATION AREAS

1. **Education.** Computers can be used for research and online learning, examination processing, online resources like books, dictionaries, record keeping etc.
2. **Business.** Computers are used for secretarial beaux or services like typing, scanning, printing and much more. They can also be used for electronic commerce (e-commerce) where commodities are purchased online, improved means of record keeping, fast advertisement etc.
3. **Security.** Computers have improved security in the following;
   - Identification cards. Computers among ICTs can be used to design cards that can help when identifying people in the country and this has improved security since people fear to commit crimes.
   - Investigation. This can be done by use of **biometrics etc.**
   - Ue of CCTV cameras.
4. **Banking.** At the dawn of the 20th Century, it became almost impossible to run a bank without computers. Computers are a vital set of equipment for the effective running of a bank. They are used for a number of activities like maintaining accounts, balancing books of accounts, online banking and keeping records for all the banks' clients in terms of their personal data, account numbers, and their deposits and withdrawals on their respective accounts.
5. **Entertainment and Recreation.** In our Leisure time, most of us prefer to go to various recreation sites to relax our minds. Places like amusement parks, Casino's and other Gambling places run some of their machines using computers. Some computerized toys like Play Stations, Video games are a source of entertainment. Computer games like Solitaire, Tetris, Free Cell, Packman etc. are forms of entertainment.

6. **Police.** In many of the countries in the World, the police department uses computers to do most of their work. For example the Traffic Police use computer-controlled traffic lights to control traffic flow on the roads, speed sensors are also used to find over speeding drivers.

   The Criminal Investigation Police Departments (CID) use computers to track suspects, interview suspects and store most of the information they get.

7. **Military.** Computers are used in manufacturing of bombs, scared missiles, land mines, electronic machine guns etc.
8. **Hospital/Health.** In big modern hospitals especially in the developed countries, over 95% of the hospital undertakings are computerized e.g, admissions into the hospital are entered in computers, the health condition of patients in the emergency rooms, intensive care units and operation theatres is monitored using computers.
9. **Transport.** All the known modes of transport use computers in one way or another. For Air transport, computers are used at the airports to take record of all the flights and passengers for each and every place that will fly off or land at that Airport.

   Used for security check-Ups at the Airport, e.g. to check whether one is smuggling in or out weapons for war, drugs, etc.

   While inside the Aeroplane, computers are used to give the pilot sense of direction by indicating how high he is flying, the temperatures, the pressure and weather conditions of the space in which he is flying. They also show some physical features which could obstruct the planes movements.

   In the cars, we have the speedometer, which determines at what speed the car is moving.

   In a ship, computers are used to guide the captain movements while he sails. By showing the landscape of the sea bed, the captain is able to draw the right direction and bearing in which he should sail the ship.

10. **Industries and factories.** Computers can be used in the production process, packaging process and recycling process. They can also be used in tasks like branding products, locking bottle tops, filling containers etc.
11. **Communication.** Computers here can be used for sending and receiving of e-mails.
12. **Homes.** In the first world countries every home, however small has a machine or two which falls in the category of a computer e.g Washing Machines, Dish Washers, Microwaves, Baby Monitors etc. Some very rich people in the third world countries can also afford such machines. These machines can automatically carry out tasks that would have been carried out by human beings.

    In other cases, there are computers in form of PCs which are used for communication, budget planning, data storage, playing and training e.tc.

THE COMPUTER SYSTEM

A computer system is a set of interconnected components which include;

1. Hardware like system unit or case, microprocessor, motherboard, power supply, CD/DVD Drives etc.
2. Software
3. Human ware (user)
4. Data

FACTORS TO CONSIDER WHEN PURCHASING A COMPUTER SYSTEM

1. **Cost.** The cost of the computer depends on:

- **It's processing capability.**
- **Its size.** Portable computers are more expensive than the desktop computers.
- **Whether it branded or clones.** Branded computers are more expensive than their equivalent clones.

2. **Microprocessor type and speed.** The speed, processing power and cost of the computer mainly depends on the type of a microprocessor and its clock speed.
3. **Monitor.** Choice of the monitor may depend on the size, resolution and technology used on it. These days flat screen monitors are commonly used than CRT (Cathode Ray Tube) monitors.
4. **Portability.** Portable computers such as laptops, PDA's are ideal for people who don't take most of their time in office.
5. **Multimedia capability.** Multimedia capability refers to the ability of a computer to process and output text, sound, video, audio and pictures. A multimedia system consists of speakers, CD/DVD drive and sound card.

6. **Upgradability and compatibility.** The hardware bought must be compatible across all platforms (technologies) and easily upgradable.
7. **Warrant.** A warrant is an agreement between the buyer and the seller that shows terms and conditions of, after selling a product in case of failure or malfunction.

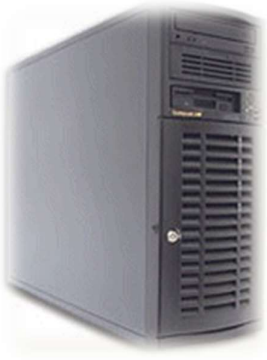
   A good warrant should cover the following points;

   - Scope of cover for example six months, one year etc.
   - Preventive maintenance for example regularity of service at intervals etc.

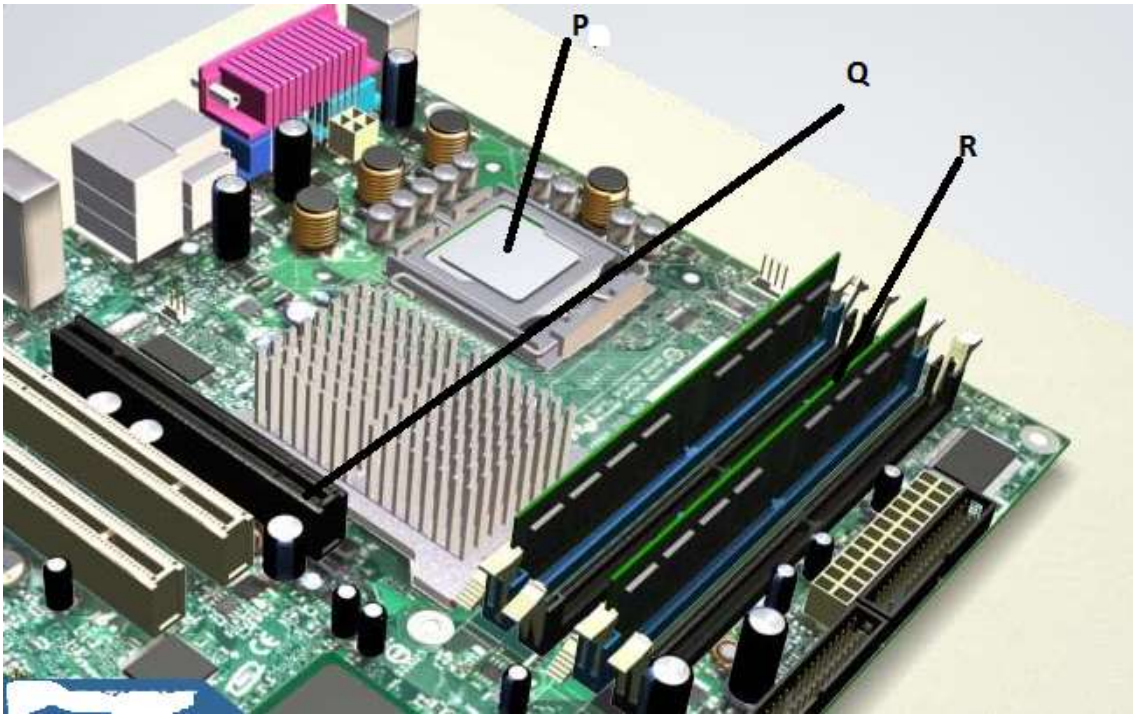
TOPIC 2: COMPUTER HARDWARE

Computer hardware refers to the physical components or parts that make up a computer. **Or** they are the tangible parts of the computer system that can be seen with the ordinary eyes. Like System unit or case, microprocessor, power supply, motherboard, hard disk, main memory, video card, CD/DVD drives etc.

