1. INTRODUCTION TO COMPUTERS

1.1. A computer;

A computer is an **electronic device**, operating under the control of instructions stored in its own memory, that can be programmed to **accept data** (input), **process** it into useful **information** (output), and **store** it in a secondary storage device (store) for safekeeping or future use.

Or

It is an electronic device that converts raw data into meaningful information.

1.2. CHARACTERISTICS OF MODERN COMPUTERS

1. Speed

Computers are quite fast in their operation in that their speed is measured in Millions of Instructions Per Second (MIPS) or Megahertz (MHz)

Inside the computer's system unit, the processing occurs through electronic circuits.

Data and program instructions travel through these circuits at speeds close to the speed of light.

Many computers process billions or trillions of operations in a single second.

NB: *Processing involves computing (adding, subtracting, multiplying, dividing), sorting, organizing, formatting, checking spelling and grammar, charting, displaying pictures, recording audio clips, playing music, and showing a movie.*

2. Accuracy

Computers are known to be accurate. They can process large amounts of data and generate error-free results, provided the data entered is correct.

They hardly make any mistake. They are capable of detecting and correcting any mistakes made.

It follows therefore, that if wrong data is fed into the computer, the resulting output will be incorrect.

Hence the saying; Garbage In Garbage Out (GIGO)

3. Storage

For a computer to be able to work, it must have a work space where data is stored before being processed or where information is stored before being output to particular devices.

This storage space is known as **Memory.**

4. Automation

Computers work automatically.

They do not need any supervision in order to perform programmed routines.

This is because of the instructions (programs) installed in them.

5. Diligence (Consistency)

Computers have the ability to perform the same task over and over for a long time without getting bored and with nor mistakes (errors).

6. Artificial intelligence

Computers are artificially intelligent.

They can respond to requests given to them and provide solutions. This is because of the programs installed in them.

Evidence is seen in **industrial Robots.**

7. Versatility / Flexibility

Computers are capable of performing different kinds of tasks provided the specified task is followed in a proper order.

1.3. USES COMPUTERS IN SOCIETY

We all come in contact with computers in our daily life, whether Analog or Digital, in one way or another.

Below are some of the fields in society where we come in contact with computers:

(a) Homes

- Many people nowadays use computers for shopping purposes. The computers provide them with lists of shopping items as well as prices and electronic fund transfer (EFTs) facilities.
- There is also a variety of entertaining information for those looking for leisure. This includes music, videos and games.
- People use computers in homes to pay bills through the payment by phone services (PPS).
- People use computers for education and research from home. People can take online courses, learn to speak foreign languages and learn how to read, write and count using the internet facility.
- People use computers in homes for communicating with friends and relatives. This is achieved through use of e – mails, telephones, chat rooms, etc.
- They are used to store family records such as names of family members, family background, etc.
- 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.
- They are used by students and other learners in doing take home assignments.

(b) Office

- Managers use computers to create memos, letters and reports about their institutions.
- Bursars and cashiers use computers to calculate payroll, prepare income statements and balance sheets.
- Business managers use computers to track inventory and generate invoices and receipts.
- Computers have been used to present projects and ideas by means of presentation software.
- In offices, computers are used for communication through use of fax machines, electronic mails and videoconferencing.
- Through telecommuting, employees can work away from a company's standard workplace. This can only be achieved through use of computers.
- Offices have used computers to provide selected information, advertise products and services and conduct electronic commerce.

(c) Entertainment and recreation

- Computers are used to play music.
- They are also used to play movies and videos which help in entertaining people
- People use computers in playing modern computer games. These include Solitaire, Tetris, Free Cell, Packman etc.
- They are used in composing and editing video and audio clips.
- With the use of internet, people are able to use computers to read books or magazines online.
- Places like amusement parks, Casino's and other GUMBLING places run some of their machines using computers.

(d) Banking

- As a way of solving the problem of standing in queues at the banking Hall, a new technology which allows clients to draw their money from a computerized Teller known as an ATM (Automated Teller Machine) was invented. It is used to;
    * Make deposits of cash and cheques
    * Withdraw cash
    * Transfer money between accounts
    * Obtain account balances.

- Computers are used to carry out online banking. They are used to transfer money electronically among different accounts, apply for loans, obtain bank statements, account balances and credit card statements.
- Keeping record of all the banks' clients in terms of their personal data, account numbers, and their deposits and withdrawals on their respective accounts.
- They are used to run Magnetic Ink Character Recognition (MICR) to process cheques.
- They are used to run microfilm and microfiche to store transaction records.
- They are used when conducting electronic commerce.

(e) Industry

In many of the Industries, be it Large Scale, Small Scale or Heavy duty industries, computers of all kinds are widely used for the daily operations of such industries.

- In Manufacturing Industries/Factories, Computers are used to make the production and sometimes packaging processes faster. E.g. in a Car Manufacturing Industry, there is a section where the size of tyres is determined for each car and then fitted on the car, another section in charge of seats and another in charge of fixing the dash boards, these sections are all operated by robots.
- They are used for communication with different industries and business men.
- They are used to manage large volumes of financial transactions within the industries.
- In Food and beverage Processing Industries, computers are used to determine the right portions of each ingredient that should make up the final product.
- Computer driven machines such as robots are used to carry out repetitive tasks, lift heavy equipment, and carry out tasks which require a high degree of precision.
- They are used in Computer Aided Design (CAD) and computer aided manufacturing for creating engineering, architectural and scientific drawings.
- They are used for research about new stock especially through the use of the internet.
- In Lighter Manufacturing Industries, e.g. Cigarette Manufacturing or Soap Manufacturing Industries, computerized machines carry out the tasks in the various sections: For instance, some machines are responsible for fitting the cigarette filter others for packing the right number of cigars in a packet, like wise in a Soap manufacturing industry, some machines are responsible for marking the soap with the brand name and mark it with lines While others pack the soap in boxes of 24 bars which are later sealed by the personnel in the department responsible.

(f) Health

- They are used to maintain patient's records in hospitals, clinics and other health centres. This information may include the names of the patient, diagnose information, date admitted, etc.
- They are used to monitor patients' vital signs in hospitals, at home and clinics.
- They are used to carry out computer – assisted medical tests in clinics and hospitals.
- They are used in diagnosing medical conditions of patients.
- Doctors and other medical workers used computers to carry out research about new medicine and diseases.
- They are used during implanting of computerized devices (i.e. Pace makers e.g. heart) that allow patients to live longer.
- Computes are used to control computer – controlled devices that require great precision during operations. These operations include laser eye surgery and heart surgery.
- They are used in telemedicine through use of computers with videoconferencing capabilities.
- They are used by experienced doctors and surgeons to train others through computer – aided surgery prior to performing surgery on live humans.

(g) Education/schools

Education is one of the fields in society where computers have a wide-spread usage. For instance:

(i) Students
- Students use computers and appropriate software to learn at their own pace. This learning is known as Computer Assisted Learning (CAL).
- They use them as learning aids.
- Through use of computers and internet, distance learning has been possible.
- They are used in edutainment (i.e. They are used for educative entertainment)
- They are used by researchers to quickly gather and analyze experimental data.
- They use them to do their assignments.
- Students also use computers to do school- related tasks like designing posters during campaigns, publishing school newsletters etc.

(ii) Teachers/Educators/Lecturers
- Teachers use computers and other related IT equipment to present teaching materials in a more interesting way. This learning is known as Computer Assisted Instruction (CAI).
- They use them to do internet research and enrich their notes or to keep up to date information
- In the advanced education systems, teachers use computers to deliver their lessons.
- They use them to compile and analyze student's performance.
- Computers are used to simulate experiments and other real life situations that may be hazardous.

(iii) Education Support Staff;
- Computers are used in school libraries to take record of the stock of books and the borrowers of the books.
- School bursars use them to compile data concerning finances and payments of institutions' students and staff and also to create statistical documents that show the flow of funds in and out of the institution

(iv) Administrators
- Organizations such as examination boards use computers to mark answer scripts (Computer Assisted Assessment, CAA). This helps to reduce time and labour.
- Schools nowadays use electronic library system for searching, borrowing and returning books.
- Most schools today are adopting the school administration and management systems (SAMS) for keeping records about students and producing report cards and other related documents.
- They are used by secretaries to quickly produce exams, and other administrative documents.
- Administrators use computers to keep records of the employees' personal data (e.g., Employees' Date of birth, Nationality, Marital Status, Job Title, etc.) Such kind of information is kept in for of an "Employees' Database.
- Administrators also use computers for communication purposes – communicating instructions to their juniors at work or to partners and Board members about meetings to be held.
- With the invention of the Internet, Websites where both teachers and students can interact to learn and teach each other have been created.

(h) Government
- Computers are highly used in many government ministries such as finance, education, etc, to store government records.
- They are also used to improve the efficiency of work within the civil service.
- They are used for easy communication between governmental institutions.
- They are used for easy budgeting for governments.

(i) Police

- Police use computers to store databases on security controls such as fingerprints which are automatically analyzed by computers.
- Traffic Police uses computer-controlled traffic lights to control traffic flow on the roads. They also use speed sensors to find over speeding drivers.
- They are used in computer based recognition and scene monitoring.
- They are used in electronic news gathering.
- They are also used in efficient communication, detection and tracking of targets, radar systems, warning systems and military laser and guided missile systems.
- The Criminal Investigation Police Departments (CID) use computers to track suspects, interview suspects and store most of the information they get.

(j) Music:
- Musical instruments such as electronic piano, synthesizers can be connected to certain kinds of computers which then control and create sounds.
- They are also used to store the created sound and video clips for future reference and use.

(k) 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 Airports, e.g. to check whether one is smuggling in or out weapons for war, drugs, etc.
- While inside the Aero plane, 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 the speed at which the car is moving. Modern technology has offered us Satellite-watched cars, i.e., at any one time, the car can be located in any part of the World because the Satellite keeps tracking it.
- 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 sheep

1.4.   LIMITATIONS OF COMPUTERS
*   Unlike human beings, Computers cannot think.
*   If wrong data is entered, wrong results will be output.
*   Computers do not learn from experience.
*   Computers do not provide alternative ways of doing jobs in case one fails.
*   In case the program used to execute correct data has errors, the results are likely also to contain errors.

1.5.   ADVANTAGES OF COMPUTERS
i)   Computers can be used to share data and information with other computers unlike the manual systems.
ii)   Computers are very fast. Therefore, tasks can be completed faster.
iii)   They can process large amounts of data.
iv)   Computers can store enormous (large) amounts of data for future reference/use.
v)   Computers generate only error free results provided that the data entered is correct.
vi)   Computers are efficient which increases their productivity.
vii)   The running costs of computers become lower in the long run.

viii) Data in computers is more secure due to less human intervention.

ix) Since computers are automatic, very many tasks can be completed with little human intervention (automatic)

1.6. DISADVANTAGES OF COMPUTERS

i) **Unemployment**

Computers have brought about unemployment in the society.

Although computers have improved productivity in many ways and created an entire industry with hundreds of thousands of new jobs, the skills of millions of workers and managers have been replaced by computers.

Most people who are illiterate about the new technologies have lost their jobs.

ii) **High maintenance costs**

Hardware and software costs are too high and not affordable to some individuals.

This has left some people poor.

iii) **Moral degeneration**

Youth and children are being exposed to ill – material via the internet.

They spend much of their time watching pornographic films which have led to increase in lesbians, cults, hackers, etc.

iv) **Health risks**

Prolonged or improper computer use can lead to injuries or disorders of the hands, wrists, elbows, eyes, necks, and back.

Computer users can protect themselves from these health risks through proper workplace design, good posture while at the computer, use of anti – glare screens and taking appropriately spaced work breaks.

v) **Training of staff**

For one to use a computer has to be having some prior knowledge about it. Therefore, introduction of computers in an organization requires training or retraining of the staff which may be costly and time consuming,

vi) **Computer virus**
- Many computer systems get infected by the viruses
- These are normally produced and sent over the internet, through use of contaminated disks etc.
- These viruses in turn infect the computers and lead to loss of useful information and data in storage.

vii) **Reduced human interaction;**

Face – to – face interactions among staff members may be reduced because they have to spend much of their time interfacing with computers.

viii) **Violation of Privacy:**

Nearly every life event is stored in a computer somewhere, for example in medical records, credit reports, tax records, etc.

In many instances, where these records are not properly protected, individuals have found their privacy violated and identities stolen.

ix) **Public Safety:**

Adults, teens, and children around the world are using computers to share publicly their photos, videos, journals, music, and other personal information.

Some of these unsuspecting, innocent computer users have fallen victim to crimes committed by dangerous strangers.

Protect yourself and your dependents from these criminals by being cautious.

For example, do not share information that would allow others to identify or locate you.

x) **Impact on Environment:**

Computer manufacturing processes and computer waste are depleting natural resources and polluting the environment.

The amount of resources required to manufacture a personal computer equals that of a midsized car.

When computers are discarded in landfills, they release toxic materials and potentially dangerous levels of lead, mercury, and flame retardants which can degrade the environment.

This can be minimized by recycling, regulating manufacturing processes, extending the life of computers, and immediately donating replaced computers.

xi) Forgery

Computers are being used to forge documents.

People use computers and high quality printers to try forging sensitive documents such as money notes, passports, driving permits, national Identity cards, certificates, report cards, company seals, etc.

1.7. COMPUTER CARE AND SAFETY

Laboratory rules and regulations

➢ Handle every computer device with maximum care without dropping them down.

➢ Do not allow external diskettes, flash disks and other external storage devices. These may have viruses.

➢ Do not expose computers to dusty environments, dump places and strong heat.

➢ Do not expose computers to direct sunlight.

➢ You should move with a lot of care when you are in the lab. Never enter the lab while running.

➢ Call the lab technician or any experienced person in case you encounter any problem when you are using the computer.

➢ Avoid smoking from the Computer lab.

➢ Avoid disconnecting the parts of the computer unless you have been told to do so.

➢ Always report any case of theft within the lab to the concerned authorities.

➢ Do not eat or drink anything near computers. Liquid can splash on the machines and spoil them.

➢ Avoid abrupt on and off of computers to avoid damage. Always shut them down through the right procedure.

➢ Cover the hardware devices after they have been cooled down.

➢ Always clean the surface of the hardware with a clean, dry piece of cloth. Avoid using water.

➢ Always follow instructions of the instructors while in the computer lab.

Computer maintenance and management

✓ Switch on the computer hardware systems starting from the wall socket switch, U.P.S or stabilizer, computer and then the computer.

✓ Protect the computers with U.P.S or a Stabilizer.

✓ Avoid making connections (e.g. Mouse, Monitor) when the computer is on power.

✓ Minimize the number of visitors to your computer lab.

✓ Computers should be regularly serviced e.g. blowing the dust from the system, cleaning the keyboard etc.

✓ Storage devices should be kept safely as recommended by the manufacturers.

✓ The computer lab must be well ventilated to avoid computers from being affected by heat.

✓   The computer lab must be painted with water color paint to avoid problems of fire out breaks.

✓   There must be a fire extinguisher in the computer lab in case of fire outbreaks.

✓   Keep daily record of the condition of the computers.

✓   Only allow qualified personnel to clean the inside of the computer.

✓   Always clean the surface of the hardware with a clean, dry piece of cloth. Avoid using water.

1.8. HEALTH AND SAFETY

There are a number of **safety hazards** linked with using computers and ICT devices.

This section looks into some of these potential hazards and what you can do to prevent them.

We will also look at some of the **medical conditions** and **health problems** that prolonged use of ICT devices can cause and what you can do to avoid them.

Health problems

There are a number of health problems that you can suffer if you use **ICT devices incorrectly** or for **too long**. The main ones are:

- **Repetitive Strain Injury (RSI)**
- **Back and Neck Strain**
- **Eye Strain and Headaches**

Health Problem & Description	Causes	Prevention
a) Repetitive Strain Injury (RSI) RSI causes **painful swelling of the wrist and fingers**. Sufferers with really bad RSI are unable to use their hands at all. RSI is caused by **doing the same small movements over and over again** across a long period of time. For example, clicking a mouse button repeatedly.	• Typing on a computer for too long. • Using a mouse for long periods. • Holding the mouse incorrectly. • Working in a cramped workspace.	• Take breaks to rest your hands. • Use an ergonomic keyboard/mouse. • Arrange your workspace so you are not cramped. • Use a wrist rest.
b) Back and Neck Problems Back ache and neck ache can cause **great pain** and affect the quality of your life. Both back and neck ache can be caused by **sitting incorrectly** and using **poor quality chairs without back rests**. This is called **poor posture**.	• Working in a cramped workspace. • Not sitting upright in your chair. • Incorrect positioning of the computer screen.	• Take regular breaks to stretch your body. • Use adjustable chairs so you can sit in a position suitable for your height. • Sit upright against the back rest. • Tilt the computer screen so it is set just below your eye level. • Keep your feet flat on the floor.
c) Eye Strain and Headaches	• Staring at a computer screen for a long time.	• Take regular breaks (every hour or so).

Staring at a computer screen for too long can **strain your eyes and cause headaches**. Eye strain can cause your **vision to blur**. Common causes of eye strain are screen flicker and having **direct light** causing screen glare (click links for video examples).	• Working in a room with bad lighting. • Using a computer screen with glare or flickers. • Dirt on the screen.	• Use LCD screens rather than CRT as they have less flicker. • Use an anti-glare screen. • Ensure that room lighting is good with no direct light causing glare on the screen. • Keep the screen clean of dirt. • Have eyes tested regularly.

NOTE!
The key to reducing **wrist**, **finger**, **neck** and **back pains** is **ergonomics**.
Ergonomics focuses on creating **comfortable environments for people**. **Adjustable chairs**, **Wrist rests** etc are examples of ergonomics.

Safety Issues

There are a number of safety issues that can arise from using ICT devices.
Some of these safety issues include:
- **Electrocution**
- **Tripping over wires**
- **Heavy equipment falling on you**
- **Fire risks**

Safety issue& Description	Causes	Prevention
a) *Electrocution* Most ICT devices require an **electrical power source**. Whenever you have electrical power sources you run the **risk of the electrocution**.	• Faulty equipment (bare wires etc). • Spilling drinks over electrical equipment. • Opening up an electrical device when you don't know what you're doing.	• Make sure wires are insulated. • Keep drinks away from equipment. • Report any malfunctioning equipment to a technician. • Never open up an electrical device.
b) *Tripping over wires and cables* ICT devices with wires can make a room a potential hazard. Trailing **wires are easy to trip over** if they are not secured or tucked away.	• Long wires spread across a floor.	• Hide wires in cable ducts (Trunkings). • Tuck trailing wires under desks or carpets. • Use wireless technology to eliminate the use of wires altogether.

c) **Heavy equipment falling on you** Some ICT devices (like computer screens) are fairly heavy and can cause injury if they fall on you. Equipment should be positioned securely on strong desks and tables well away from the edge.	• Equipment not positioned securely onto desks. • Poor quality and flimsy desks.	• Make sure that equipment is positioned away from the edge of desks. • Use strong desks/tables that can support the weight with ease.
d) **Fires** ICT devices require power from a mains outlet. If too many devices are plugged into a single mains at the same time it is possible to overload the circuit and start an electrical fire.	• Too many devices plugged into a single mains outlet. • Leaving devices plugged in unattended for long periods. • Covering air vents on devices like laptops.	• Make sure that your room has plenty of power outlets (sockets). • Don't plug too many devices into the same outlet. • Turn off and unplug devices if you are going to be away for a long time. • Have a CO_2 fire extinguisher in the room. • Leave air vents on devices uncovered.

1.9.   AREAS OF LABORATORY SECURITY

Physical security measures

i) *Lock up the server room*

The server room is the heart of your physical network. Therefore, someone with physical access to the servers, switches, routers, cables and other devices in that room can do enormous damage.

Before you turn on the servers, you should ensure that there are good locks on the server room door.

You should also put up policies requiring that the doors be locked any time the server room is unoccupied.

ii) *Install burglar proofing*

On top of the doors and windows, one should put burglar proofs such as strong iron bars in doors, windows and any other entrance on the computer laboratory. These will help to reduce chances of burglars breaking into the computer installations.

iii) *Set up surveillance*

⮝ *Introduce a log book*

Locking the door to the server room is a good first step, but someone could break in, or someone who has authorized access could misuse that authority.

You need a way to know who goes in and out and when.

A log book for signing in and out is the most elemental way to accomplish this, but it has a lot of drawbacks. A person with malicious intent is likely to just bypass it.

⮝ *Install Authentication systems*

A better solution than the log book is an authentication system incorporated into the locking devices, so that a smart card, token, or biometric scan is required to unlock the doors, and a record is made of the identity of each person who enters.

⮝ *Install Video surveillance cameras*

A video surveillance camera, placed in a location that makes it difficult to tamper with or disable (or even to find) but gives a good view of persons entering and leaving should supplement the log book or electronic access system.

Surveillance cams can monitor continuously, or they can use motion detection technology to record only when someone is moving about.

They can even be set up to send e-mail or cell phone notification if motion is detected when it shouldn't be (such as after working hours).

iv) Make sure the most vulnerable devices are in the locked room

Remember, it's not just the servers you have to worry about.

A hacker can plug a laptop into a hub and use sniffer software to capture data travelling across the network.

Make sure that as many of your network devices as possible are in that locked room, or if they need to be in a different area, in a locked closet elsewhere in the building.

v) Use rack mount servers

Rack mount servers not only take up less server room; they are also easier to secure.

Although smaller and arguably lighter than some tower systems, they can easily be locked into closed racks that, once loaded with several servers, can then be bolted to the floor, making the entire package almost impossible to move, much less to steal.

vi) Protect the workstations

* Hackers can use any unsecured computer that is connected to the network to access or delete information that is important to your business.
* Workstations at unoccupied desks or in empty offices (such as those used by employees who are on vacation or have left the company and not yet been replaced) or at locations easily accessible to outsiders, such as the front receptionist's desk, are particularly vulnerable.
* Disconnect and/or remove computers that are not being used and/or lock the doors of empty offices, including those that are temporarily empty while an employee is at lunch or out sick.
* Equip computers that must remain in open areas, sometimes out of view of employees, with smart card or biometric readers so that it's more difficult for unauthorized persons to log on.

vii)   Keep intruders from opening the case

* Both servers and workstations should be protected from thieves who can open the case and grab the internal components such as the hard drive. It's much easier to make off with a hard disk in your pocket than to carry a full tower off the premises. Many computers come with case locks to prevent opening the case without a key. Ensure that these locks are always locked with a padlock.

viii)   Protect the portables

Laptops and handheld computers pose special physical security risks. A thief can easily steal the entire computer, including any data stored on its disk as well as network logon passwords that may be saved.

* If employees use laptops at their desks, they should take them with them when they leave or secure them to a permanent fixture with a cable lock.
* Handhelds can be locked in a drawer or safe or just slipped into a pocket and carried on your person when you leave the area.
* Install motion sensing alarms to alert you if your portable is moved.
* For portables that contain sensitive information, full disk encryption, biometric readers, and software that "phones home" if the stolen laptop connects to the Internet can supplement physical precautions.

ix) Pack up the backups

Backing up important data is an essential element in disaster recovery, but don't forget that the information on those backup tapes, disks, or discs can be stolen and used by someone outside the company.

* They should be locked in a drawer or safe. Ideally, a set of backups should be kept off site, and you must take care to ensure that they are secured in that offsite location.
* Don't overlook the fact that some workers may back up their work on floppy disks, USB keys, or external hard disks. If this practice is allowed or encouraged, be sure to have policies requiring that the backups be locked up at all times.

x) Disable the drives

* If you don't want employees to copy company information to removable media, you can disable or remove floppy drives, USB ports, and other means of connecting external drives.
* Some organizations go so far as to fill ports with glue or other substances to permanently prevent their use, although there are software mechanisms that disallow it.
* Disk locks can be inserted into floppy drives on those computers that still have them to lock out other diskettes.

xi) Protect your printers

* You might not think about printers posing a security risk, but many of today's printers store document contents in their own on-board memories. If a hacker steals the printer and accesses that memory, he or she may be able to make copies of recently printed documents. Printers, like servers and workstations that store important information, should be located in secure locations and bolted down so nobody can walk off with them.
* Also think about the physical security of documents that workers print out, especially extra copies or copies that don't print perfectly and may be just abandoned at the printer or thrown intact into the trash can where they can be retrieved. It's best to implement a policy of immediately shredding any unwanted printed documents, even those that don't contain confidential information. This establishes a habit and frees the end user of the responsibility for determining whether a document should be shredded.

Electric power security

Most ICT devices require an electrical power source.

Whenever you have electrical power sources you run the risk of the electrocution (electric shocking) and fire outbreaks most especially if some of your electric wires are not insulated.

It is essential that all wires are always insulated and should be hidden in trunkings to avoid the above risks.

Also avoid over loading of sockets and having very many devices plugged into a single power outlet.

Connect all devices which use electricity to power regulators. These regulators include;

  Uninterruptible Power Supply (UPS)
  Stabilizers etc.

The UPS regulates the amount of power entering into the device. It also provides a power backup which can keep power for some time.

This saves a computer user from losing his/her data in case of power disturbances such as spikes, brown outs, black outs, and others.

Security (Surveillance) cameras

Video surveillance systems installed inside and outside the workplace can help to monitor and record criminals who vandalize or steal company property.

First Aid Boxes

A **first aid kit or first aid box** is a collection of supplies and equipment for use in giving first aid to computer users in case of any accident during computer usage.

It is recommended that all kits are in a clean, waterproof container to keep the contents safe and aseptic.

Typical contents include adhesive bandages, regular strength pain medication, gauze and low grade disinfectant.

Kits should also be checked regularly and restocked if any items are damaged or expired.

Commercially available first aid kits have traditionally been intended for treatment of minor injuries only.

Fire extinguisher

It is a portable device that discharges a jet of liquid, foam or gas to extinguish (put off) fire.

It is normally filled with carbon dioxide gas which is used to extinguish fire.

It is essential to always refill the fire extinguishers after a stipulated period of time.

It is also essential that all computer users are taught how to use fire extinguishers.

Air conditioning

Air conditioning is the removal of heat from indoor air for thermal comfort.

In another sense, the term can refer to any form of cooling, heating, ventilation, or disinfection that modifies the condition of air.

An air conditioner (often referred to as AC or air con.) is an appliance, system, or machine designed to change the air temperature and humidity within an area.

It is used for cooling as well as heating depending on the air properties at a given time, typically using a refrigeration cycle but sometimes using evaporation, commonly for comfort cooling in buildings and motor vehicles.

Wool carpets

These help to trap / absorb dust that comes along with shoes of computer users. The dust may also come from other sources e.g. from outside the computer installations through the windows, doors or through any other entrance.

Benefits of Computer Maintenance

Just like maintenance on your car, house or even your own body, routine computer maintenance can provide tremendous benefits while saving time and money. There are several maintenance tasks that are easy to do and can be managed by anyone with basic computer knowledge.

Longer Computer Life

- Plugging your computer into an electrical surge protector is something everyone does to protect against changes in the electricity supply.
- But, you also must test your surge protector regularly.
- The manufacturer of the surge protector provides instructions on how to perform this test.
- If your surge protector is not adequately working, your computer's motherboard or hard drive could be destroyed from even the most minor electrical surge. This simple test can prolong your computer's life by months or years, and it only needs to be done about every six months or so.

Reduced Likelihood of Lost Files

- Backing up your computer files is a task that many people put off because it can be time intensive or it may seem unnecessary.
- Unfortunately, if your computer crashes, you won't usually get a second chance to recover your files and photos. Make back-ups a regular part of your routine.
- In addition to making your own backups with CDs or an external hard drive, there are online services that you can use to automatically back-up your files for a small fee such as Carbonite or Mozy. They work in the background anytime you are on your computer without intervention, making file back-ups easy and safe.

Faster Speed

- Defragmenting your hard drive, running spyware and virus removal programs as well as installing the latest drivers and software updates are all computer maintenance tasks that help keep your computer running at top speed.
- Don't forget the Windows updates if you are running that system. Not only do these updates help your computer run more efficiently, but they help close any recent security holes.

Protection Against Threats

- Keeping your spyware and anti-virus programs updated and running on a regular basis is essential to keeping threats at bay.
- You may never realize you have any spyware or viruses on your computer, but they could be there wrecking havoc in the background by stealing your personal information and transmitting it to third parties, destroying your files or even making your computer unusable.
- Most spyware and anti-virus programs can be set up on a schedule so that they run automatically on your chosen day and time.

1.10. Software safety

The most important (vital) part of a computer system is the data.

However, data in storage is exposed to a number of risks which include;

- ⊕ Accidental loss
- ⊕ Accidental damage or corruption
- ⊕ Theft by hackers / crackers
- ⊕ Deliberate damage or corruption especially by viruses
- ⊕ Un authorized disclosure

The following must be practiced to ensure safety to the data

- ✓ Always backup your data. However, you should first ensure that data to be backed up is error free.
- ✓ Minimize the number of visitors to your computer installations and restrict people to your server except the network administrator.
- ✓ Avoid secondary storage devices such as floppy diskettes, flash disks, whose sources are not trusted as these may spread viruses to your computers.
- ✓ Destroy all the unwanted printouts to avoid your data falling in hands of unauthorized people.
- ✓ Save your data regularly most especially if you don't have a UPS because abrupt power cut off may corrupt your data.

1.11. CLASSIFICATION AND CATEGORIES OF COMPUTERS

CATEGORIES OF COMPUTERS

Computers are categorized according to how the processed data is represented.

There are three categories i.e.

(a) **Digital** *Computers*
(b) **Analog** *Computers*
(c) **Hybrid** *Computers*

(a) ***Digital Computers***
- These are computers that process data that is represented in form of discrete values.
- Discrete values are numbers that can be defined like, 1, 2, 3, etc.
- They can count and process data in a more accurate way.

Examples of digital computers include **Digital Watches.**

123456789

(b) ***Analog Computers***
- These are computers that process data that is presented in a continuous form or measurable quantities/units.
- These units can be pressure, electrical voltage, speed, current, etc.
- These computers are less accurate.

Examples of analog computers;

Thermometers, Voltmeters, Tide predictors, Speedometers etc

(c) ***Hybrid Computers***
- These are computers that have the combined features of both the digital and analog computers.
- They are used in specific applications e.g. **industrial control processes such as Robots.**

CLASSIFICATION OF COMPUTERS

Computers are further subdivided into three major classes according to their;

(i) ***Purpose/Function***
(ii) ***Size***
(iii) ***Processor power***

(i) Classification By Purpose

Hybrid computers are further classified according to the work they are designed for;

These are categorized into two classes;

(a) Special Purpose Computers
(b) General Purpose Computers

(a) ***Special Purpose Computers***
- These computers are designed to handle only a particular task.
- Their form of operation is limited in nature.
- Currently, these computers are employed in devices like missiles. These will never do anything like word processing.

Examples include; **Digital watches, Pocket calculators, Lifts in buildings, Missiles (Computer Guided Missiles)**

(b) ***General Purpose Computers***
- These are computers designed to solve a wide range of problems.
- A typical computer of this type can perform calculations, keep date and time, process word documents, store databases, tabulate student's grades, play games, etc.
- They perform all tasks as desired by the user.

These computers include;

i) Stand – alone computers
A standalone computer is a computer that is not connected to a network and is capable of performing the operations in the information processing cycle.

ii) Networked computer (NC);
Is a computer designed specifically to connect to a network especially the internet.

iii) Real time systems
These are systems that process data without significant delay.