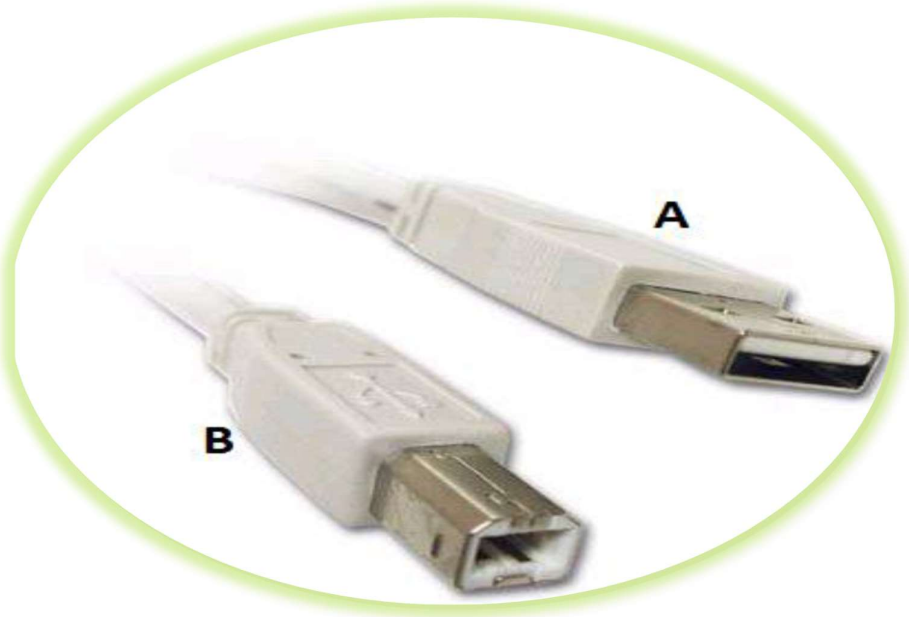
a) System unit or case. The computer is housed inside of what is called **the computer case.** Therefore, a system unit by definition is a box or casing that that contains the internal components of a computer. **Or** this is a rectangular case or box that houses all the internal components of a computer. These components include **hard disk, microprocessor, slots, ports and connectors, data buses, motherboard, CMOS Battery etc.**



- **The motherboard.** This is the main circuit board of a computer where most of the internal components are attached or connected or fixed. For example **RAM chips, processor, CMOS battery, slots, NIC, sound card, video cards, power supply etc.**



- **Ports and connectors.** A port is a device with a hole where other devices can be connected. They are commonly found on the outside part of the system unit. They include; **USB ports, serial ports and parallel ports.**
  - **USB (Universal Serial Bus) ports.** These are connectors that support newer peripherals and plug and play devices such as mice, keyboards, digital cameras, printers, personal media players, flash drives, and external hard drives onto the computer system unit. USB standard uses "A" and "B" connectors.

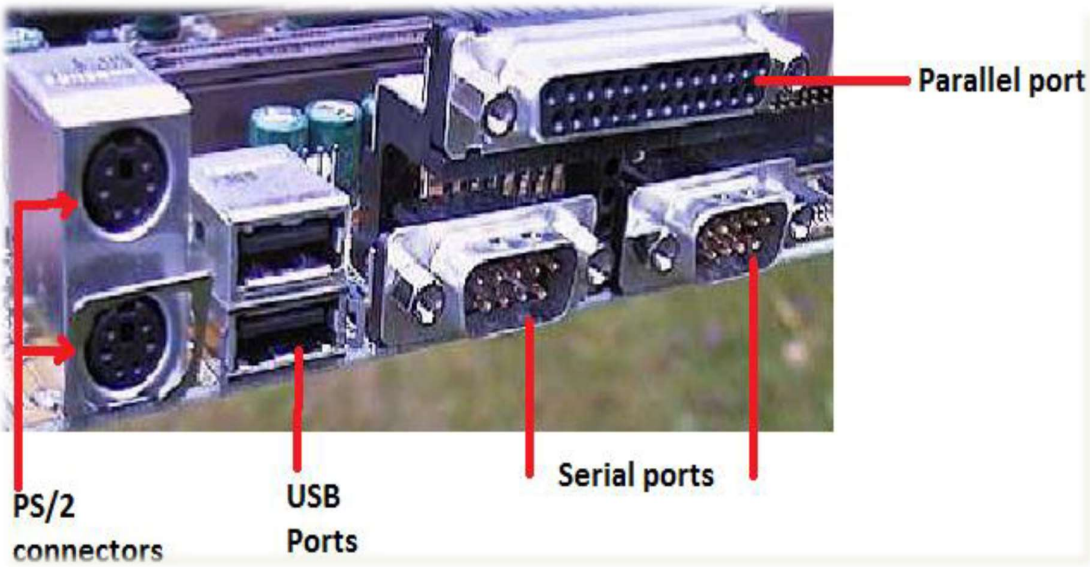


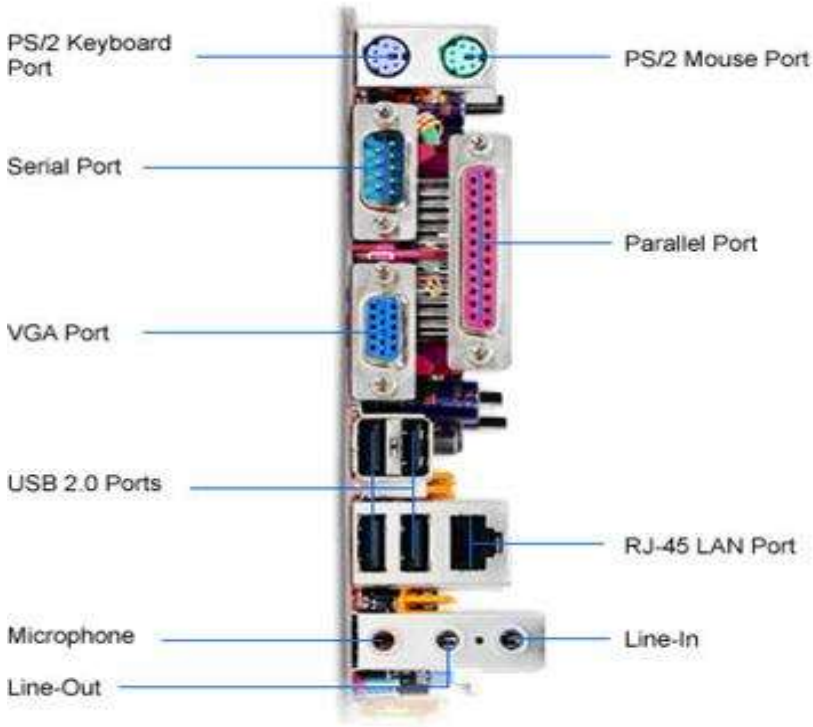
  - **Serial parts.** Serial cables and ports transmit one bit of data at a time (in series). Serial ports are used to connect slow speed devices like the mouse, keyboard, and communication devices such as the Modem. It also allows VGA cable to be connected.

– **Parallel ports.** Parallel cables and ports transmit 8 bits at a go (in parallel) as opposed to serial transmission.

  Parallel ports and cables are normally used to connect devices that send or receive large amounts of data such as printers, scanners, External hard disk drives, external CD/DVD drives, speakers and microphone ports.

TYPES OF PORTS





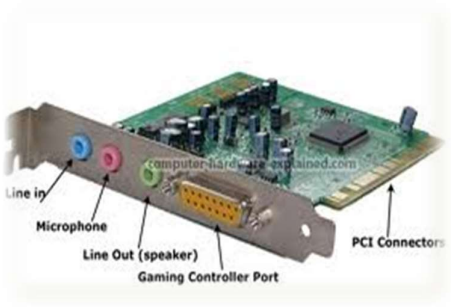
b) Card slots. Alternatively referred to as **expansion slots,** an expansion slot is a socket on a PC motherboard designed to hold a circuit board called **an expansion card. Or** it is a slot located inside a computer on the motherboard that allows additional cards to be connected to it.