Examples include;
- Anti – missile defense systems,
- Airplane landing control systems
- Flight simulation systems
- Electronic fund transfer systems
- Ticket reservation systems.

iv) Integrated systems

(ii) CLASSIFICATION OF COMPUTERS BY SIZE
- General purpose computers are further sub – divided depending on the user capacity and the size of the machine.
- They are classified under four main categories i.e.
    - *(a) Super Computers*
    - *(b) Main Frame Computers*
    - *(c) Mini Computers*
    - *(d) Micro (Personal) Computers.*

(a) Super Computers
- This is the fastest computer.
- It is the most expensive and most powerful computer.
- It is used for applications that require complex and sophisticated mathematical calculations at extremely high speeds
- They include machines used **to launch missiles, to explore minerals, to determine weather forecasts and control space crafts by NASA.**
- They normally require specialists to operate them.

Examples of Super Computers
- ✓ **CRAY T3D**
- ✓ **NEC – 500**

(b) Mainframe Computers
- These are the biggest general purpose computers.
- They have extensive processing, storage and input/output capabilities.
- They can accommodate many users at a time.
- They are capable of supporting between **500** to **1000** users at a time.
- Each user work separately with a separate keyboard and monitor but all using the same processor.
- They require dust free environments.
- They are used by **large multinational companies, government departments, software houses, insurance companies, electricity boards, etc**.

Examples of Mainframe Computers;
- ✓ **IBM 4381**
- ✓ **ICL 39 series**
- ✓ **CDC Cyber series**

(c) Mini Computers
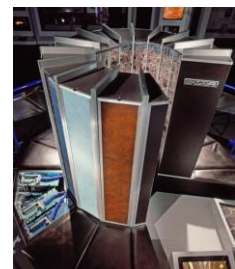
- These are multi user machines that can serve between **50 – 500** users at a time.
- They possess the same working principle as the Mainframe computers but they are considerably smaller.
- They can be used for applications such as **accounts, payroll, stock control**, etc.
- They are used in industries to control the manufacturing process, e.g. **Mukwano industries, Car assemblies, UNEB, UEB, etc.**

Examples include;
- ✓ **PDRS**
- ✓ **DECS VAX range**
- ✓ **IBM AS400 range. Etc.**

(d) Micro Computers (Personal Computers [PCs])
- These are the smallest in size.
- They can be used by one user at a time.
- They are also referred to as personal computers (PCs) or Personal Systems (PSs)
- They are the most widely used computers in our everyday life.

Examples of personal Computers
- ✓ **IBM PS/2 PCs**
- ✓ **Apple Macintosh**
  Etc.

Microcomputers are further subdivided into;

i) **Desktop Computers**
  - These are microcomputers designed to be stationed in one place preferably on top of the desk.
  - They can be used in offices, computer labs, etc.
  - They are the standard computers.

ii) **Tower Model Computers**
  - This has a tall and narrow system unit that usually sits on the floor.

iii) **Laptop Computers**
  - it is a portable personal computer which is small enough to fit on the lap such that even if one is in a bus or plane can still work like one on a deskt

  Notebook Computer;
  This looks like a laptop but it is much smaller than a laptop.

iv) **Palmtop Computers / Personal Digital Assistants (PDAs)**
  - These are hand held computers used by people who are ever on move.
  - They don't possess all the featured of a desktop computer.
  - They can easily fit in a shirt pocket.
  - Modern PDAs have been integrated with cellular phones.

Examples of PDAs;
- ✓ **Digital Diaries**
- ✓ **Mobile Phones.**

(iii) **CLASSIFICATION OF COMPUTERS BY PROCESSOR POWER**
  - Due to the rapid changes in technology, processor power is also rapidly increasing. Computers are getting faster and faster each year.
  - The higher the processing power, the faster the computer.
  - Earlier computers had processing power of less than 0.4MIPS but today 15 MIPS is the least.

(MIPS: Millions of Instructions Per Second)
  - The most common types of processor power are;

- ✓ **80286 or simply 286**
- ✓ **80386**
- ✓ **80486**
- ✓ **Pentium I (80586)**
- ✓ **Pentium Pro or Pentium II**

- ✓ **Pentium III**
- ✓ **Pentium IV**
- ✓ **Celeron**
- ✓ **Duo Core**

HISTORY AND EVOLUTION OF COMPUTERS

Computers have gone through a series of stages during their evolution.

ORIGIN OF CALCULATION

- ❖ Although electronic computers have become popular in the past 4-5 decades, man had always had the urge to solve problems and manage information/data in a much easier way.
- ❖ As a result, various mechanical devices were invented by man to help him fulfill his needs.
- ❖ Some of these devices could not work on their own – they required some human assistance in order to carry out their tasks effectively.
- ❖ Examples of such devices included:-
  - i) The Abacus
  - ii) Napier Bones
  - iii) Slide Rule
  - iv) Mechanical Adding Machine or *Pascal's Adding Machine or Pascal's Arithmetic Machine*
  - v) Leibniz's Stepped Reckoner or Leibniz's Calculator
  - vi) Jacquard's weaving Loom
  - vii) Babbage's Analytical Engine and difference engine
  - viii) Hollerith Electric Tabulating System or *The Census Tabulating System*

i. ABACUS
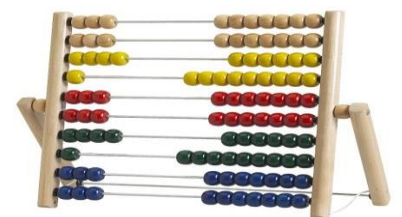
- This was the first computing device used in the 16th Century in China and Japan to compute volume in China and Japan for thousands of years Before Christ.
- It then moved to Egypt Greece, Rome and today it is said to be still in use in China and Japan to computer returns from their home-based businesses.
- It consisted of a rectangular wooden rack which had horizontal wires running from left to right.
- Theses wires had beads stuck on them. It is these beads that were used for simple addition and subtraction.

ii. Napier's Bones

- It was invented by a Scottish Mathematician called John Napier in 1617.
- It was made of ivory rods which looked like bones and they had numbers painted on them.

- It was used to solve mathematical problems involving multiplication, subtraction, division and addition.
- This could be done by sliding the bones back and forth. This idea of sliding bones laid a foundation for the next invention – *The Slide Rule*

iii. Slide rule

- In **1620**, a British mathematician called ***William Oughfred*** invented the first kind of analog computer which was referred to as the Slide Rule.
- This device was made up of two sets of scales marked in logarithms.
- This Mechanical Computer could also solve mathematical problems involving multiplication, division, addition and subtraction. All these computations could be done by sliding its cursor.
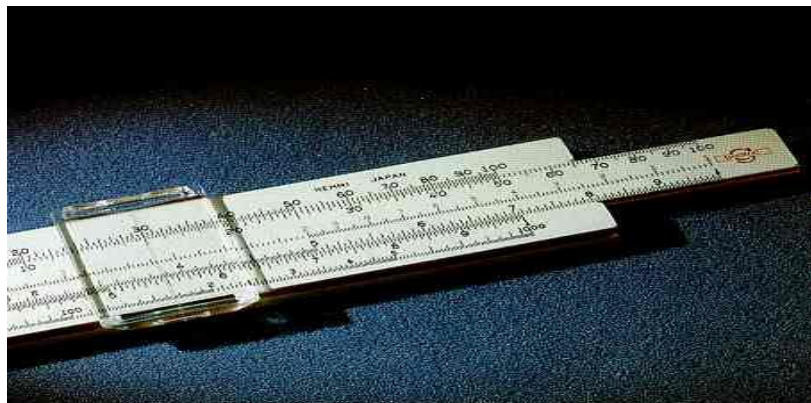

MECHANICAL ERA (1623 – 1945)

The machines invented in this era had moving parts, mechanical gears and greatly used punched cards and tapes for storage.

Examples of machines in this era;

i. Pascal's arithmetic (Adding) machine/Mechanical Adding Machine

- It was invented by Blaise Pascal in around 1642.
- 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 was the first mechanical adding machine which used a system of gears and wheels.
- 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 rotate automatically.
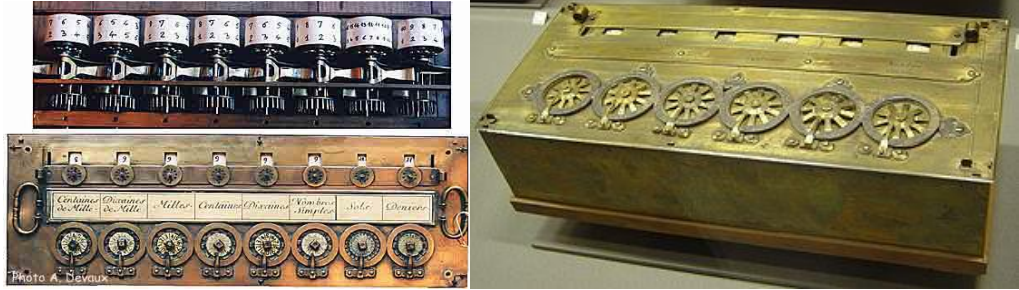
ii. Leibniz calculator /Leibniz Stepped Reckoner
- It was invented by Gottfried Wilhelm Leibniz in 1671
- He improved Pascal's Arithmetic machine so that it could perform addition, subtraction, multiplication, division.
- It could also compute square roots.
- In order to multiply a digit by '10', it would shift it one place to the left while dividing a digit by '10', would shift it one place to the right.

iii. Jacquard Weaving Loom
- It was developed by **Joseph Jacquard** in 1801
- It was a textile weaving equipment whose instructions were stored on punched paper cards.
- These instructions could automatically control this machine.
- He developed it with the intention of devising means of simplifying the weaving process of complex patterns with in the textile industry.

iv. Babbage's Analytical Engine and Difference Engine
Difference Engine
- These two machines were partially developed by Charles Babbage.

- Charles Babbage was the first to propose the concept of the modern computer hence called the Father of Computing.
- In 1823, with the help of a grant from the British Government, he partially built a steam driven mechanical calculator called the Difference Engine to compute logarithms tables.

Analytical Engine

- He then thought of an Analytical engine which was a mechanical steam driven mechanical machine.
- This had many characteristics of a modern computer.

The Analytical engine had five logic units which carried out functions and they are similar to those carried out by the logic units of the present day computer. These logic units included:

The Input

- This unit was responsible for entering data into the computer.

The Store.

- The store was to keep all the data which was waiting to be operated upon and that data which had been operated upon but waiting for output instructions.

The Control

- It was very similar to the control unit of the present day computer. It would keep all the instructions to be carried out by the computer in their respective order.

The Mill

- It was also very similar to the Arithmetic Logic Unit (ALU) of the modern computer i.e. it would perform Arithmetic and Logic computations which are feed into the computer.

The Output

- It was responsible for producing results after the computer had carried out its operations on the data entered into it.
- Some points to note about the Analytical Engine.
- It used punched cards to restore its data and instructions.
- It had both input and output units.
- It used modern computing principles such as cycles and loops.
- He then died in 1871 before completing any of his machines.
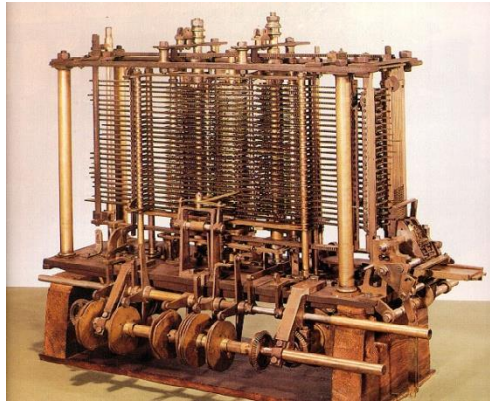
Lady Augusta Ada Bryon
- She recorded and analyzed many of ideas of Babbage.
- She is considered to be the world's first computer programmer

v. Hollerith's Tabulator
- It was developed by Dr. Herman Hollerith.
- It was a hand operated computer which used punched card for storing and tabulating data.
- It allowed the **1890** US census to be completed in less than three years.
- It is said that before the introduction of this computer, it had taken the Bureau seven years to compile the results but with this computer, it took the Bureau few months to compile the results of 1890 census.
- He then left the census Bureau to start a business Firm (company) to produce punched card machines. He called his company **Dr. Hollerith's Tabulating Machine Company.**
- He later named it the **International Business Machine Corporation (IBM),** the present day computer manufacturer.

THE ELECTRONIC ERA

The electronic computer generations

A computer generation refers development and accumulation of computer technology over the years.

Computers have gone through five (5) stages during their development

Each generation is characterized by dramatic improvements in;
i)   Technology to build the computer
ii)   Internal organization of the computer
iii)   Programming languages used.
iv)   Reduction in size
v)   Increase in performance capabilities.

1. **FIRST GENERATION (1945 – 1959: the vacuum tube years)**

   Technological innovations
   - Introduction of **Vacuum tubes** which were used for power distribution and internal operations.
   - Introduction of magnetic drums which were used for storage.
   - Introduction of punched cards for input and output.

Characteristics of first generation computers
- They had limited primary memory, a maximum of 2000bytes (2KB) of RAM
- Programming was done in machine code.
- They had a speed of 10 kilo instructions per second.
- They consumed a lot of power.
- They gave off a lot of heat.
- They were very expensive
- They had maintenance problems and needed a standby technician.
- They were very heavy (about 30 tons)
- They were very big (almost of a size of a room)
- They had no operating system.

Fig: A Vacuum tube

Examples of first generation computers
- ✓ ENIAC (Electronic Numeric Integrator and Computer)
- ✓ UNIVAC (Universal Automatic Computer)
- ✓ EDVAC (Electronic Discrete Variable Automatic Computer)
- ✓ IBM 650 (International Business Machine)
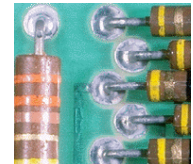
Fig; A transistor

2. **SECOND GENERATION (1959 – 1964: the era of the Transistor)**
Technological innovations
- ↗ Introduction of **transistors** which were used for power distribution and internal operations.
- ↗ Introduction of magnetic core memories for storage.
- ↗ Introduction of high level programming languages such as FORTRAN (Formula Translation, COBOL (Common Business Oriented Language), etc.
- ↗ Introduction of super computers e.g. LARC and IBM 7030

Characteristics of second generation computers
- Speed of operation increased to 200,000 – 300,000 instructions per second.
- They generated less heat and consumed less power compared to their predecessors.
- They became more reliable compared to the first generation computers.
- The computers became smaller in size.
- Computers became less expensive.
- They had no operating system.
- The primary memory increased to 32KB of RAM

Examples of 2nd generation computers
- ✓ NCR 501
- ✓ CDC – 6600 mainframe computer.
- ✓ IBM 7030
- ✓ TRADIC
- ✓ IBM 7030
- ✓ LARC (Livermore Atomic Research Computer)

Fig;Magnetic core memory

3. **THIRD GENERATION (1964 – 1972: Integrated circuits)**
Technological innovations
- ↗ Introduction of **Integrated Circuits (ICs)** for power distribution and internal operations.
  - o ICs were made by combining several transistors onto a single chip.
- ↗ Introduction of magnetic disks for storage
- ↗ Production of the first **mini computers**.
- ↗ Introduction of the first **operating systems** e.g. Multics.

Fig; An integrated

Characteristics of third generation computers
- Primary memory increased to 64KB of RAM.
- The speed increased to 5 – million instructions per second.
- Introduction of simple programming languages like BASIC (Beginners All purpose Symbolic Instruction Code)
- Computers greatly reduced in size compared to their predecessors.
- They became reliable, smaller in size, cheap and consumed little power which made them popular.

Examples of 3ʳᵈ generation computers
- ✓ IBM 360
- ✓ IBM 370
- ✓ PDP – 11
- ✓ IBM 360 series etc.

4. **FOURTH GENERATION (1973 – Present: large and very large scale integration circuits)**

Technological innovations
- ↗ Introduction of **Large Scale Integration Circuits** and **Very Large Integration Circuits.**
- ↗ Development of the **microprocessor by a team led by M.E Tedd Hoff of the Intel Corporation**
- ↗ Development of the first **microcomputers**

Characteristics of 4ᵗʰ generation computer
- They used large and very large integration circuits (LSI and VLSI)
- They used magnetic disks for storage
- Primary memory increased to 128, 256KB, etc

A microprocessor

- Introduction of a wide variety of software
- Use of secondary storage devices like Diskettes, Compact disks, etc.
- Development of programming languages which are easy to use which resemble human languages like C, C+, C++ etc.
- Direct use of input and output devices like keyboards, mice etc to provide a more natural user interface
- Computers became more powerful and cheap enough that schools and homes were able to purchase them.

Examples of 4ᵗʰ generation computers
Mainframe computers such as;
- ✓ IBM 308
- ✓ Amdah 580

5. **FIFTH GENERATION (1990 – and years to come: use of artificial intelligence)**
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.

Technological innovations
- ↗ Use of **artificial intelligence**.
- ↗ Production of Robots.

Characteristics of fifth generation computers
- Development of powerful and intelligent computers with the ability to see, listen, talk and think started.
- Increased use of wireless communication through the use of mobile phones
- Computer hardware and software costs and sizes decreased drastically.
- Offices and small business firms heavily rely on computers
- Use of Very large microprocessor circuits in parallel processing.
- Use of highly sophisticated operating systems

Fig; A robot

- Use of **robots** most especially in industries
- Increased use of internet for communications
- Increased use of mobile communication devices such as mobile phones.

Artificial Intelligence is a group of related technologies that attempt to develop machines to emulate human like qualities such as learning, reasoning, communicating, seeing and hearing.

Artificial intelligence includes:

- **Games Playing**: programming computers to play games such as chess and checkers
- **Expert Systems**: programming computers to make decisions in real-life situations (for example, some expert systems help doctors diagnose diseases based on symptoms)
- **Natural Language processing**: programming computers to understand natural human languages
- **Neural Networks**: Systems that simulate intelligence by attempting to reproduce the types of physical connections that occur in animal brains
- **Robotics**: programming computers to see and hear and react to other sensory stimuli

THE COMPUTER SYSTEM

A *computer system* is a functional unit consisting of integrated assembly of devices, centred on at least one processing mechanism which are used to input, process, store, and output data and information.

A computer system consists of interrelated organs or parts which function together for the same goal.

It is made up of six different components:
- Hardware (Input, Output, storage, processing and communication hardware)
- Software
- Data and information
- Users (People/Human ware)
- Procedures
- Communication

(i) Hardware

Hardware comprises the electronic and the electromechanical parts of the computer.
Hardware devices are the physical and tangible of a computer.
Examples;
Monitor, keyboard, mouse, system unit. Etc
Hardware is important because it carries out the

- in putting,
- processing,
- storage,
- out putting
- Communications of the system.

(ii) Software

· **Software** are electronic instructions that tell the computer how to perform a task.

· These are a series of programs (instructions) that tell the computer what and how to work.

Examples

System software –

System software is a software that manages and coordinates the computer and its resources.

Examples;

- **Operating systems** - Windows XP, Vista, Windows 95
- **Programming languages** – C+, Java Script, SQL
- **Utilities** – ANTIVIRUS software, disk defrag mentors, data recovery.

Application software;

Off the shelf (packed software) e.g. MSOffice suite

Custom (tailor made) e.g. school management system SMS

- o Application software solves the needs of the end user.
- o The made the computer more user friendly case for utilities
- o Production of other programs (programming)

(iii) Data

· **Data** refers to raw facts and figures that are processed into information.

| letters (e.g., a, b, c, ...) |
| words and symbols |
| numbers |
| examination scores |
| musical notes |
| Names e.g. Moses |

· **Data** is the foundation for information.

(iv) Information

· **Information** is the processed data which is organized, meaningful and useful.

· Is manipulated/ processed data.

Examples

| words (e.g., apple, boy, cat) |
| a report, a letter, an essay |
| a mathematical formula |
| comments, grades |
| a piece of music, a song |

Importance of information

· In all organizations, managers depend on information to make decisions.

· They also base on information when planning for the organizations.

· They base on information when analyzing their performance.

· They depend on information to forecast the likely outcomes of certain actions.

· Information helps in discovering the past, present and future.

(v) Procedures

- These are descriptions of how things are done (i.e. step for accomplishing a result)
- They normally appear in documentation materials which contain guides for using the hardware and software.

(vi) User

User – the most important component of a computer system – used to design and develop computer systems, operate the computer hardware, create the software, and establish procedures for carrying out tasks.

Ordinary user - is someone without much technical knowledge of computers but uses computers to produce information for professional or personal tasks, enhance learning, or have fun.

A **computer professional** user -is a person in a profession involving computers who has had formal education in the technical aspects of computers; an example is:

Examples of users.

➢ Computer programmer   ➢ Database administrator
➢ System analyst   ➢ Network administrator.
➢ System administrator

Importance of users –

- Data entry
- manipulating the computer system
- programming the computer
- administering the network
- analyzing the computer system, etc.

(vii) Communications hardware

· **Communications hardware** facilitates connection between computers and computer systems over phone lines and other channels.

· This is the linking of one device of a computer to another.

Examples are:

➢ Modems   ➢ fax modems
➢ Cable   ➢ routers
➢ Computer   ➢ gateways

Importance of communications

- Linking up computer devices and computers
- Enabling the flow of data
- Enabling the flow of information
- Enabling the flow of instructions
- Networking of computers

2. COMPUTER HARDWARE

DEFINITION;

Hardware refers to the physical and tangible components of a computer.

These are devices you can see, touch and feel.

Hardware can be

- Input hardware   - Processing hardware
- Output hardware   - Communication hardware.
- Storage hardware

2.1. PROCESSING HARDWARE

CENTRAL PROCESSING UNIT (CPU)

-It is an electronic device that interprets and carries out the basic instructions that tell the computer how to work.

-It is the main part("**Brain"**)of the computer.

-It is normally called a **microprocessor** on a personal computer

Parts of a CPU

(a) Control Unit

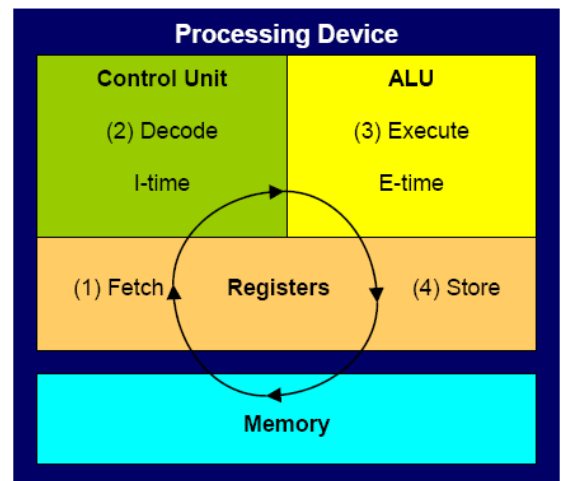-The *control unit* is the component of the processor that directs

and coordinates most of the operations in the computer.

-It interprets each instruction issued by program and then initiates the appropriate action to carry out the instruction.

-It directs data from storage to memory.

-It sends data required for mathematical operations from the memory to the ALU.

-It sends the data processed to the printer or a storage device.

-It erases/deletes/rubs data from memory when instructed to do so.

For every instruction, the control unit repeats a set of four basic steps:

- **Step 1: Fetching the instruction.** The instruction to be executed is obtained from memory by the control unit.
- **Step 2: Decoding the instruction.** The instruction is translated into commands the computer understand. Relevant data is moved from memory to the register, and the location of the next instruction is identified.
- **Step 3: Executing the instruction.** The commands are carried out. This could involve making either an arithmetic computation or a logical comparison in the ALU.
- **Step 4: Storing results.** The results are stored in registers or memory.

(b)   Arithmetic Logic Unit (ALU)

It is a part of the CPU that performs the execution step of a machine cycle.

Specifically, the ALU performs the ***arithmetic***, ***comparison***, and ***logical*** operations.

Arithmetic operations include;

➢ Addition,

➢ Subtraction,

➢ Multiplication, and

➢ Division.

Examples of arithmetic operations include;

- The payroll deduction for social security,
- The day-end inventory level, and
- The balance on a bank statement.

Examples of Comparison operations;

- comparing one data item to another to determine if the first item is greater than, equal to, or less than the other item.

Logical operations work with conditions and logical operators such as AND, OR, and NOT.

Examples of logical operations

If you wanted to search a student database for senior in the Business School, you would search for any students classified as senior AND listed under business school.

(c)   Program registers (or simply registers)

Registers are high-speed working storage areas in the CPU that temporarily hold instructions and data.

Registers are part of the processor, not a part of memory or a permanent storage device.

They are additional storage locations that offer the advantage of speed.

Types of registers and their roles

- **instruction register**, which contains the instruction being executed;
- **address register**, which keeps track of where a given instruction or piece of data is stored in memory.
- **storage register**, which temporarily holds data taken from or about to be sent to memory.
- **accumulator**, which collects the result of computations;
- **general-purpose register**, which is used for several functions, such as arithmetic operations.

Types of CPUs

- Intel – type Pentium series chips
- Motorola type "68000" series type
- RISC (Reduced Instruction Set Computing) chips
- AMS series
- CISC (Complex Instruction Set Computing) chips
- superscalar CPU
- Integrated CPU (which combines functions of a CPU, memory and Graphics card on a single chip)
- Math processor
- Graphics processor chip

THE PROCESSING CYCLE / INFORMATION PROCESSING CYCLE

This is a series of input, process, output and storage activities
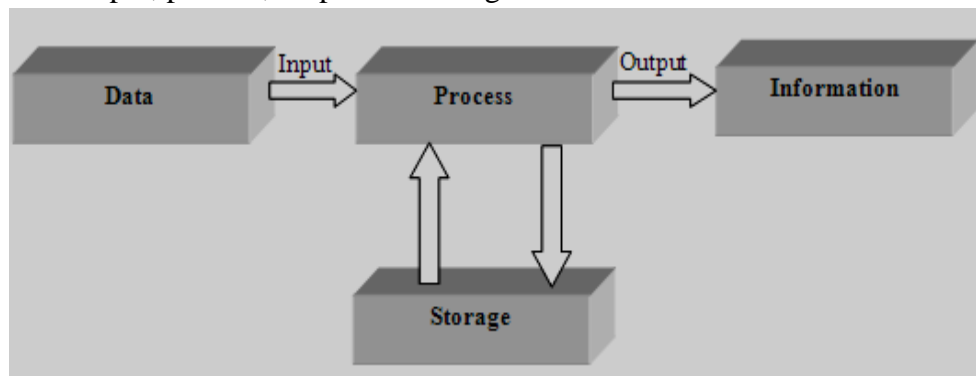
The five basic stages of information processing are;-

1. **Collection of data;**
   This involves capturing data from their sources and recording it onto some media such as paper.
2. **Preparing of data**
   This involves copying, grouping or arranging data in a more convenient way for input.
3. **Input of data**
   Involves entering the data or sending the stored data into the processing system
4. **Processing of data**
   It involves calculating or manipulating the input data and storing the results for future use

5.   **Output of information**

It involves giving out the processed results in a readable form e.g. a report.

Other Terms related to processing

❖ **Multitasking**

It is the use of one processor to solve more than one task at ago.

❖ **Multiprocessing**

It is the use of more than one processor to execute or solve a single task.

❖ **Coprocessor**

Is a special processor chip designed to assist the processor in performing specific tasks

❖ **Parallel processing**

This is the use of multiple processors simultaneously to execute a single program.

❖ **Pipelining**

Here, the CPU begins executing a second instruction before the first instruction is completed.

2.2.   INPUT AND INPUT DEVICES

2.2.1. Input

Is any data or program instructions people enter into the memory of a computer.

2.2.2. An input device

Is any hardware component that allows the user to enter data and instructions (programs, commands, and user responses) into the computer.

Input devices translate our data and communications into a form that the computer can understand.

- *Data*

Is collection of raw unorganized facts that can include words, numbers, images, sounds, and videos. Data is the raw material to be processed by a computer, such as grades in a class, bar codes, light and dark areas in a photograph, or speech that enter the computer through a microphone.

- *Information*

Is processed data that is organized, meaningful and useful.

- *A program*

Is a series of instructions that directs a computer how to perform the tasks necessary to process data into information.

Programmers write a program and then store the program in a file that a user can execute (run).

When a user runs a program, the computer loads the program from a storage medium into memory.

- *A command*

Is an instruction given to a computer program to perform a specific action.

Commands can be issued by typing keywords, pressing special keys on the keyboard, selecting menu choices, clicking the mouse on a graphical user interface, speaking into a microphone, or touching an area on a screen.

- *A user response*

Is an instruction users issue to the computer by replying to a question posed by a computer program.

A response to the question instructs the program to perform certain actions.

2.2.3. *Examples of input devices*

i. *Keyboard*	v. *Digital Cameras and Video Input*
ii. *Pointing Devices*	vi. *Scanners and Reading Devices*
iii. *Controllers for Gaming and Media Players*	vii. *Terminals*
iv. *Audio Input*	viii. *Biometric Input*

2.2.3.1. KEYBOARD AND NAVIGATION
KEYBOARD

It is a primary input device made up of keys with numbers, letters, symbols and special keys used to enter data into the computer.

Keyboard layouts

The arrangement of the English language keyboard keys was modeled after the QWERTY type writer keyboard developed by **Christopher Sholes in 1868.**

Its name was derived from the first six letters at the top of the keyboard.

Q W E R T Y

NB; The alternative to the QWERTY keyboard is the **Dvorak** keyboard developed by Dr. Dvorak in 1936. With the Dvorak, the most used letters are positioned in the middle row of the keyboard, intending to reduce typing time and finger movements.

Types of keyboards

- 82 key keyboard
- 102 keyboard
- 102/3 enhanced keyboard (the most commonly used type today)
- 105 (developed from 102/3 enhanced keyboard)

Parts of a Computer Keyboard
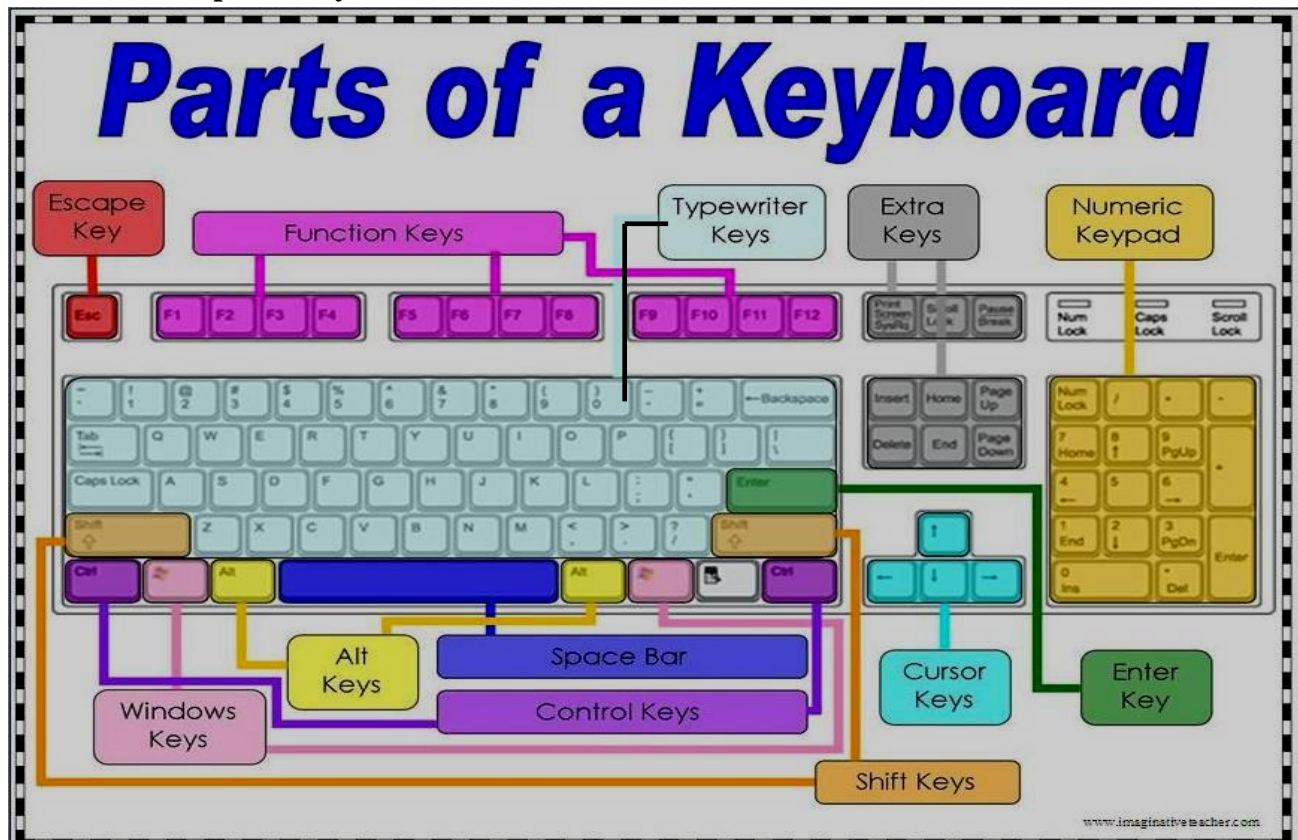
i. Functional keys
These are keys found across the top row of the keyboard.