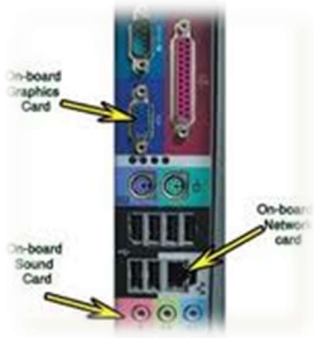
Expansion Cards (adaptors)

Expansion cards therefore are circuit boards that are plugged into slots on a PC motherboard to add extra functions. **Or** cards are components added to computers to increase their functionality. When adding a peripheral device, make sure that your computer has a slot of the type needed by the device.

Examples of cards:

- Network
- Video
- TV
- Sound





c) **CMOS Battery.** Complementary Metal Semi-Conductor is a device that stores information about the computer like current time and date. The CMOS battery is a device that helps the CMOS to retain its content when the computer is switched off by powering it up.

d) **Buses.** These are communication channels (wires) between the CPU and other devices in the system unit. Data buses allow data move from one device to another.

e) **Power supply unit (PSU).** This is a hardware device in the computer system unit that is responsible for supplying the required amount of power to the computer components. It converts the alternating current (AC) to direct

current (DC) that can be used by the computer. It is linked or connected to the power socket with the aid of a power cable from the external and is linked to the motherboard and other primary and secondary devices.

NOTE:

Note that there is also another important external device called **stabilizer** and is a device that regulates the flow of current that is being used by the computer. It ensures that when power voltages go down, the computer remains functioning normally and when power voltages go high, it steps down and prevents damages to the computer set.

Hardware components can be put in the following categories;

1. Input devices
2. Output devices
3. Storage devices
4. Processing devices
5. Communication devices

INPUT DEVICES

These are devices that feed the computer with data as well as give it commands. **Or** these hardware devices that transfer data to a computer. **Or** these are devices that help a computer user to enter or feed data into a computer. **Or** these are hardware devices that allow a user to enter or feed data into a computer.

These devices convert user input which is in human readable form to machine language that a computer can process.

They include the following;

- The keyboard
- The mouse
- Light pens and stylus
- Point of scale terminal
- Bar Code Reader

- Scanner
- Voice recognition system/ voice recognition device
- Touch screen
- Digitizers (Graphic tablet)
- Digital image recorder
- Joystick

1. **The keyboard.** It is simply a device that is used to enter data into the computer when a key is pressed or stroked. **Or** this refers to the almost rectangular device that is made up of buttons or keys that represent over 104 characters designed to represent special standardized electronic codes that are displayed when the keys are stroked or pressed.

Structure of a Keyboard

Most keyboards have keys arranged in five groups:

- **Alpha numeric area.** This is a typing area that includes the letters of alphabet, numbers, punctuation marks, upper characters like @, #, $, ^, &, *, %, ! e.t.c and other keys like enter key, backspace key, spacebar and others.

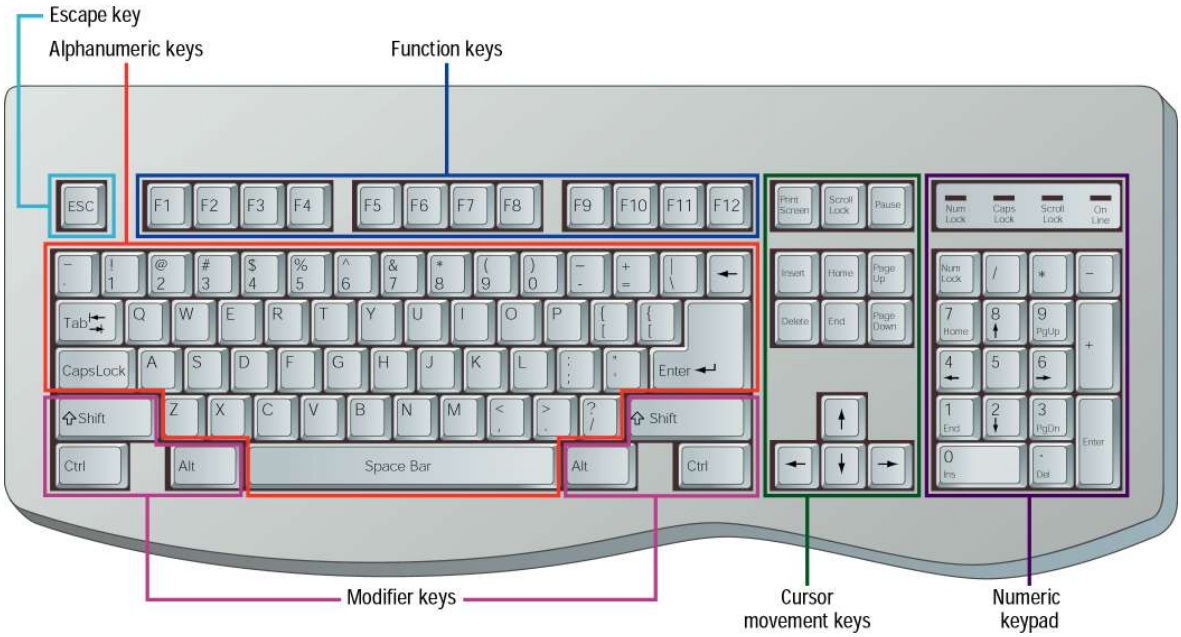
- **The numeric pad area.** This is located on the right hand side of the keyboard in a calculator like format. It has keys with numbers from **0-9** and mathematical operators like **+, -, *** and **/.**This area is activated by stroking a key labeled **Numlock** and some light will be seen to show that the area is activated. The numeric pad area has got some navigation keys which are labeled **8, 6, 2** and **4**with arrows. These keys are activated by locking the number keys using **Numlock** key.

- **The function key area.** This area is made up of keys labeled **F1-F12.** It is found at the extreme top of the keyboard just above the **upper characters.** These keys have special functions for example **F5** refreshes the computer, **Alt + F4** shuts down the computer and others. They represent several shortcuts when used in line with control, alternate and shift keys or buttons.

- **Cursor-movement keys (navigation keys) area.**

These are four keys labeled with arrows facing in different directions or sides of the keyboard. They are used to move the cursor/insertion point in a page. They can also help you scroll around the page just like a mouse.

- **Modifier keys.** These include Shift, Alt and Ctrl keys which are used in combination with other keys to execute functions.



TYPES OR KEYBOARD LAYOUT

1. **QWERTY.** This is a standard layout of letters, numbers and punctuation that is known as **QWERTY** because they first six typing keys on the top row of letters spell **QWERTY.** The QWERTY keyboard was designed in 1800s for mechanical typewriters and was actually designed to slow typists down to avoid jamming the keys on mechanical units.

2. **AZERTY.** This is the French version of the standard QWERTY layout. AZERTY keyboards defer slightly from the QWERTY keyboard. For example the **Q** and **W** keys have been interchanged with the **A** and **Z** keys.
3. **DVORAK.** Another well-known design is the DVORAK, which has letters positioned for speed typing. Unlike the traditional QWERTY, the DVORAK is designed so that the middle row of keys includes the most commonly used letters in alphabet.

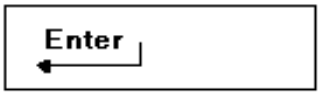
Ergonomic Keyboards

Keyboard ergonomic is a keyboard designed for comfort, ease of use and reduced strain on the user. Such keyboards may include features like concave or tapered keys or keys that are well spaced. These keyboards look like an inverse letter "**U".**

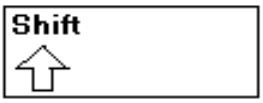
HOW A KEYBOARD WORKS

- When you press a key, the keyboard controller detects the keystroke.
- The controller places a scan code in the keyboard buffer, indicating which key was pressed.
- The keyboard sends the computer an interrupt request, telling the CPU to accept the keystroke.

SPECIAL KEYS ON THE KEYBOARD

a) **Enter key**. 