Each key is composed of letter **F** and a number ranging from **1** to **12.**

Each functional key performs a specific operation based upon the software being used.

ii. Numeric keypad
This is an extra section to the right of the keyboard.

iii. Navigation/Cursor/Arrow keys
These keys are used to navigate through documents and websites. They include the up, down, left, and the right arrows.

iv. Typewriter Keypad (Alphanumeric Keypad)
This consists of the keys in the centre of the keyboard. It has buttons with alphabetical letters and numbers hence the name "**alphanumeric**" keypad.

Most of the typing is done with these keys.

v. Special Keys
These are the keys that are used to perform specific functions in the computer.

They include;

Shift key, Tab key, Control key, Caps Lock, Num Lock, Backspace key, Enter key, Delete key, Alt key, etc.

Functions of some selected keys on the keyboard

↗ **Backspace Key**

- Deletes the characters to the left of the cursor (or insertion point) and moves the cursor to that position.

Or

Ctrl+ Backspace key removes the whole word to the left of the cursor.

↗ **Caps Lock Key**

- A toggle key that, when activated, causes all alphabetic characters to be uppercase.

- To facilitate continuous typing in upper case when activated.

↗ **Delete Key**

- To remove the character, space, text or word to the right ofthe cursor position. Ctrl+Del removes the whole word to the right of the cursorposition.

– Sometimes labeled Del, deletes the character at the current cursor position, or the selected object, but does not move the cursor.

For graphics-based applications, the Delete key deletes the characters to the right of the insertion point.

↗ **Space bar**
- To create space .
- Alignment
- Moving the cursor to the next line.
- Pausing music in some music programmes e.g Power DVD,
- Playing games e.g in pinball
- Resizing or closing the current window with a modifier key e.g Ctrl Key +Space bar
- Helps in scrolling in some web browsers when used with Shift Key.

↗ **Shift Key**
- Activates second function of different keys.
- Activates sticky keys
- Selects files and folders in specific order
- Modifies function Keys e.g Shift + F1 = F13 and Shift + F2=F14.
- Anchors the insertion pointer in word processors
- Used in modifying the mouse behavior while using a web browser.

↗ **Ctrl key**
– Short for Control, this key is used in conjunction with other keys to produce control characters.
The meaning of each control character depends on which program is running.

↗ **Enter Key**
– Used to enter commands or to move the cursor to the beginning of the next line. Sometimes labeled Return instead of Enter.

↗ **Esc Key**
– Short for Escape, this key is used to send special codes to devices and to exit (or escape) from programs and tasks.

↗ **Alt key**
– Short for Alternate, this key is like a second control key.

↗ **Arrow Keys**
– Most keyboards have four arrow keys that enable you to move the cursor (or insertion point) up, down, right, or left. Used in conjunction with the Shift or Alt keys, the arrow keys can move the cursor more than one position at a time, but this depends on which program is running.

2.2.3.2. POINTING DEVICES

A pointing device is an input device that allows you to control a pointer on the screen and interact with computer via a graphical user interface (GUI).
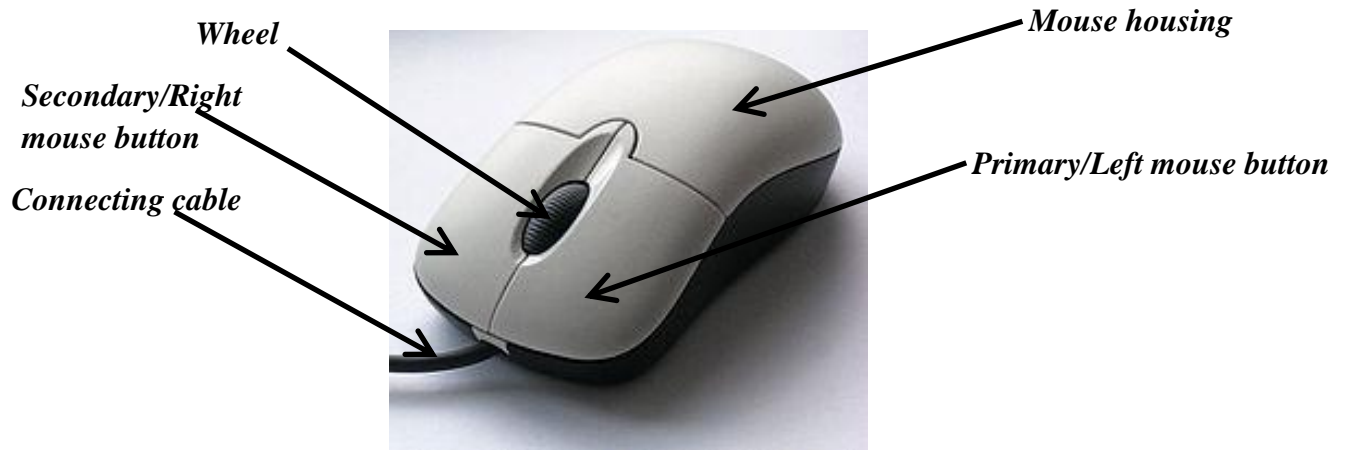
Examples of pointing devices

- Mouse
- Mechanical mouse
- Opto mechanical mouse
- Optical mouse
- Joystick
- Touchpad

- Stylus and Graphics tablet;
- Light pen;
- Touch Sensitive Screen
- Digitizer and digitizing tablet
- Cyber glove

A pointer often takes the shape of a block arrow (⇖), an I-beam (I), or a pointing hand (✋).

Using a pointing device, you can position the pointer to move or select items on the computer

Mouse

This is a hand operated device used to position the cursor, point, select and move objects on the computer screen.

Wheel

Mouse housing

Secondary/Right mouse button

Connecting cable

Primary/Left mouse button

The top and sides of a mouse have one to four buttons; some also have a small wheel. The bottom of a mouse is flat and contains a mechanism, such as a ball or a light, that detects movement of the mouse.

Types of mice

Mechanical mouse

A mechanical mouse has a rubber or metal ball on its underside. Electronic circuits in the mouse translate the movement of the mouse into signals the computer can process.

Optical mouse

Most computer users today have some type of optical mouse, which has no moving mechanical parts inside.
Instead, an optical mouse uses devices that emit and sense light to detect the mouse's movement.
Some use optical sensors, and others use a laser.

An optical mouse is more precise than a mechanical mouse and does not require cleaning as does a mechanical mouse, but is more expensive.

Air mouse

Is a motion-sensing mouse that, in addition to the typical buttons, allows you to control objects, media players, and slide shows by moving the mouse in predetermined directions through the air.
For example, raising the mouse up would increase the volume on your media player.

Many types connect with a cable that attaches to a serial port, mouse port, or USB port on the system unit.

A *wireless mouse* (or cordless mouse) is a battery-powered device that transmits data using wireless technology, such as radio waves or infrared light waves.

Basic mouse operations

Point

Means positioning the pointer on the screen to an object such as a button, a menu, an icon, a link, or text.

Click

Means pressing and releasing the primary mouse button, which selects or deselects items on the screen or starts a program or program feature.

Right-click

Involves pressing and releasing the secondary mouse button, which displays a shortcut menu.

Double-click

Means pressing and releasing quickly the primary mouse button twice without moving the mouse; this action starts a program or program feature.

Drag

Means pointing to an item, holding down the primary mouse button, moving the item to the desired location on the screen and then releasing the mouse button.

Right-drag

Displays a shortcut menu after moving an object from one location to another.

Rotate wheel (Scrolling)

Involves rolling the wheel forward or backward that scrolls up or down a few lines.

A Trackball

A trackball is like an upside-down mouse.

It is a stationary pointing device with a ball mechanism on its top.

You roll the ball directly with your hand.

It usually has one or more buttons around the trackball that work just like mouse buttons.

A trackball requires frequent cleaning because it picks up oils from fingers and dust from the environment.

Touchpad

A touchpad is a small, flat, rectangular pointing device that is sensitive to pressure and motion.

To move the pointer using a touchpad, you slide your fingertip across the surface of the pad.

Some touchpad have one or more buttons around the edge of the pad that work like mouse buttons.

They are found most often on notebook and laptop computers.

i. *Pointing Stick*

A pointing stick is a pressure-sensitive pointing device shaped like a pencil eraser.

Because of its small size, the pointing stick is conveniently positioned between the GBH keys on the keyboard.

To move the pointer using a pointing stick, you push the pointing stick with your finger.

The pointer on the screen moves in the direction that you push the pointing stick.

By pressing buttons below the keyboard, users can click and perform other mouse-type operations with a pointing stick.

ii. Touch Screen

A touch screen is a touch-sensitive display device.

Users can interact with these devices by touching areas of the screen. You touch words, pictures, numbers, letter, or locations identified on the screen.

With some smart phones, portable media players, and other personal mobile devices, you can touch the screen to perform tasks such as dialing telephone numbers, entering text, and making on-screen selections.

Application of touch screens

↗ Many handheld game consoles also have touch screens.

↗ Kiosks, which are freestanding computers, usually have touch. For example, travelers use kiosks in airports to print tickets ordered online and in hotels for easy check in and check out.

iii. Pen Input

With pen input, users write, draw, and tap on a flat surface to enter input. The surface may be a monitor, a screen, a special type of paper, or a graphics tablet.

A light pen

Is handheld input device that can detect the presence of light.

To select objects on the screen, a user presses the light pen against the surface of the screen or points the light at the screen and then presses a button on the pen.

Advantages of Light pen

- It is direct and precise than using a mouse.
- It is convenient for applications with limited desktop space.

Disadvantages of a light pen

- It normally requires a specially designed monitor to work with.

A stylus and graphics tablet

A *stylus* is a small metal or plastic device that looks like a tiny ink pen but uses pressure instead of ink to write text and draw lines on a pressure sensitive screen.

A *graphics* tablet is a flat, rectangular, electronic plastic board on which a stylus writes or draws.

They are mainly used for computer - aided design (**CAD**) and drafting by architects, mapmakers, artists and designers.

Advantages of stylus and graphics tablet

-A stylus can be pointed to different positions on the tablet quickly.

Disadvantages of stylus and graphics tablet

-They have to work together and cannot work separately.

A digitizer

It looks like a mouse, except that it has a glass with a cross hair in the middle. It is used with a digitizing tablet in making maps (cartography) and architectural drawings to accurately trace out lines on a map.

They are commonly used by architects, mapmakers, designers, artists, and home users create drawings and sketches by using a pressure-sensitive pen or a cursor (digitizer) on a graphics tablet.

A cursor looks similar to a mouse, except it has a window with crosshairs, so that the user can see through to the tablet.

iv.   **Controllers for Gaming and Media Players**

These are used in video games and computer games to direct movements and actions of on-screen objects.

Game controllers include

- ↗ Gamepads,
- ↗ Joysticks and wheels,
- ↗ Light guns,
- ↗ Dance pads, and
- ↗ Motion-sensing controllers

A gamepad

This controls the movement and actions of players or objects in video games or computer games. On the gamepad, users press buttons with their thumbs or move sticks in various directions to trigger events.

Gamepads communicate with a game console or a personal computer via wired or wireless technology.

Joystick and wheels

They are commonly used in modern computer games

Users running game software or flight and driving simulation software often use a joystick or wheel to control an airplane, vertical, or player.

A joystick is a handheld vertical lever mounted on a base. You move the lever in different directions to control the actions of the simulated vehicle or player.

The lever usually includes buttons, called triggers, that you press to initiate certain events.

Some joysticks also have additional buttons you press to perform other actions.

A wheel is a steering wheel- type input device.

Users turn the wheel to simulate driving a vehicle.

Most wheels also include foot pedals for acceleration and braking actions.

Joystick and wheels typically attach via a cable to a personal computer or game console.

In addition to games, these devices are used in practical training applications such as in the military and aviation.

A light gun

This is used to shoot targets and moving objects after you pull the trigger on the weapon.

Instead of emitting light, most light guns work by detecting light. When the user pulls the trigger, the screen sends light, which is received by a receptor in the barrel of the gun.

A dance pad

This is a flat electronic device divided into panels that users press with their feet in response to instructions from a music video game.

These games test the user's ability to step on the correct panel at the correct time, following a pattern that is synchronized with the rhythm or beat of a song.

Motion-sensing game controllers

These allow the use to guide onscreen elements by moving a handheld input device in predetermined directions through the air.

Some are sold with a particular type of game; others are general purpose.

The touch-sensitive pad

It is an input device that enables users to scroll through and play music, view pictures, watch videos or movies, adjust volume, and customize settings.

They are commonly found on most portable media players e.g. iPods.

They normally contain buttons and/or wheels that are operated with a thumb or finger.

2.2.3.3. Audio Input

Audio input is the process of entering any sound into the computer such as speech, music, and sound effects.

To enter high-quality sound into a personal computer, the computer must have a *sound card*.

Users enter sound into a computer via devices such as microphones, tape players, CD/DVD players, or radios, each of which plugs in a port on the sound card.

The automated telephone system at your bank may ask you to answer questions by speaking the words Yes or No into the telephone.

Some current cell phones and other mobile devices allow you to store voice commands such as "Call Tom".

Operating systems, such as Windows Vista, also include voice recognition programs.

Some users also enter music and other sound effects into a computer using external MIDI devices such as electronic piano keyboard.

MIDI (musical instrument digital interface)

This is the electronic music industry's standard that defines how digital musical devices represent sound electronically.

These devices connect to the sound card on a computer.

Software that conforms to the MIDI standard allows users to compose and edit music and many other sounds. For example, you can change the speed, add notes, or rearrange the score to produce an entirely new sound.

Voice Recognition Equipment (VRQs) e.g. A Microphone

These are input devices used to capture sound into the computer.

2.2.3.4. *Digital Cameras and Video Input*

*A **digital camera*** allows users to take pictures and store the photographed images digitally.

Some models are built in smart phones and other personal mobile devices. When you take pictures, the images are electronically stored in the camera.

With some digital cameras, you transfer a copy of the stored pictures to your computer or printer by connecting a cable between the digital camera and your computer or printer and using special software included with the camera.

With other digital cameras, the digital pictures can be stored directly on a variety of storage media including PC Card, mini-CD, flash memory card, or memory stick.

Types of digital cameras

↗ Studio cameras,

↗ Field cameras, and

↗ Point-and-shoot cameras.

A studio camera,

Is a stationary camera used in professional studio work.

It is the most expensive and has the highest quality.

A field camera

Is a portable camera that has many lenses and other attachments.

It often used by photojournalists.

A point-and-shoot camera

It is more affordable, lightweight and provides acceptable quality photographic images for home or small business users.

A point-and-shoot camera often has features of flash, zoom, automatic focus, and special effects.

Some allow users to record short audio narrations for photographed images, record short video clips, etc.

Some often have a built-in TV out port, which allows users to display photographed images or play recorded video clips directly on a television.

Factors affecting the quality of a digital camera

i.   Resolution

Resolution is the number of horizontal and vertical pixels in a display device.

A pixel is the smallest element in an electronic image.