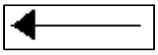
.Also referred to as the **return** key; it is located on the right-most side of the **Alphabetic Keys Area** of the enhanced keyboard. At times marked with a long arrow, it can be used to move the **cursor** to the next new line/paragraph in the document. Or it can be used to create a new sentence or execute a command. It can also be used to open a document or a file. There are two enter keys one found on the alpha numeric area and another one on the numeric pad area.

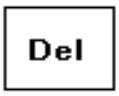
b) The shift Keys. 

There are **two** shift keys on the standard keyboard; one located on the left hand side of the **Typewriter Area/Alphabetic Keys Area** (below the Caps Lock Key) and another located on the right hand side of the **Typewriter Area/Alphabetic Keys Area**(below the Enter Key), hence the Left Shift Key and the Right Shift key. It usually has the words **Shift** and a thick upward arrow as seen above. Some keys on the keyboard bear more than one character such as the ones shown below.

In order for the user to activate or add the upper characters on these keys (#, $,!, %, @, *, &, ? < or >), he/she has to press down that key together with the **shift** key at the same time.

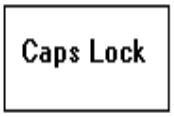
In other words, when pressed down together with another character bearing **two** characters, the **Shift** key activates the upper Character.

c) The Backspace Key  It is located on the right side of the **Alphabetic Keys Area** just above the enter key. It usually has the words Backspace and a long left arrow printed on its key button. When pressed down, it erases or deletes characters to the left or from right to the left on the same line.

d) **The Delete Key**  or  It is located in the section between the **Alphabetic Keys Area** and the **Numeric Key pad** just above the **Cursor Keys *Area***. It usually has the words **Delete** or **De**l printed on its key button. When pressed down, it erases or deletes characters to the right or in front of the **cursor**. Or the key deletes characters from left to right or at the cursor point or position. It also clears or deletes the selected text at once. It can also be used in conjunction with other keys to restart a computer

(Alt + Ctrl + Del)

e) The Space Bar. It is the longest/biggest/wide key on the enhanced keyboard. It is located on the bottom-most row or at the lower base of the **typewriter Area** with no character engraved or printed on it. When pressed down, the Space bar creates space between words or sentences when typing. It can also be used when running other programs like pausing music players.

f) **The Caps Lock Key.**  This is used to change alphabetical characters (**A-Z)** to be typed in Capital Letters when turned on or when it is

on and small letters when turned off or when it is off. In short it changes between Upper and Lower case or characters. It is located on the left side of the **Typewriter Area** just above the **left Shift Key**. It usually has the words **Caps Lock** or just **Caps** printed on its key button. In order for the user to know whether the Caps Lock is ON or OFF, he/she checks the **status light** above the words Caps Lock in the **Status Lights Area** i.e, when the light flashes green ON otherwise it is OFF.

g) Num lock Key. 

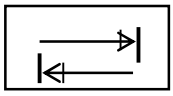
Each keyboard is built with a provision of extra numerical numbers that operate as a calculator. It is located in the top-left corner of the **Numeric Key Pad**. When turned on, it activates all the numeric characters and deactivates numeric characters when it is off in the **Numeric Keys Area or numeric keypads**. In other wards it activates and deactivates the numeric key pads. It usually has the words Num Lock printed on its Key button.

Just like the Caps Lock Key, the only way to find out whether the Num Lock key is turned on or off, is by checking the Status Light above the words **Num Lock** whether it is flashing green or not. When the Num Lock light emitting diode (LED) is flashing green it ON, otherwise it is off.

h) The Insert Key. 

It is located in the section between the **Alphabetic Keys *Ar***ea and the **Numeric Keys Area** just above the **Cursor Keys Area**- just above the **Delete** key. It usually has the words Insert printed on its key button as shown above.

It is commonly used when editing documents; if the user turns on this key, any further typing after the key has been turned on replaces/over writes what has already been typed. In other words, the **Insert** key is used to overwrite already existing characters.

i) **Tab key.**  This key is used to move the text cursor at set intervals on the same line. Or this helps cursor to skip equal gaps/space between words or sentences.

Other Keys include:-

- **Alt and Ctrl keys**: Used in combination with other keys to activate short cut menus.
- **Page up Key**: Moves cursor to the beginning of the current page.
- **Page Down**: Moves cursor to the bottom of the current page.
- **Home**: Moves the cursor to the beginning of the current line.
- **End**: Moves cursor to the end of the current page.
- **Esc**: Cancels the initially issued command.
- **Print screen:** Prints what is displayed on the screen.
- **Pause break:** Used to stop a running command temporarily when pressed alone which is resumed by pressing any letter key. And it is used for cancelling or aborting a command when you press ctrl + pause break while in MS DOS.
- **Keyboard status light.** These are Num lock, Caps lock and scroll lock.
- **Letter O and numerical 0.** These two characters must not be interchanged or confused during data entry. A zero is oval whereas letter O is circular or round.
- **Period (.).** Commonly known as full stop. It is used to separate file names from their extensions e.g. John.html, Dan.doc etc.
- **Forward slash (/).**It is used as a division sign in an arithmetic comparisons or operations.
- **Back slash (\).** It is used to separate the directory names when specifying a path to a certain file stored in the computer e.g.

C: **My documents\Biology\John.doc.**

- **Asterisk (*).** It is commonly called **a star** and is used as a multiplication sign.
- **Query (?).** It is commonly called **a question** mark. It is used to mean or stand for a single unknown character of no interest. It is also used to ask questions.
- **Cursor.** A cursor is a blinking block or under scope on the screen showing where typed characters go or are placed.

Some keyboard shortcuts

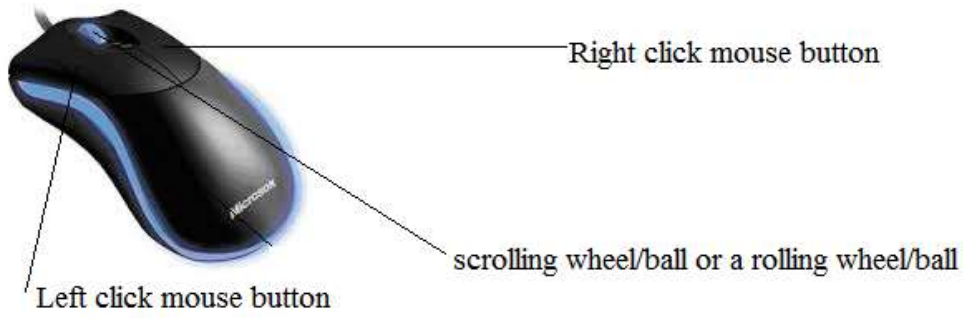
- ❖ Ctrl + S: Saves a document.
- ❖ Ctrl + C: Copy a document
- ❖ Ctrl + X: Cut a text
- ❖ Ctrl + V: Paste
- ❖ Ctrl + A: Selects the entire document
- ❖ F3: Search
- ❖ Shift + F3: Changes a text case in a file
- ❖ Ctrl + U: Underline a text in a text file
- ❖ Ctrl +E: Align text center
- ❖ Ctrl + B: Bolding text in a file
- ❖ Ctrl + Z: Undo last done action
- ❖ Ctrl + Y: Redo last done action
- ❖ Alt + F4: Close a file or a folder
- ❖ Etc.

2. **The Mouse.** The mouse is a pointing device that enables a user to execute commands. **Or** it is a pointing device that functions by detecting motion relative to its supporting surface. **Or** the mouse is a device that allows one to

control the movement of the insertion point on the screen. It is used to control the arrow displayed on the screen. To execute commands, the user moves the mouse which consequently moves the pointer on the screen.

TYPES OF MICE

a) **Desktop or optical mouse.** This uses LED (Light Emitting Diode) sensor beneath it to coordinate its movement. Some of the optical mice can be connected to the computer via the Bluetooth technique. And these are known as **wireless.** It is made up two buttons i.e. **Right and Left** click buttons and **a rolling wheel** or **a ball** or **a wheel** in between as shown below.



b) **Track ball mouse.** A trackball is like a mouse turned upside-down. This has a rolling ball positioned above or laying on its back. To move a pointer, you rotate the ball with your thumb finger or the palm of your hand. This device is useful when the space for moving the mouse is small because it does not need a flat surface for it to move.

c) **Touch pad mouse.** A touch pad mouse is a touch-sensitive pad that provides the same functionality as a mouse. **Or** it is a rectangular pad found on the lower side of the modern laptop computers. It uses a sensitive touch to direct the cursor on the screen. It also has two buttons for right and left clicking.

There are four functions performed by mouse:-

- **Clicking.** This is the pressing of left mouse button once.
- **Double clicking.** This is the pressing of left mouse button twice.
- **Right clicking.** Refers to the quickly pressing of the right mouse button once.
- **Dragging.** Refers to clicking and holding the left mouse button down while moving the mouse. This is used to move objects.
- **Pointing.** Refers to moving the mouse to move the on pointer screen.

General activities that can be performed using a mouse include;

– Opening files
– Closing files
– Playing games
– Saving files
– Transferring files
– Restarting computers
– Minimizing and maximizing windows
– Etc

3. Light pens and stylus. This has a beam of light rays radiated to different parts of a specialized screen to input data. It is used for capturing clients' signatures when required for example opening up ATM accounts, National Identity Cards, Passports, Company cards etc.

4. **Bar Code Reader.** This refers to an input device that is used to read items labeled with a universal product code. When moved across the **UPC,** the device automatically captures the product name, quality and price which it enters into the **POST** machine and later produces a cash receipt. They can also be used in super markets, select shops, airports and mail delivery companies.

5. **Point of Scale Terminal.** Also abbreviated as **POST,** it refers to an input device that directly input codes, quality and prices into computer systems manually or electronically by scanning it. After the input process, the information input is immediately released in form of a cash receipt and on it are details of transaction. This terminal can be used mainly in supermarkets and select shops where a number of items are stored and sold.
6. **Scanner.** This refers to an electronic device that captures data that is in form of a hardcopy and converts it to a soft copy form. **Or** it is a device that converts hardcopies to softcopies. **Or** this is a device that converts a printed image into a bitmap image. After data has been converted, it can be edited and stored by the computer.

   Scanners are categorized into two forms namely;

   Optical scanners and **Magnetic scanners**

   a) **Optical scanner.** This refers to a scanner that captures existing documents using a special concentration of beams of light when passed over the object or image and converts it to electronic form or digital format. The converted document is thus stored in a computer and can be either accessed in a default folder or a destination folder selected by the user. Most optical scanners are connected to computer system units through **USB** port (Universal Bus Serial) port and require unique software to be installed for it to be recognized by the computer systems and to execute instructions.

Types of optical scanners

- **Optical Bar Recognition (OBR).** This is a device that uses varying thickness (words) where it extracts particular information on items and sends it for further processing basing on their interpretation.

- **Optical Mark Recognition (OMR).** It detects marks made on a piece of paper using ink or soft pencil by passing an infra-red beam over them. **Or** it is a device that uses infra-red light to detect marks written on a piece of paper with soft pen or pencil by scanning an item. It can identify shape of words written on a piece of paper and can be used for objective questions and questionnaires.
- **Optical Character Recognition (OCR).** It is used to typewritten, computer printed or hand written characters and transforms the image into a softcopy that can be manipulated using word processor. The commonly used OCR is a flat bed scanner. It appears like a notebook and is flat bed with an almost rectangular shape.

b) Magnetic scanner. This refers to a device that uses magnetic technology to capture their information and there after arranges the captured characteristics in a continuous form.

Types of magnetic scanners

- **Magnetic Ink Character Recognition (MICR).** It can read characters written in special format. It is commonly used in banking institutions, Embassies, Cooperative institution and Casinos.
- **Magnetic Stripe Card Recognition device.** This uses a magnetic force to pick data from thin plastic magnetic tape. It is commonly used in Automated Teller Machines.

7. **Voice Input device.** This is a device that captures sound or spoken words and stores them into a computer. Examples include; microphones, desktop microphones, cordless microphones etc. It can be used for sound production and voice recognition that converts it to words or text. Microphones require a sound card in the PC.

8. **Touch screen.** Touch screen use sensors to detect the touch of a finger. **or** it a touch sensitive screen that is programmed to read and execute defined

instructions when touched. It responds to the movement of the finger or object being used and its motion is displayed on a display unit.

9. **Digitizer (Graphic tablet).** This is a computer input device that enables a user to hand draw images and graphics, similar to the way a person draws images with a special and paper.

10. **Digital Image Recorder.** This records pictures and store them inside the camera memory or directly into the computer systems. They can later on be developed into still pictures or motion pictures. They include;

    a) **Digital Camera.** A digital camera can be used in the same way a traditional film camera can, but instead of storing images on rolls of films, the images are stored digitally in memory housed within the camera. The images are later transferred to a computer using a serial cable and then can be manipulated or edited using graphic programs

installed in your computer like adobe Photoshop, windows photo manager, paint etc

The following are the advantages of digital camera over traditional film cameras;

- You can store hundreds of images or pictures.
- No need to buy films again.
- You can delete unwanted pictures.
- One can instantly see the picture you just took.

b) **Web cam (web camera).** This is a camera capable of uploading images to a computer for transmission over the internet or other network. It can be connected to the computer through **USB** port or can be inbuilt within a computer system for example on portable computers like **laptops.**

11. **Game Controllers.** The two primary types of game controllers i.e.

a) **Joysticks**. This is a device used for playing computer games like flight simulator and driving games. It can be connect through a serial connection of a computer.

b) **Game pads.** Game pads usually provide controls for each hand.

OUTPUT DEVICES

These are hardware devices connected to the computer in order to output information in form of text, numbers, graphics or images, video, audio and sound. **Or** Output devices are the devices used to get information out

of the computer. **Or** these are devices that are used to produce information after processing. After a C.P.U processing data, information is temporarily stored in the RAM (buffer area) and can be picked by the output devices.

The information processed is in two forms i.e. **hardcopy and softcopy.**

- **Hardcopy** refers to the tangible output that can be felt such as a paper, cloth, plastic material or metal. **Or** it is the information recorded on a tangible media such as a paper, cloth etc. **Or** output devices are devices that return processed data back to the user or to another computer system
- **Softcopy** refers to the intangible output that can be seen or heard. The expression "What You See Is What You Get (WYSIWYG)" is commonly used in reference to softcopies of documents. It is usually displayed on output devices such as **monitors, data projectors and speakers.** Output devices include;
  1. Monitors
  2. Printers
  3. Projectors
  4. Plotters
  5. Speakers

1. MONITORS

These are often referred to as **Visual Display Units (VDUs).** So a monitor by definition is a visual display unit that displays information on the screen with

conjunction with a video graphic array card (VGA) in the computer. There are two major types of monitor.

1. **Cathode Ray Tube (CRT) monitors.** These resemble a TV screen with an extended back. In CRT monitors, electrons are fired at phosphor dots on the screen. The dots are grouped into pixels, which glow when struck by electrons to create a visible image on the screen. In color CRTs, each pixel contains a red, green, and blue dot. These glow at varying intensities to produce color images.

Advantages of CRT monitors include the following;

- They are cheap to buy.
- They produce very clear images.
- They can be viewed from any angle.
- They are durable. Their brightness cannot be affected easily.
- They are very good when playing video games due to their higher pixel response.

Disadvantages of CRT monitors include the following;

- They are bulky and difficult to move and store.
- They consume a lot of power which can increase on the cost of maintenance

- They produce a lot of heat during their operation or working.
- Due to their size, they are hard to dispose when they are no longer in use.
- Their radiations produced from them can be dangerous to human life.

2. **Flat screen monitors.** They can also be called **flat panel monitors.** These monitors are much different from CRT monitors in appearance and their operation.