The grater the number of pixels the camera uses to capture an image, the better the quality of the image.

ii.   Number of bits

Each pixel consists of one or more bits of data.

The more bits used to represent a pixel, the more colors and shades of gray that can be represented.

Advantages of a digital Camera over the ordinary film camera

- Saves money for buying films.
- Images taken can be previewed and even edited on the camera.
- Unwanted images can be deleted after preview.
- Digital cameras can be best for three - dimensional objects.

Disadvantages of digital camera

- They are normally expensive than the ordinary film cameras with the same functions.
- Photo printing costs are higher than that of the ordinary film cameras.

2.2.3.5.   Video input

Is the process of capturing full-motion images and storing them on a computer's storage medium such as a hard disk, DVD, etc.

Some video devices record video using analog signals.

Computers, by contrast, use digital signals.

To enter video from an analog device into a personal computer, the analog signal must be converted to a digital signal. To do this, plug a video camera or other analog video device in a video capture port on the system unit.

One type of adapter card that has a video capture port is a video capture card, which converts an analog video signal into a digital signal.

Most new computers are not equipped with a video capture card because not all users have the need for this type of adapter card.

A digital video (DV) camera, by contrast records video as digital signals instead of analog signals.

Many DV cameras can capture still frames, as well as motion.

To transfer recorded images to hard disk or DVD, users connect DV cameras directly to a USB port or a FireWire port on the system unit.

Thus, the computer does not need a video capture card. After saving the video on a storage medium, you can play it or edit it using video editing software.

A webcam;

It is also called a PC video camera.

It is a type of digital video camera that enables small business usersor a home user to;

- ✓ capture video and still images,
- ✓ send e-mail messages with video attachments,
- ✓ add live images to instant messages,
- ✓ broadcast live images over the Internet (videoconference), and
- ✓ make video telephone calls.

It is normally attached to the computer's USB port or FireWire port, and normally placed on top of the monitor.

Most modern notebook computers have built-in Web cams.

2.2.3.6. Scanners and Reading Devices

These are devices that capture data directly from source documents and converts it into a digital form that can be stored into a computer.

They include

- o *optical scanners,*
- o *optical readers,*
- o *bar code readers,*
- o *RFID readers,*
- o *magnetic stripe card readers,*
- o *magnetic-ink character recognition readers, etc.*

Optical Scanners (Scanners)

An optical scanner is a light-sensing input device that can convert text, drawings, or pictures into computer-recognizable digital data by using a form of optical recognition.

In a process called *imaging*, a scanner converts source documents to an electronic version, which can then be stored on a disk and retrieved when needed.

Types of scanners

↗ *Flatbed ,*

It works like a photocopy machine except that it creates a file of the document rather than a paper copy.

↗ *Sheet-fed,*

This has motorized rollers that can feed the source document across the scanning head during the scanning process

↗ *Drum, and*

Items to be scanned are rotated around a stationary scanning mechanism.

It is very large and expensive and commonly used in publishing industry.

↗ *Handheld*

This can be manually passed over the image to be scanned.

Many scanners include OCR (optical character recognition) software, which can read and convert text documents into electronic files.

NB: The quality of a scanner is determined by its **resolution** and **color depth**.

Disadvantages of Scanners

- It is best for only two - dimensional objects
- Scanned images usually take up a lot of storage space.

2.2.3.7.   Optical Readers

An optical reader is a device that uses a light source to read characters, and codes and then converts them into digital data that a computer can process.

Two technologies used by optical readers are optical character recognition and optical mark recognition.

➤ *Optical character recognition (OCR) readers*

These are input devices used to read typewritten, computer-printed, or handwritten characters from ordinary documents and translate the images into a form that the computer can understand.

Most OCR devices include a small optical scanner for reading characters and sophisticated software (OCR software) for analyzing what is read.

During the scan of a document, an OCR device determines the shapes of characters by detecting patterns of light and dark.

OCR software then compares these shapes with predefined shapes stored in memory and converts the shapes into characters that computer can understand.

Application of OCRs

They are used to read characters on turnaround documents (documents that you return to the company that creates and sends it e.g. electricity bills, you tear off a portion of the bill and send it back to the electricity company with your payment).

Advantages of OCR readers

- Written data and printed data can be read at the same time.
- Hard copies of documents can be read directly into a computer without retyping.
- The characters converted can later be edited by word processing software.

Disadvantages of OCR readers

- Often don't work well with hand written characters or those in unusual fonts.

➢ *Optical mark recognition (OMR) devices*

These are input devices that read hand-drawn marks such as small circles or rectangles.

A person places these marks on a form, such as a test, survey, or questionnaire answer sheet.

The OMR device first reads a master document, such as an answer key sheet for a test, to record correct answers based on patterns of light; the remaining documents then are passed through the OMR device and their patterns of light are matched against the master document.

Advantages of OMR readers
- It has a better recognition rate than OCR hence can read marks.
- Large volumes of data can be quickly collected without the need of specially trained staff.
- The cost of data input is reduced.
- The chance of data errors can also be reduced because it is not necessary to type the details for data entry.

Disadvantages of OMR readers
- Documents for OMR are complicated to design.
- The OMR reader needs to be reprogrammed for each new document design.
- It needs the person putting marks on the documents to follow the instructions precisely.
- Any folding or dirt on a form may prevent the form from being read correctly.

A bar code reader,

It is an optical reader that uses laser beams to read bar codes by using light patterns that pass through the bar code lines.

A bar code is an identification code that consists of a set of vertical lines and spaces of different widths, or a two-dimensional pattern of dots, squares, or other images.

The bar code represents some data that identifies the item and the manufacturer.

Advantages of using Bar Code Reader and Bar Codes
- The process of data entry is fast and accurate.
- Bar codes can be printed by normal printing methods.
- No need to write down any key in the name of the item or its accurate price.

Disadvantages of Bar Codes and Bar Code Readers
- Only numbers can be coded
- Bar codes cannot be read directly by people.
- A bar code reader may misread a bar code if there is any dirt or mark on the code.

2.2.3.8.   Radio Frequency Identification (RFID) Readers

RFID (radio frequency identification) is a technology that uses radio signals to communicate with a tag placed in or attached to an object, an animal, or a person.

 RFID tags, which contain a memory chip and an antenna, are available in many shapes and sizes and sometimes are embedded in glass, labels, or cards.

A RFID reader reads information on the tab via radio waves.

RFID readers can be handheld devices or mounted in a stationary object such as a doorway.

Each product in a store would contain a tag that identifies the product.

As consumers remove products from the store shelves and walk through a checkout area, an RFID reader reads the tags and communicates with a computer that calculates the amount due, eliminating the need for checking out each item.

They are also used in

- ✓ tracking times of runners in a marathon;
- ✓ tracking location of soldiers,
- ✓ trackingemployee wardrobes,
- ✓ trackingairline baggage, and
- ✓ trackingmisplaced or stolen goods;
- ✓ gauging pressure and temperature of tires on a vehicle;
- ✓ tracking payment as vehicles pass through booths on tollway systems;
- ✓ managing inventory;
- ✓ Checking out library books, etc.

2.2.3.9.   *Magnetic Strip Card Reader*

 A magnetic stripe card reader reads the magnetic stripe on the back of credit cards, entertainment cards, bank cards, gift cards, and other similar cards.

The stripe, which is divided in three horizontal tracks, contains information identifying you and the card issuer.

Some information stored in the stripe includes your name, account number, the card's expiration date, and a country code.

Information on magnetic card stripes is used to make payments, authenticate users, record attendance, and provide access to secure areas.

When a consumer swipes a credit card through the magnetic stripe reader, it reads the information stored on the magnetic stripe on the card.

Advantages of Magnetic Strips Reader

- Reading is accurate and fast

Disadvantages of Magnetic Strips Reader

* The amount of data that can be stored on a strip is limited.
* The magnetic strips can be damaged easily by exposure to strong magnetic fields.
* The card may be rejected in case of scratches and dirt on the surface.

2.2.3.10.   *Magnetic Ink Character Recognition (MICR) Readers*

 A magnetic-ink character recognition (MICR) reader is used to read text printed with magnetized ink.

An MICR reader converts MICR characters into a digital form that the computer can process. MICR readers are used almost exclusively by the banking industry for check processing. Each check has precoded MICR characters on the lower-left edge which represent the;

- ✓ bank number,
- ✓ your account number, and
- ✓ the check number.
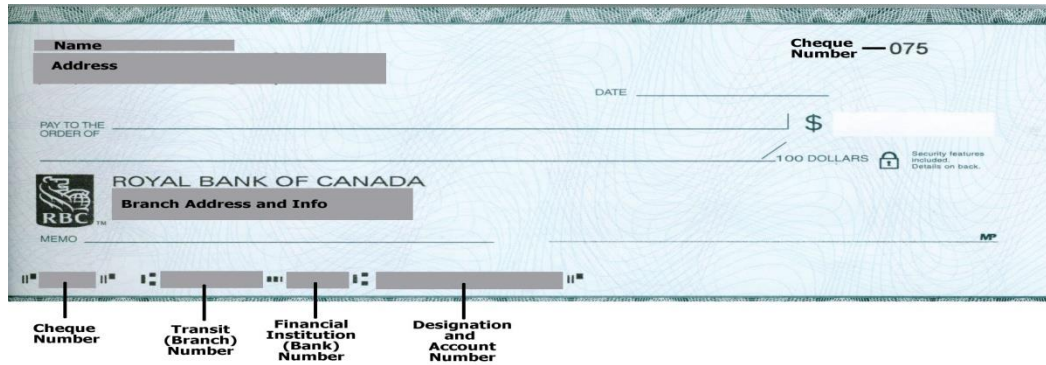
Advantages of MICR
- It is difficult to forge.
- Documents can even be read when folded or written on.

Disadvantages of MICR
   * MICR readers and encodes are very expensive.
* The system can only accept a few d6890ifferent character sets.

2.2.3.11. Terminals

A *terminal* consists of a monitor (output), a keyboard (input), memory, and a video card often housed in a single unit.
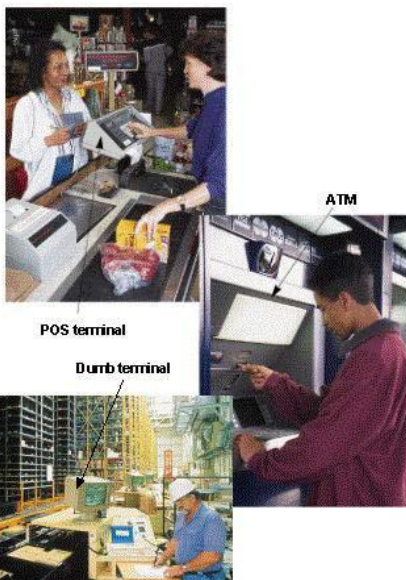
A variety of terminals enable both input to and output from a remote computer system

Categories of terminals

   i. *Dumb terminals,*
   ii. *Smart terminals,*
   iii. *Special-purpose terminals.*

A *dumb terminal*

It is a terminal that has no processing power, thus, cannot function as an independent device.

A dumb terminal can enter and transmit data to, or receive and display information from, a computer to which it is connected. It connects to a host computer that performs the processing and then sends the output back to the dumb terminal. The host computer usually is a server or mainframe.

A Smart terminal

In addition to a monitor and keyboard, a *smart terminal* also has a processor that has the capability of performing some functions independent of the host computer.

Special-purpose terminals

Theseperform specific tasks and contain features uniquely designed for use in a particular industry. Two common special-purpose terminals are;

- *Electronic Point-Of-Sale (EPOS)* and
- *AutomatedTeller Machines (ATM)*.

POS terminals are used by clerks and salespeople in retail stores, restaurants, and other establishments that sell goods and services.

When the checkout clerk scans the bar code on the item, the computer uses the manufacturer and item number to look up the price of the item and the complete product name in a database.

Some EPOS terminals are Web-enabled, which allows updates to inventory at geographically separate locations.

An ATM is a self-service banking machine that connects to a host computer through a network.

You insert a plastic bankcard with a magnetic strip into the ATM and enter your personal identification number (PIN), to access your bank account.

Some ATMs have a touch screen; others have special buttons or keypads for entering input.

2.2.3.12. Biometric Input

Biometrics is the technology of authenticating a person's identity by verifying a personal characteristic. Biometric devices grant users access to programs, systems, or rooms by analyzing some biometric identifier.

A *biometric identifier* is a physiological (related to physical or chemical activities in the body) or behavioral characteristic.

Examples include *fingerprints, hand geometry, facial features, voice, signatures, and eye patterns*.

Biometric devices

A biometric device is an input device that translates a personal characteristic into a digital code that is compared with a digital code stored in the computer.

If the digital code in the computer does not match the personal characteristic's code, the computer denies access to the individual.

Examples of biometric devices

A *fingerprint scanner;*

A fingerprint scanner captures curves and indentations of a fingerprint. Some grocery and retail stores now use fingerprint readers as a means of payment, where the customer's fingerprint is linked to a payment method such as a checking account or credit card.

A *face recognition system*;

This captures a live face image and compares it with a stored image to determine if the person is a legitimate user.

Some buildings use face recognition systems to secure access to rooms.

Law enforcement, surveillance systems, and airports use face recognition to protect the public.

Some notebook computers use this security technique to safeguard a computer.

The computer will not start unless the user is legitimate.

These programs are becoming more sophisticated and can recognize people with or without glasses, makeup, or jewelry, and with new hairstyles.

A hand geometry system;
These measure the shape and size of a person's hand.
Some large companies use this system as time and attendance devices or as security devices.
Day-care centers use this system to verify parents who pick up their children.

A voice verification system;
*A voice verification system*compares a person's live speech with their stored voice pattern.
Some larger organizations use voice verification systems as time and attendance devices.
Many companies also use this technology for access to sensitive files and networks.
Some financial services use voice verification systems to secure telephone banking transactions.
These systems use speaker-dependent voice recognition software. That is, users train the computer to recognize their inflection patterns.

A signature verification system;
*A signature verification system*recognizes the shape of your handwritten signature, as well as measures the pressure exerted and the motion used to write the signature.
Signature verification system uses a specialized pen and tablet.

An iris recognition system;

High security areas use iris recognition systems. The camera in an *iris recognition system* uses iris recognition technology to read patterns in the iris of the eye.
These patterns are as unique as a fingerprint. Iris recognition systems are used by government security organizations, the military, and financial institutions that deal with highly sensitive data.

Some organizations use *retinal scanners*, which work similarly but instead scan patterns of blood vessels in the back of the retina.

NB:
A *smart card;*
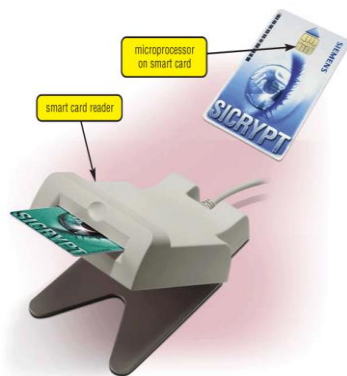
Sometimes, fingerprint, iris, and other biometric data are stored on a smart card.
A *smart card*, which is comparable in size of a credit card or ATM card, stores the personal data on a thin microprocessor embedded in the card.
Smart cards add an extra layer of protection. For example, when a user places a smart card through a smart card reader, the computer compares a fingerprint stored on the card with the one read by the fingerprint scanner.

2.2.3.13. Sensor and Remote Sensor
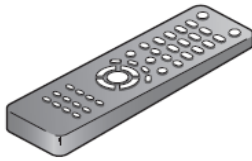
A sensor is an input device that can detect external changes in an environment.

These changes include;

- levels of light,
- temperature,
- sound,
- position,
- pH value,
- humidity etc.

When the sensors are located at some distance from the computer system, they are known as Remote sensors.

2.3. Output and Output Devices
2.3.1. Output

It is data that has been processed into a useful form called information.

Categories of output;

i. Text

This consists of characters that are used to create words, sentences, and paragraphs.