They are of three types and these include;

- **Liquid crystal display (LCD).** This type of monitor uses liquid crystals to operate. There is a set of two transparent panels with a liquid crystal solution between them. Light is shined behind the panels. Each crystal allows light either pass through or blocks the light. The configuration of the crystals forms the image.
- **Gas plasma monitor.** This type of monitor resembles an LCD monitor but instead of the liquid crystal layer, it uses a gas layer. It emits light in the presence of electronic current.
- **Thin film transistor**. Thin-film transistor displays use multiple transistors for each pixel. It is the latest technology that uses high quality display.

Advantages of Flat panel monitors include the following;

- They are portable and simple to move and store.
- They consume less power compared to CRTs.

- They produce less heat compared to CRTs.
- They emit fewer radiations.
- They are disposable.

Disadvantages of CRT monitors include the following;

- They are expensive to buy.
- They do not produce clear images.
- They are not durable for example when you leave them on for quite a long period of time they may lose their brightness.
- They are limited to viewing angles. You may not see the images on the screen from some angles.
- Lower pixel response time which may delay you when playing a game.

Note: We also need to know the following with respect to computer monitors.

- **A pixel.** This word is made up two other words i.e. **a picture** and **element.** A pixel is the smallest element or a dot or an image on the screen.
- **Dot par inch.** There are very many pixels on the screen and these pixels are separate. The distance between each pixel to other is the one we call dot per inch.
- **Monitor resolution.** This refers to the sharpness or clarity of the image on the screen. Monitors have different resolutions. The resolution signifies the number of pixels on the entire screen e.g. a 15 inch VGA monitor (640x480) displays about 50 dots per inch and 307200 pixels.
- **Refresh rate.** This refers to the numbers of times in a second that a monitor draws the image or information repeatedly. This process is repeated and done in cycles per second. The speed taken to complete a cycle can be referred to as **a frequency,** measured in **hertz.** Most of our monitors have 75

HZ (that is the redraw the image 75 times every 1 second), 120HZ and beyond. The higher the refresh rate the higher the clarity of the image.

2. PROJECTORS

A projector is another visual display unit that displays or projects an image onto the screen or any white surface. It creates a light-projected image by shinning a light through a small transparent lens. In order to refine this image, it uses lenses in order to focus the light. Projectors can transform a very small image into a large one because the image which is projected will be the same size as the pool of light created by the light source behind the transparent image. Some of the projector types are LCD, CRT and DLP (Digital Light Processing) projector.

3. PRINTERS

These are devices that are primarily used to produce information on a piece of paper. **Or** these are devices that transfer the output of the computer on printing media e.g. a paper. There are two categories of printers i.e. **impact printers** and **non-impact printers.**

a) **Impact printers.** These are printer types which print directly touching the paper surface. They use a striking mechanism by striking the paper in order to form a hardcopy or print output on a paper. They include;

- **Dot matrix printer.** Dot matrix printers are a common type of impact printer. A dot matrix printer's print head contains a cluster of pins. The printer can push the pins out to form patterns in rapid sequence. The pins press an inked ribbon against the paper, creating an image. Speed is measured in characters per second (cps). Some dot matrix printers print 500 cps.

  This is the cheapest and noisiest of the printer family. The standard of output or print obtained is poor. These printers are cheap to run and relatively fast. They are useful in low carbon copy printing.
- **Daisy wheel printer.** Daisy wheel printers can print graphics and in general they are noisy and slow, printing from 10 to about 75 characters per second. Molded metal characters like those on a typewriter are mounted on extensions attached to a rotating wheel and are printed onto the paper by means of a hammer and print ribbon. This results in a great deal of movements, so printing is slow (less than 90 cps). The standard print is similar to that produced by an electric typewriter. As the characters are fixed, the size and font can only be changed by using a different wheel. However, this is very rarely done.
- **Line printers.** These ones use the same principle during printing just like daisy wheel printers except that these are much faster. It prints the whole line of character i.e. they print at once. They pint from one end of the paper to another.

ADVANTAGES OF IMPACT PRINTERS

- They are cheap to buy and maintain.

- They use any type of paper i.e. they don't require special papers for printing.
- They can produce multiple copies hence good for commercial printing.
- They don't use chemicals for printing.

DISADVANTAGES OF IMPACT PRINTERS

- They produce a lot of noise during printing process.
- Their print quality is not good.
- They are slow during printing.
- The print resolution is slow.
- They are limited to color capacity.

b) Non-impact printers. These are printers which print while their heads are not touching on the paper surface. They include;

❖ **Inkjet printers.** The printer sprays tiny droplets of ink onto the paper. Ink jet printers are available for color and black-and-white printing. Ink jet printers offer speeds of (2 – 4 pages per minute ppm) and resolution (300 – 600 dots per inch dpi). They produce print quality comparable to that of laser printers, though laser printers still have an advantage in terms of speed. They are very expensive to run due to high cost of replacing the cartridges.

❖ **Laser jet printers.** They use a beam of light directed to a light sensitive drum and the type of ink used is called toner that is charged electro statically. Toner is applied to drum and then moved to the paper. Laser

printers are available for color and black-and-white printing. Laser printers provide resolutions from 300 – 1200 dpi and higher.

Black-and-white laser printers usually produce 4 – 16 ppm.

Laser printers produce higher-quality print than ink jet printers, but are more expensive. They print at a very high speed.

- **Thermal printers.** This type of print has print heads with heat elements. During its operation, the heating elements can melt the wax coated papers or transparences to form characters on them. It does not use ink. Some of their characteristics are; they expensive printers produce a lot of heat during printing process etc.
- **Photo printers.** They are special printers designed to print photos.

ADVANTAGES OF NON-IMPACT PRINTERS

- They print at a very high speed.
- They print colored materials. For example thermal and inkjet printers
- They are very quiet printers during their operation.
- They print graphics.
- They have a very high print resolution.
- Their printouts are clear

DISADVANTAGES OF NON-IMPACT PRINTERS

- They are expensive to buy or purchase.
- Difficult to use with the old computers.

- Some non-impact printers are big and occupy a lot of space.
- They don't use any type of paper i.e. they require smooth papers.
- Non-impact printers like LaserJet emits radiations that cause body abnormalities.

FACTORS TO CONSIDER WHEN PURCHASING A PRINTER

- **Print quality.** Dot matrix printers are good for printing bulk documents; laser jet printers are good for printing official documents while thermal printers are good for checkout counter receipts.
- **Initial cost.** Though prices of printers have come down, laser and thermal are still expensive compared to inkjet.
- **Running cost.** The cost of maintaining an inkjet printer is higher than that of maintaining laser jet printers.
- **Speed.** The speed of the printer is measured in pages printed per minute.
- **Color printing.** Most of the printers support black and color printing. However, color printers especially lasers are relatively expensive.

4. **PLOTTERS.** These are printer like output devices that produce information on papers. The difference between printers and plotters is that plotters are capable of printing heavy graphics and use wider papers. They are most used when printing charts, land titles and construction plans. The plotter use pens to write on paper and is usually used for engineering drawing like maps, advertisement posters etc.



5. **SPEAKERS.** This is another output device that produces information in form of sound. They can be connected to the system unit through the sound

ports. In order for these devices to work, the computer should have a sound card and sound drivers (software that helps to connect audio devices to the operating system **or** programs that help devices communicate with the operating system). They are able to produce output or sound with today's media programs such as **windows media player, auto mix, virtual dj, vlc among others.**

STORAGE DEVICES

A computer can store data or information. This can be either during the processing or after processing. The devices used to store data or information are the ones we call **storage devices.** Storage devices are classified into two i.e. **primary storage and secondary storage devices.**

1. **Primary storage devices.** These are temporary storage areas for programs and data in use. There are two types of primary memory i.e. **RAM** and **ROM** chips.

a) **RAM (Random Access Memory).** This is sometimes called the **main memory.** It is a space where programs and data are kept during operation. **Or** this refers to the chip used by the CPU to hold data and programs in use. Unfortunately this memory temporarily stores data (its volatile memory) and if computer is switched off; all the content on it cannot be recovered. Hence it's advisable to keep on saving your work when using a computer for example when working with a word processor application.