Examples of text-based output are;

- memos,
- letters,
- announcements,
- reports,
- advertisements,
- newsletters,
- envelopes,
- mailing labels,
- e-mail messages, etc.

ii. Graphics

These are digital representations of non-text information such as drawings, charts, and photographs.

Output uses graphics to enhance its visual appeal and convey information.

iii. Audio

This can be music, speech, or any other sound.

iv. Video

This consists of full-motion images that are played back at various speeds.

2.3.2. Output devices

These are devices used to bring out information from the computer and present it in a suitable form to the user.

Output from a computer can either be is a softcopy form or hardcopy form.

Softcopy

Advantages of a hardcopy
- ✔ It cannot easily be changed without trace.
- ✔ It can be read off-line without a computer.
- ✔ It doesn't require computer devices in order to read the output hence becoming cheap.
- ✔ Hardcopies last longer if stored in a safe place compared to a softcopy which must all the time be changed with the technological developments taking place.
- ✔ Hardcopies cannot be attacked by viruses as the case with the softcopy.

2.3.3. *Examples of output devices;*
- ↗ Display devices
- ↗ Printers
- ↗ Speakers
- ↗ Headsets
- ↗ Earphones
- ↗ Fax machines
- ↗ Multifunction peripherals
- ↗ Data projectors
- ↗ Interactive whiteboards
- ↗ Terminals
- ↗ 3D – Spectacles

2.3.3.1. *Display Devices*

A display device is an output device that visually conveys text, graphics, and video information.

Information shown on a display device often is called soft copy, because the information exists electronically and is displayed for a temporary period of time.

Display devices consist of a screen and the components that produce the information on the screen.

Most display devices show text, graphics, and video information in color.

Desktop computers typically use a monitor as their display device.

Kinds of Monitors

a. Monochrome Monitors

These display only one color on a different color background (e.g. white on a dark background).

Advantages of Monochrome Monitors
- They are relatively cheap.
- They are suitable for word processing and other applications where color is not much applicable.

b. Color Monitors

They are most often called Graphics Monitors

They display text and graphics in color.

Examples of color monitors
- CGA (Color Graphics Adapter)
- EGA (Enhanced Graphics Adapter)
- VGA (Video Graphics Array)
- SVGA (Super Video Graphics Array)

Advantages of using colors

- They make the screen displays more attractive.
- Colors can be used to highlight error messages and menu options.

Disadvantages of using colors
- * Screens with a lot of colors take too long time to process.
- * More memory is required to display a lot of colors.

Types of display devices
- ✓ Flat-Panel Displays
- ✓ CRT monitors.

i. Flat-Panel Displays

A ***flat-panel display*** is a lightweight display device with a shallow depth and flat screen that typically uses LCD (liquid crystal display) or gas plasma technology.

Types of flat -panel displays;
- ➢ *LCD monitors,*
- ➢ *LCD screens,*
- ➢ *Plasma monitors.*

An **LCD monitor**

It is a desktop monitor that uses a liquid crystal display (LCD) to create images on the screen.

These monitors produce sharp, flicker-free images.

They are available in a variety of sizes, with the more common being 17, 19, 20, 22, 24, 27, 45 or 65 inches.

Many are widescreen, which are much wider than they are tall.

The size of a monitor is measured diagonally from one corner to the other.

Mobile computers and devices often have built-in LCD screens.

Notebook computer screens are available in a variety of sizes, with the more common being 14.1, 15.4, 17 and 20.1 inches. On smart phone, screen sizes range from 2.5 inches to 3.5 inches.

LCDs typically contain fluorescent tubes that emit light waves towards the liquid-crystal cells, which are sandwiched between two sheets of material.

When an electrical charge passes through the cells, the cells twist. This twisting causes some light waves to be blocked and allows others to pass through, creating images on the display.

Color display in LCD displays

LCD displays produce color using either ***passive matrix*** or ***active matrix*** technology.

Active-matrix display;

An ***active-matrix display***, also known as a ***thin-film transistor (TFT)*** *display*, uses a separate transistor for each color pixel and thus can display high-quality color that is viewable from all angles.

A newer type of TFT technology, called organic LED (OLED), uses organic molecules that produce an even brighter, easier-to-read display than standard TFT displays.

OLED are less fabricated on expensive to produce, consume less power, and can be flexible surfaces.

Passive-matrix display

A *passive-matrix display*, also called a *dual-scan display*, uses fewer transistors and requires less power than an active-matrix display.

The color on a passive-matrix display often is not as bright as an active matrix is play.

You can view images on a passive-matrix display best when working directly in front of the display.

Advantages of LCD Monitors
- ✓ Requires little power.
- ✓ Take up less desk space that CRT.
- ✓ Very little radiation is emitted.

Disadvantages of LCD Monitors
- • More expensive than CRT monitors
- • Can only be viewed from a very narrow angle.

Factors affecting the quality of an LCD monitor
   i) Resolution
   ii) Response time,
   iii) Brightness,
   iv) Dot pitch,
   v) Contrast ratio.

i) **Resolution** is the number of horizontal and vertical pixels in a display device.
   A pixel is a single point in an electronic image.
   A higher resolution uses a greater number of pixels and thus provides a smoother, sharper, and clearer image.

ii) **Response time** of an LCD monitor or screen is the time in milliseconds (ms) that is takes to turn a pixel on or off.

iii) **Brightness** of an LCD monitor or screen is measured in nits.
   A *nit* is a unit of visible light intensity equal to one candela (formerly called candlepower) per square meter.
   The candela is the standard unit of luminous intensity.

iv) **Dot pitch**, sometimes called *pixel pitch*, is the distance in millimeters between pixels on a display device.

v) **Contrast ratio** describes the difference in light intensity between the brightest white and darkest black that can be displayed on an LCD monitor.

A plasma monitor

This is a display device that usesgas plasma technology, which sandwiches a layerof gas between two glass plates.

When a voltage is applied, the gas releases ultraviolet(UV) light.

This UV light causes the pixels on the screen to glow and form an image.

Advantages of plasma monitors

Plasma monitor offer screen sizes upto 60 inches wide

Have a richer colordisplay than LCD monitors

Disadvantages of plasma monitors

They are more expensive.

ii. Cathode Ray Tube (CRT) Monitors

A *CRT monitor* is a desktop monitor that contains a cathode-ray tube with a large, sealed glass tube.

The front of the tube is the screen coated with tiny dots of phosphor material.

Each dot consists of a red, a green, and a blue phosphor.

These three dots combine to make up the smallest particle on the screen called a *pixel*.

Inside the CRT, an electron beam moves back and forth across the back of the screen which causes the dots on the front of the screen to glow, hence producing an image on the screen.

Many CRT monitors use an analog signal to produce an image.

Connecting a CRT monitor on the system unit

The CRT monitor plugs in a port on the system unit, which enables communications from a graphics chip on a video card.

Advantages of CRT monitors

✓ Can produce fast and rich color output.

✓ Can be viewed from a very wide angle.

✓ They are cheaper than the LCD.

Disadvantages of CRT monitors

• Emit high electromagnetic radiation (EMR) than the LCD.

• Consume a lot of power than the LCD.

• Bulky hence consuming a lot of desk space.

Advantages of display devices (Visual Display Unit)

✓ The time to display the image is fast.

✓ Screen displays can include text, graphics and colors.

✓ Display devices are usually quiet.

✓ No paper is wasted for obtaining the output.

Disadvantages of display devices (Visual Display Unit)

• Information produced on the screen is only temporary and will be lost when the power of the device is off.

• Un suitable for users with display problems

• Needs a separate device (Such as a printer) to produce the hard copy.

2.3.3.2. *Printer*

A *printer* is an output device that produces text and graphics on a physical medium such as paper or transparency film.

Printed information is called *hard copy*.

It exists physically and in a more permanent form.

Connecting a printer to the system unit

Printers are either connected to a computer via a USB or parallel port.

Today, some printers are connected to notebook computer, Tablet PC, PDA, digital camera, or smart phone via wireless technology (i.e. Bluetooth and infrared).

Categories of printers;
- *Impact printers*
- *Non-impact printers*

Impact Printers

a) Impact printers

These are printers that produce a hard copy output by the print heads physically touching the print media.

Print media include paper, transparencies, cloths, some plastics, etc.

Impact printers form characters and graphics on a piece of paper by striking a mechanism against an ink ribbon that physically makes contact with the paper.

Examples of impact printers;
- Character printers
- Line printers (High speed printers)
- Dot matrix printers

i. Character printers
- These are low speed printers that mimic the action of typewriters by printing one character at a time.
- The characters are directly engraved on the print heads.
- This implies that the font type cannot be easily modified
- Their speed is measured in characters per second (CPS)

Examples include;

Daisy wheel printers and thimble printer

ii. Line printers
- A *line printer* is a high-speed impact printer that prints an entire line at a time. This makes them to be speedy
- They print from one end of a paper to the other end, hence the name line printers.
- Their speed is measured in lines per minute (LPM)

Types of line printers
↗ *Band matrix printers*
↗ *Shuttle-matrix printers*

iii. Dot Matrix Printers
- A *dot-matrix printer* produces printed images when tiny wire pins on a print head mechanism strike an inked ribbon.
- These form characters by print heads forming a pattern of dots on paper to make out a character.

- When the ribbon presses against the paper, it creates dots thatform characters and graphics. Most dot-matrix printers usecontinuous-form paper, in which thousands of sheets of paper areconnected together end to end.
- Their speed is measured in characters per second andranges from 375 to 1100 cps.

Examples of dot matrix printers
Epson LQ1170 ESC/P2 (24pin)
Epson LQ2170 ESC /P2 (24pin)
Epson FX880 (9pin)

iv. Page printers
- These are printers that use the method of printing page by page.
- They are much faster than all the above.
- Examples include;
  Epson LQ 1170.
- Their speed is measured in pages per minute.

Advantages of impact printers
✓ Easy to maintain (can withstand dusty environments, vibrations and high temperatures)
✓ They are more flexible and inexpensive.
✓ Can print various styles and heavy graphics.
✓ They have a longer life span. Can print over 100 million characters in their life span.

Disadvantages of impact printers
• They are noisy during operation.
• They tend to overheat up especially during long print outs.
• Have a lower print resolution compared to non – impact printers.
• Their print speed is too low.
• They require special form of paper.

Applications of impact printers
↗ Businesses may use impact printers for routine jobs such as printing labels.
↗ Impact printers are ideal for printing multipart forms because they easily can print through many layers of paper.
↗ Factories, warehouse, and retail counters use impact printers because these printers can withstand dusty environments, vibrations, and extreme temperatures.

b) Non – impact printers;
These are printers that produce a hard copy output without the print heads physically touching the printing surface.
Examples of non – impact printers;

- Inkjet printers	- Mobile printers
- Photo printers	- Label and postage printers
- Laser jet printers	- Plotters
- Bubble jet (thermal inkjet) printers	- Large – format printers
- Thermal printers	

i. Inkjet printers

- These are non – impact printers that form characters and graphics by spraying tiny drops of liquid ink onto a piece of paper.
- The liquid is spray painted on the paper either by drop – on – demand or intermittent jet technique.
- Its resolution is measured in dots per inch (dpi).
- Its speed is measured in pages per minute (PPM).

Examples include;

HpDeskJet 690C

Epson Stylus 640 e.t.c.

Operation

The print head mechanism in an ink-jet printer contains ink-filled print cartridges.

Each cartridge has fifty to several hundreds of small ink holes, or nozzles.

The ink propels through any combination of the nozzles to form a character or image on the paper.

Most ink-jet printers have two or more print cartridges: one containing black ink and the other(s) containing colors.

Some color cartridges contain a variety of ink colors; others contain only a single color. The number of pages a single cartridge can print varies by manufacturer and the type of documents you print.

Advantages of inkjet printers
- ✓ Are generally quiet during printing.
- ✓ Can produce high quality color output.

Disadvantages of inkjet printers
- Special papers are required for high color output.
- Ink cartridges and specialized papers are too expensive.
- Ink may smear when printed on ordinary paper.

Applications of inkjet printers
They are used for printing greeting cards, banners, business cards, and letterhead, envelopes, labels, greeting cards.

ii.   A *photo printer*
This is a color printer that produces photo-lab-quality pictures.

Some photo printers print just one or two sizes of images. Others print up to letter size, legal size, or even larger.

Most photo printers are PictBridge enabled, so that you can print pictures without a computer.

iii.   A *laser printer*
This is a high-speed, high quality nonimpact printer.

Operation
It creates images using a laser beam and powdered ink, called *toner*, which is packaged in a cartridge.

- They have the greatest NLQ (Near Letter Quality) capability and a high speed output
- They can print text and graphics in very high quality resolutions, usually 1200 dpi for black-and white printers and up to 2,400 dpi for color printers.
- They are also known as page printers because they process and store the entire page before they actually print it.

They have some memory where the page is first stored.

Examples include
HP Laser Jet 100 series printer
HP LaserJet 5M (color) printer
Epson EPL – N2000PS printer

Advantages of LaserJet printers
- ✓ Are generally quiet and fast.
- ✓ Can produce high quality output on ordinary papers.
- ✓ Cost per page of toner cartridges is lower for than for other printers.

Disadvantages of LaserJet printers
- • The initial cost of LaserJet printers can be high.

iv. A *thermal printer;*

These are printers which generate images by pushing electronically heated pins against heat sensitive paper.

Types of thermal printers

A *thermal wax-transfer printer*

This generates rich, non-smearing images by using heat to melt colored wax onto heat-sensitive paper.

A *dye-sublimation printer*

This issometimescalled a *digital photo printer*, uses heat to transfercolored dye to specially coated paper, which cancreate image that are of photographic quality.

Advantages of Thermal Jet printers
- ✓ They are inexpensive.
- ✓ They are nearly noiseless
- ✓ They consume very little power compared to other printers
- ✓ They don't experience inconveniences like paper jams or blocked nozzles.
- ✓ They can produce clear and crisp images with very high resolutions.

Disadvantages of Thermal Jet printers
- • Needs a special temperature sensitive paper which may be expensive.
- • Over heats during printing.
- • The papers have limited shelf lives. They are easily damaged by sunlight, humidity and chemical vapors.
- • The papers have to be specially prepared before they can be used in printing
- • Their print heads cannot be serviced or repaired even if a single dot heater fails.
- • The print speed is so slow because the heads have to be allowed time to cool before the next printing cycle.
- • The print heads also have a short life span than for the other printers.

Applications of thermal printers

Thermal printers are ideal for use in small devices such as ***adding machines*** or ***receipt printers***. They are also used in Applications requiring very high image quality, such as photography studios, medical labs, and security identification systems.

v. A *mobile printer*

This is a small, lightweight, battery-powered printer that allows a mobile user to print from a notebook computer, Tablet PC, PDA, smart phone or other personal mobile device while traveling.

Barely wider than the paper on which they print, mobile printers fit easily in a briefcase alongside a notebook computer.
Mobile printers mainly use ink-jet, thermal, thermal wax-transfer, or dye-sublimation technology.
Many of these printers connect to a parallel port or USB port.
Others have a built-in wireless infrared port through which they communicate with the computer wirelessly.

vi.   A *label printer*

This is a small printer that prints on an adhesive type material that can be placed on a variety of items such as envelopes, packages, DVDs, photographs, file folders, and toys.
Most label printers also print bar codes.
Most label printers typically use thermal technology.
A *postage printer* is a special type of label printer that prints postage stamps.

Plotters

These are sophisticated printers with a pen like print head that can accurately draw straight, thin and meandering lines.
They are used to produce high-quality architectural drawings such as blueprints, maps, circuit diagrams, posters, and signs.
Because blueprints, maps, and other such drawings can be quite large, these printers typically can handle paper with widths up to 98 inches.
These printers are usually very costly.
They are used in specialized fields such as engineering, drafting, and graphic art.

NB: Many printers can handle Internet printing.
With *Internet printing*, you send a print job from a remote computer or Web-enabled device to an Internet service on the Web that in turn sends a print instruction to a printer that may be at a location different from your computer or device.