Therefore the term **saving** refers to the process of copying data or information from RAM to a secondary storage device called **a hard disk (HDD).**

The space on RAM that can store data is called **the amount of RAM** and can be measured in bytes. Most computers today use form 32MB, 64MB, 128 MB, 512 MB, 1GB…….. The bigger the amount of RAM the more speed a computer during operation.

The RAM is fixed in slots or chip on the motherboard but can be replaced or upgraded if it stops working. Different computers use different types of RAMs hence some RAMs may not be compatible for some computers (care is needed when buying them).

Types of RAM

- **Static Random Access Memory (SRAM).** Static RAM costs more, but the memory is faster and it is a type of memory mostly located inside a microprocessor. It is often used to implement cache memory. Example are, **DDR1 (Double Data Rate 1), DDR2** etc.

Therefore, **cache memory** means a smaller, faster memory which stores copies of data from the most frequently used main memory locations. It helps to speed up computer processes by storing frequently used instructions and data.

- **Dynamic Random Access Memory (DRAM).** DRAM costs less, and requires less physical space, making it ideal for large capacity memories. However, access times are slower and especially smaller than static RAMS.

Virtual memory. This is a type of memory that supplement on the RAM space. When the space of the RAM is finished and the computer still has data to process, it uses a small part or space of the hard disk for temporary storage. This part of the hard disk used is the one we call the **virtual memory.**

b) ROM (Read Only Memory). After manufacturing a computer, the manufacturer design instructions that can help the computer start and also write some information about his/her company i.e. **HP Compaq.** All these instructions and information are stored on a memory known as **ROM.** The information on this memory cannot be deleted and altered by the computer user (hence read only) even if the computer switched off the information remains (non-volatile memory). The instructions on this memory include the **BIOS** (Basic Input and Output system) that help to check the operating system, hard disk, the amount of RAM and the processor used. BIOS is also responsible for identifying the boot drive and controlling the boot sector on the boot drive, which launches the operating system.

Types of ROM

- **PROM (Programmable Read Only Memory).** This allows the user to alter it only once after the content is written on it. For example **compact disc-Recordable (CD-R).**

- **EPROM (Erasable Programmable Read Only Memory).** This kind of memory, instructions can be erased once and be programmed again. In other wards it can be changed or altered by the user. For example **compact disc re-writable (CD-RW).**
- **EEPROM (Electronically Erasable Programmable Read Only Memory).** This type of memory can be erased and programmed using electricity. Here users can erase and store information several times without restrictions. An example is a **mobile phone** where numbers can be erased and re-entered several times.

Difference between RAM and ROM

RAM	**ROM**
RAM is volatile (its content is lost when the computer is switched off)	ROM is non-volatile (its content is not lost when the computer is switched off)
Its contents can be changed or altered by the user	Its contents cannot be changed or altered by the user
RAM stores data temporarily	ROM stores data permanently

MEMORY MEASUREMENTS

We already saw memory as a storage space of a computer. We need to know the size of the memory we have and we need.

The smallest unit of data that can be stored in a computer is called **a bit.** Or a bit can also be define as the smallest unit of information handled by a computer. A bit comes from two words i.e. **binary** and **digit.** A computer uses a binary (1s and 0s). The term **binary** therefore refers to the method for representing numbers using two digits i.e. 0s and 1s. A nibble is a collection of four (4) bits. Each character in a computer is made up eight bits and we call this combination **a byte.** So in short, the term byte means an eight bit unit of information that represents a single character. For example "**computer**" has how many bits?

1byte = 8bits, therefore the term computer= 8*8 which is equal to 64bits.

The table below represents more measurements of data comparing a bit and a byte.

Unit	**Approximation Value (bytes)**	**Equivalence value (bytes)**	**Actual Value (bytes)**
8 bits	1	2^0	1
Kilobyte (KB)	1,000	2^{10}	1,024
Megabyte (MB)	1,000,000	2^{20}	1,048,576
Gigabyte (GB)	1,000,000,000	2^{30}	1,073,741,824
Terabyte (TB)	1,000,000,000,000	2^{40}	1,099,511,627,776

In short, 1KB=1024bytes 1MB=1000KB, 1GB=1000MB, 1TB=1000GB

Data representation codes

- **ASCII (**American Standard Code for Information Interchange)
- **EBCDI (**Extended Binary Code Decimal Interchange)

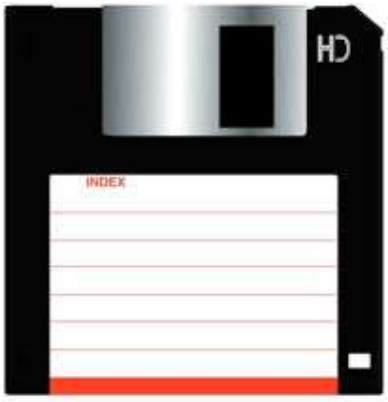
- **BCD (**Binary Code Decimal)

2. **Secondary storage devices or Auxiliary storage.** These are devices used to store information permanently. They are categorized as **removable** and **non-removable** storage devices.

REMOVABLE STORAGE DEVICES

These are devices that can be attached to the computer and can be removed together with the information on them. Some of the removable storage devices include;

a) **Floppy diskettes or disks.** A floppy disk is a circular piece of oxide-coated plastic sealed inside a protective casing that stores data as magnetic spots. A floppy can store 1.44MB of information that is approximately 300 pages of text. The use of floppy disks has reduced since the modern computers lack floppy drives and due to introduction of high quality storage devices batter than floppy diskettes.



Floppy disks were and are advantageous in the following ways;

- They are portable hence easy to move.
- They are cheap to buy.

- They can be used more than one time (re-writable)

Floppy disks were and are disadvantageous in the following ways;

- They are small in size
- They are easily damaged due to their plastic material
- They can transfer virus
- They are affected by magnetic fields

b) Magnetic tapes or magnetic disks. These emerged due to the failure of punched cards. They comprise of tape which is coated with magnetic surface onto which data in form of magnetic particles is stored.

c) Zip disks. These were very popular for making backups both in the industry, offices and at home. They were magnetic disks but the medium was made of high density magnetic material. Zip disks used special compression software

which packs large amounts of data into smaller sized data. The disks required drives to read them. These disks store data ranging from 100MB to 250MB. Modern computers do not have zip disk drives.

d) **Compact discs (CDs).** These are circular optical storage devices (information is written and read from the surface of the disk using a laser beam of light in the drive) that have a strong storage capacity ranging from 700MB to 720MB. To a compact disc, you insert it in a CD drive on your computer.

There are three major types of compact discs and they include;

- **CD-ROM.** CD-ROM stands for Compact Disc Read Only Memory. We have earlier saw that Read Only Memory carries information that cannot be altered. Thus the compact disc read only memory is bought with its information written by the manufacturer or supplied with data which is accessed but not editable. Take an example of **an audio CD.**

- **CD-R (**Compact Disc Recordable**) or WORM disks** (Write Once Read Many). A user can record his data on it which cannot be edited or erased or changed, but can record data many times.
- **CD-RW (Compact Disc Re-writable).** This type of a CD, a user can save or write his work or data as many times he wants and can remove the information if there is a need thus recordable and erasable (rewritable).

Compact Discs are good in the following ways;

- They are small in size hence movable
- CDs have bigger storage space or capacity compared to floppy diskettes
- They are relatively cheap to buy

Disadvantages of using compact discs include;

- They can easily be damaged by drives
- They are very slow in saving information
- They have a smaller storage capacity compared to the DVDs and hard disks.

e) **Digital Versatile Disk (DVD).** A DVD is another optical storage device that has more of the compact disc characteristics except the storage capacity

ranging from 4.7GB. Some DVDs can store on both sides and can store up to 9GB. DVDs have many types like DVD-R, DVD-RW. These types of DVDs behave exactly the same way as CDs.

They are advantageous in the following ways;

- They have a bigger storage capacity that a CD and a floppy diskettes.
- Their drives can also read CDs
- They are relatively cheap

Disadvantages of using DVDs include;

- They are easily damaged
- They cannot be read by CD drives.
- Saving data on them takes much time.

Note: A disk drive is a device that reads data from and writes data to a disk.

f) **Electronic (flash) memory.** They are small, re-recordable, and able to retain data without power. Used in many electronic devices, including digital cameras, mobile phones, computers, MP3 players. Example of electronic (flash) memory include,

- **Flash disks.** They are newer and widely used removable storage devices that can be attached to computer through a USB (Universal Serial Bus) port on the system unit. They have storage capacity or space ranging from 500MB, 1GB, 2GB, 4GB, 8GB, 16GB……Flash disks have a circuit that is covered with a plastic material and has a USB connector.

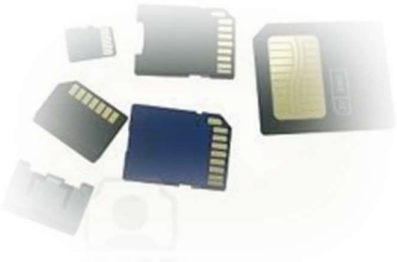
Advantages of flash disks include;

- They are portable and movable
- They carry more information than a floppy and a CD
- It is cheaper than hard disk
- Save data more than one time

Disadvantages of flash disks include;

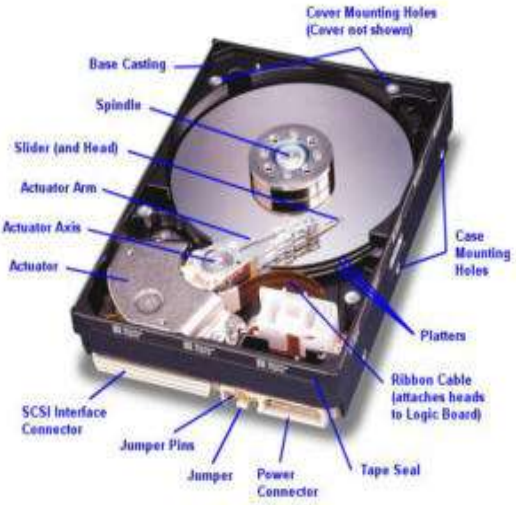
- They are easily affected by viruses
- They can easily be lost or misplaced due to their size.

- **Memory Cards-Secure Digital (SD) cards.** These are also newer and widely used removable storage devices that can be attached to computer through a USB (Universal Serial Bus) port on the system unit using a memory card reader. They have storage capacity or space ranging from 128MB, 1GB, 2GB, 4GB, 8GB, 16GB……



NON-REMOVABLE STORAGE DEVICES

g) **Hard disks.** The hard disk is the main magnetic storage device in the computer where most of the files, operating system and other programs installed in a computer are stored. The hard disk contains small circular metals (known as **platters**) coated with magnetic substance. Information is stored on these platters. The hard disk is fixed inside the system unit but there some others that can just be connected to computer from outside (external hard disk). It has a bigger storage ranging from 2GB to a tera byte (TB). If a computer has one hard drive, it is called drive C. If a computer has additional hard drives, they are called drives D, E, and so on.



Merites or advantages of using hard disks include;

- Information is not easily affected since they reside or kept inside the system unit.
- They have a bigger storage capacity compared to CDs, DVDs and Flppy disks.
- They are fast in saving information.
- Information is permanently stored.

Demerites or advantages of using hard disks include;

- They are bulky
- They are expensive to buy compared to other storage devices
- They are not movable since they are fixed or reside inside the computer

- If they get affected, it can stop the computer from working
- They are metalic and expand depending on change in temperature hence loss of data.

The following are some of the reasons why hard disks may fail to work or operate;

- Violet shaking
- Power failure
- Virus attach
- Excessive heat

h) Punched cards. A punched card was a piece of paper that contains digital information represented by the predefined positions. Data storage is by presence or absence of small holes that can be punched in specific location on the card.

The absence or of a hole 3 is sensed photo electrically by a card reader.

Punched cards were used with the first computers.

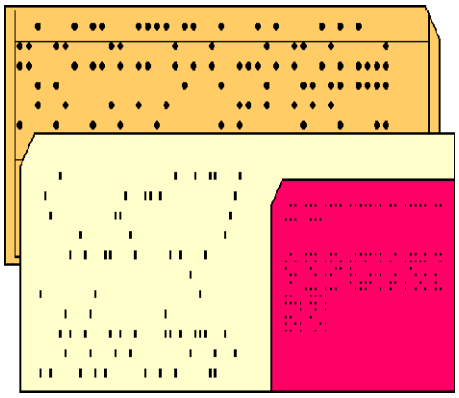
The cards were flat and consisted of numbers and letters neatly arranged in columns.

The computer punched a number of holes in rows to represent the data during storage.

In reading process, a computer made out words in order of the hole.

Cards were made out of paper and could easily be destroyed.

The cards could only store a few sentences.



Measures one should take to safeguard data stored on the diskette

- Avoid hitting the diskette hard, dropping it on the floor or exerting any other kind of pressure like placing heavy weights on them.
- Avoid exposing it to very high temperatures
- Do not spill or pour any liquids on it, liquids like Coke can erode the magnetic coating hence loss of data
- Keep it away from magnetic devices
- Do not bend or staple a diskette to a file folder etc.

NOTE: Note that the difference between storage media and storage devices is that storage media are devices that actually holds data. And the devices that save data onto storage media or read data from them are known as **storage devices**. Sometimes storage medium is removable from the device e.g. a CD-ROM can be taken out of a CD-drive.

PROCESSING DEVICES

These are hardware devices that change data into information in the computer.

The procedure that transforms raw data into useful information is called **processing**. This function is divided between the computer's processor and memory.

We have one processing device in the computer called **the central processing unit (CPU)** also known as **a microprocessor** because of its small size.

A **CPU** or **A microprocessor** is a small silicon chip on the motherboard responsible for data processing. **Or** it is a complete computer on silicon chip. The microprocessor is made up of integrated circuits. This device is the **brain** of a computer. It is responsible for all the operations that take place in the computer. The CPU does the processing in cycles. Capacity/power of a CPU is measured by its processing speed (HERTZ). Also measured by the computer **word size.** Word size is the measure of BITS accepted by the CPU circuitry at a time for example, 16 BIT, 32-BIT 64-BIT computers.

It does the following:

- Fetching instructions from the memory
- Decoding the instructions
- Executing and
- Storage

The CPU has three major parts or components i.e. the control unit, arithmetic logic unit and register.

a) **The control unit.** It coordinates or controls all the processing activities of the processor or CPU as well as input, output and storage devices.
   It determines which operation or instruction is to be executed next. To control all these activities, the control unit uses a system clock which sends electric signals as its means of communication.
b) **The arithmetic logic unit.** This is a part of the processor where all calculations take place. This part of the CPU gets data from the computer memory and performs arithmetic and logic operations. The basic arithmetic operations include multiplication, division, addition and subtraction. It also performs logical operations such as comparison of two numbers e.g. greater than, less than, equal to etc.
c) **The memory or register.** The processor has its own memory inside it in the shape of small cell. Each memory cell is called **a register**. It has a temporary storage which holds the data just before processing and also after processing. ALU gets data from registers and perform arithmetic and logical operations.

COMMUNICATION DEVICES

The hardware devices used to exchange information are the ones we call **communication devices.** They include the following;

a) **MODEM.** Also known as **modulator** and **demodulator. A modem** is a device that is capable of converting analog signals into digital signals (**modulation**) and also converting digital signals into analog signals (**demodulation**). **Or** it is a device that is used to attach a computer to a telephone line system.

With the use of a modem, **a sim card** is important and internet data which can be bought from an **inter service provider (ISP)** like Africel, MTN, airtel among others.

b) Sound card. This refers to a device that enable computers to output sound with an aid of speakers or headphones attached through an analogue port. Today's scientific technologies have tried to build sound cards that are directly linked to the speakers and act as standalone.

c) The Network Interface Card (NIC). This is an integrated peripheral device that helps computers communicate with each other through a network medium. Without a NIC, then a network cannot be created.