2.3.3.3.   *Audio Output Devices*

Audio may be music, speech, or any other sound.
Audio output devices are the components of a computer system that produce music, speech, or other sounds, such as beeps.
Examples of audio output devices
- ↗ *Speakers*
- ↗ `*Headphones/Headsets*
- ↗ *Earphones*

i.   **Speakers**

Most personal computers have a small internal speaker that usually outputs only low-quality sound.
For this reason, many personal computer users add speaker systems to their computers to generate a higher-quality sound for playing games, interacting with multimedia presentations, listening to music, and viewing movies.

ii. Earphones and Headphones;

These are used in a computer laboratory or other crowded environments, where speakers might not be practical.

They are normally connected in a port on the sound card, in a speaker, or on the front of the system unit. With the headphone orearphone, only the individual wearing the headset hears the sound from the computer.

They are used on the web to listen to interviews, talk shows, sporting events, news,recorded music, and live concerts from many radio and television stations.

Other Output Devices

Other output devices include;
- ↗ *Data projectors*
- ↗ *Fax machines*
- ↗ *Multifunction peripherals*
- ↗ *Interactive whiteboards*
- ↗ *3D - Spectacles*

2.3.3.4. A *data projector*

This takes the image that displays on a computer screen and projects it onto a screen so that an audience of people can see the image clearly.

For example, many classrooms use data projectors so all students easily can see an instructor's presentation on the screen.

Data projectors can be large devices attached to a ceiling or wall in an auditorium.

Some operating systems allow projectors to be part of the network, which enables a presenter to operate the projector remotely via a network connection.

Types of data projectors;
- ➢ *LCD projector*

This uses a liquid crystal display technology.

It attaches directly to a computer, and uses its own light source to displaythe information shown on the computer screen.
- ➢ **A digital light processing (DLP) projector**

This uses tiny mirrors to reflect light, which produces crisp, bright, colorful images that remain in focus and can be seen clearly even in a well-lit room.

2.3.3.5. A *fax machine*

This is a device that transmits and receives documents over telephone lines.

The documents can contain text, drawings, or photos, or can be handwritten.

A stand-alone fax machine scans the original document, converts the image into digitized data, and transmits the digitized image.

A fax machine at the receiving end reads the incoming data, converts the digitized data into an image, and prints or stores a copy of the original image.

Fax capability also can be added to your computer using a fax modem.
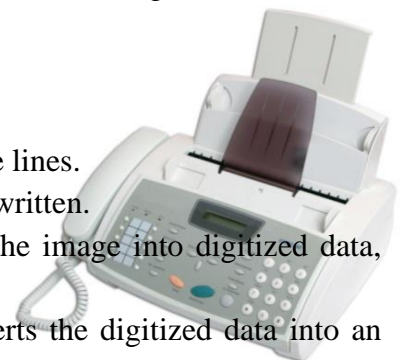
2.3.3.6. A *multifunction peripheral*

This looks like a copy machine but provides the functionality of a printer, scanner, copy machine, and perhaps a fax machine.

Advantages

It takes up less space and is significantly less expensive than if you purchased each device separately.

Disadvantages

If it breaks down you lose all functions.

2.3.3.7. An *interactive whiteboard*

This is a touch-sensitive device that displays the image on a connected computer screen.

A presenter controls the computer program by clicking a remote control, touching the whiteboard, drawing on or erasing the whiteboard with a special digital pen and eraser, or writing on a special tablet.

Notes written on the interactive whiteboard can be saved directly on the computer.

Applications of interactive whiteboards;

In classrooms as a teaching tool

During meetings as a collaboration tool

to enhance delivery of presentation or broadcasting.

Three basic technologies exist for displaying computer images on an interactive whiteboard:

- ✓ *Front* **projection:** separate projector displays an image from the computer screen on the interactive whiteboard;
- ✓ *Rear* **projection:** a projector built into the back of interactive whiteboard displays an image from the computer screen on the whiteboard; and
- ✓ An interactive whiteboard fits over an LCD screen or a plasma display.

2.3.3.8. 3D – SPECTACLES

- These are common in modern computer games especially on fights.
- The user wears the glasses like ordinary sun glasses except that here, instead of seeing through the glasses, one will be treated with high quality three – dimensional pictures.
- It is similar to being in a cinema hall.

2.3.3.9. *Terminals*

A terminal can work as an input device and as an output device. *(See input devices).*

2.4. Storage and Storage Media

Main memory is an important factor in determining overall computer system power.

However, main memory only provides a small amount of temporary storage area for the data and instructions required by the CPU for processing.

Computer systems also need to store larger amounts of data, program instruction, and information more permanently than allowed with main memory.

Secondary Storage serves this purpose.

➤ A storage medium

This is the physical material on which a computer keeps data, instructions, and information.

➤ Storage capacity

This is the number of bytes (characters) a storage medium can hold.

➤ Data and information access

Data and information access can be *sequential or Direct (Random)*;

- *Sequential access* means that data must be accessed consecutively.

  Magnetic tapes allow only sequential access; the tape must be forwarded or rewound to a specific point to access a specific piece of data.

- *Direct (Random) access* means that data can be accessed directly without the need to pass by other data in sequence.

  Magnetic disks and optical disks provide direct access.

➤ Access Time

This refers to the speed of a storage device and memory.

It measures;

- ↗ The amount of time it takes a storage device to locate an item on a storage medium, or
- ↗ The time required to deliver an item from memory to the processor.

Compared to main memory, storage devices are slow.

➤ Transfer rate

This is the speed with which data, instructions, and information transfer to and from a device.

Transfer rates for storage are stated in KBps (kilobytes per second) and MBps (megabytes per second).

➤ A storage device

This is the instrument used to record and retrieve items to and from a storage medium.

Storage devices can function as sources of input and output.

They can act as input devices when they read and act as output devices when they write.

Reading and writing on a storage device

Reading

This is the process of transferring data, instructions and information from a storage device into memory.

Writing

This is the process of transferring data, instructions and information from memory to a storage media.

2.4.1. Types of storage devices
- **Primary storage devices**
- **Secondary storage devices**

a. **Primary storage devices** are devices which store data and instructions temporarily for immediate access and use by the computer's microprocessor.

<div align="center">Examples; RAM</div>

b. **Secondary storage devices**

It refers to the media on which data, instructions, and information are kept, as well as the devices that record and retrieve these items.

These devices store data permanently in a computer.

2.4.2. Examples of secondary storage media

2.4.2.1. *Magnetic Media*

Magnetic media are based on a technology of representing data as magnetized spots on the tape or disk -- with a magnetized spot representing a 1 bit and the absence of such a spot representing a 0 bit.

Examples of magnetic storage devices

Magnetic tape

- These emerged due to the failure of the punched cards.
- A magnetic tape comprise of a reel of tape (ribbon), which is coated with a magnetic surface onto which data is recorded in form of magnetic particles.
- It was one of the first storage media used with mainframe computers.
- It can be written to and erased from, using a current of electricity.
- They had a very low transfer rate
- Had much access time
- Its data access is sequential. Data must be accessed in the order in which it is stored. If the computer is to read data from the middle of a reel of tape, all the tape before the desired piece of data must be passed over sequentially.

Similar to a tape recorder, a *tape drive*, also called *tape backup units (TBUs)*, is used to read from and write data and information onto a tape.

Although older computers used reel-to-reel tape drives, today's tape drives use tape cartridges.
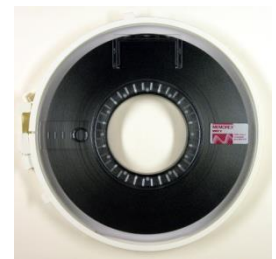
A *tape cartridge* is a small, rectangular, plastic housing for tape.

Advantages of magnetic tapes
- ✓ Its storage is large than that of floppy disks.
- ✓ It is light and portable

Disadvantages of magnetic tapes
- • Data access is only sequential which is time wasting.
- • Has limited shelf life (maximum of 2 years)

Application of magnetic tapes

Business and home users utilize tape most often for *long-term data storage* and *backup*.

Floppy disks (diskettes)
- A floppy disk is a thin, circular, flexible plastic disk with a magnetic coating enclosed in a square – shaped plastic shell.
- They can be read from and written to using a **Floppy Disk Drive (FDD)**
- The drive is usually designated letter **A** (for a computer with only one drive)
- For two drives, one is designated A and the other B.
- The diskettes are usually available in 3 sizes
    - ○ 8", 5.25" and 3.5" (inches)
- They usually spin at about 350 revolutions per minute.
- They need to be formatted before writing on them.
- Their access time is 84 milliseconds (1/12 second)
- Data access is random (direct data access)
- Their transfer rates range from 250 to 500 KBps.
    - **NB: Formatting**
        - This is the process of preparing a disk for reading and writing.

Floppy drive

Advantages of floppy disks
- ✓ They are portable
- ✓ They are cheap
- ✓ Data on a floppy disk can be accessed randomly
- ✓ Data on a floppy disk can be write – protected from being changed accidently.
- ✓ They can be used to transfer data from one computer to another.

Disadvantages of floppy disks
- They provide less storage capacity of 1.44MB (about 500 double-space pages of text, several digital photographs, or a small audio file) compared to the hard disks.
- They are not durable
- They can easily be damaged by magnetic fields
- They operate at a low speed
- Can easily be lost or misplace because of their size.
- They can easily infect machines with viruses.

Care for floppy diskettes
- Avoid touching the disk surface
- Avoid bending them or putting weights on them
- Avoid exposing them to sun or heat and cold
- Keep them in dust free environments
- They should not be exposed to chemicals such as cleaning solvents.
- Keep the diskettes in their jackets.

Zip Disks
- These are storage devices that were made to store medium amount of data.
- Their capacity is bigger than that of floppy disks.
- Data access is random / direct
- Have got a faster transfer rate.
- It can be 100MB, 250MB or 750MB in storage

Zip Drive

Hard disk (Fixed disk/Hard driver)
- This is a metallic magnetic media housed in an air tight rigid box, found inside the computer system unit to avoid contamination.
- It usually consists of several inflexible, circular metal platters coated with magnetic oxide that can be magnetized to represent data.
- Some hard disks are internal and others are external.
- Current personal computer hard disks have storage capacities from 160 GB to 1 TB and more.
- Data access is random / direct
- They have high data transfer rate

Advantages of hard disks
- ✓ They provide a greater storage capacity
- ✓ They are speedy i.e. the time of data access is very fast and convenient
- ✓ They are cheaper than floppy disks per megabyte.
- ✓ They are more reliable than floppy disks.
- ✓ There are fewer chances of being misplaced because they reside inside the system unit
- ✓ The life of hard disks is quite long once in use.

Disadvantages of hard disks

- They are bulky (not portable)
- They are susceptible to virus attacks especially in unprotected systems.
- Since they are metallic, they expand and contract depending on the temperature changes which may lead to data loss.
- May easily fail due to violent shaking (vibrations)

An **external hard disk** is a separate free-standing harddisk that connects with a cable to a USB port or FireWire port on the system unit.

A **removable hard disk** isa hard disk that you insert and remove from either a dock or a drive.

Internet hard drive, also called **onlinestorage**, is a service on the Web that provides storage to computerusers, usually for a minimal monthly fee.

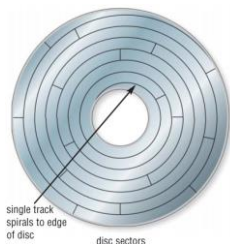### 2.4.2.2.   *Optical storage Media*

In **optical technology,** a laser hits a layer of metallic material spread over the surface of a disk.

When data is being entered, heat from the laser produces tiny spots on the disk surface.

To read the data, the laser scans the disk, and a lens picks up different light reflections from the various spots.

Examples of optical storage media

An **optical disc;**

It is a flat, round, portable storage medium made of metal, plastic, and lacquer that is written and read by a laser.

Optical discs used in personal computers are 4.75 inches in diameter and less than one-twentieth of an inch thick.

Smaller computers and devices use mini discs that have a diameter of 3 inches or less.

Many different formats of optical discs exist today.

Categories of optical discs
- *Compact discs (CDs)*
- *Digital Video Disks (DVDs)*

(a)   *Compact disks (CDs)*

- A compact disk is a flat, round, portable, storage medium usually with a diameter of 12cm and thickness of a few millimeters.
- They store items by using microscopic <u>pits and land</u> that are in the middle layer of the disk.
- Data access is random / direct
- Have a very fast access time
- Data transfer rate is very high.

      NB:

➢ **Land**

This causes light to reflect, which is read as binary digit 1

➢ **Pits**

It absorbs the light and this absence of light is read as binary digit 0.

➢ **A track**

Is a narrow recording band that forms a full circle on the surface of a disk.

➢ **A sector**

Is a pie shaped section on a disk and is capable of holding 512 bytes of data.
- The CD is designated a letter D incase the hard disk is C.

Advantages of compact disks
✓ More portable than a hard disk
✓ Has relatively large storage (650-700MB) than diskettes
✓ They are easy to store
✓ They have a very fast access speed.
✓ They are not easily attacked by viruses

Disadvantages of compact disks
- Any single scratch or breakage on a CD can render the whole CD useless.
- Most CDs are read only.

Fig; A DVD/CD drive

Care for compact disks
- Always store the CD in its jacket (jewel box) when not in use.
- Always hold a compact disk by its edges.
- Never touch the underside of the CD
- Never stack disks on top of each other
- Never expose CDs to excessive heat or sunlight.

Types of compact disks
❖ CD – ROM
❖ CD – R
❖ CD – RW
❖ Photo CD

(i) CD – ROM (Compact Disk - Read Only Memory)
- Is a compact disk that uses laser technology for recording music and data.
- Is a type of optical disc that users can read but not write or erase-hence, the name read-only.
- The contents of standard CD-ROMs are written or recorded by the manufacturer and can only be read and used.
- Contents of a CD – ROM can't be modified
   Manufacturers use the transfer rate to measure the speed of a CD ROM drive.
   Manufacturers use an X to denote the original transfer rate of 150KB per second. For example, a 48X CD-ROM drive has a data transfer rate of 7,200 (48 x 150) KB per second.
   - Current CD-ROM drives have speeds ranging from 48X to 75X or faster.

(ii) CD – R (Compact Disk - Recordable)
- Is a technology that allows a user to write on a compact disk using his or her computer.

- Once you have recorded the CD-R, you can read from it as many times as you desire.
- A CD-R is a *multisession optical* disc. It allows you to write on part of the disc at one time and another part at a later time.
- However, you cannot erase the disc's contents.
- In order to write on a CD-R, you must have a CD-R drive and CD-R software.
- A CD-R drive can read both audio CDs and standard CD-ROMs.
- These drives read at speeds of 48X or more and write at speeds of 40X or more.

(iii) CD – RW (Compact Disk - Rewritable)
- Is an erasable compact disk that can be written on multiple times.
- To write on a CD-RW, you must have a CD-RW drive and CD-RW software.
- A typical CD-RW drive has a write speed of 52X or more, rewrite speed of 32X and more, and a read speed of 52X or more, stating in the order as 52/32/52.
  NB: CD – RW cannot be read be all CD – ROM drives.

(iv) A Picture (Photo) CD
- Is a compact disc that only contains digital photographic images saved in the jpg file format.
- You can purchase Picture CDs that already contain pictures.
- A Picture CD is a **multisession disc**, i.e. you can write additional data to the disc at a later time. Thus, you can have your own pictures or negatives recorded on a Picture CD so that you have digital versions of your photographs.
- The images on a Picture CD can be printed, faxed, sent via electronic mail, included in another document, or posted to a Web site.
- Many people use Picture CD to preserve their photos.

(b) Digital Video Discs (DVDs)

- ❖ DVD – ROM
- ❖ DVD – R
- ❖ DVD + RW
- ❖ DVD – RAM
- ❖ BD-ROM
- ❖ HD DVD
- ❖ HD VMD
- ❖ UMD

(i) DVD – ROM (Digital Video Disk – Read Only Memory)
- Is an extremely high capacity compact disk capable of storing from 4.7GB to 17GB.
- A DVD – ROM drive or a DVD player is required to read a DVD – ROM.
- Operating very much like CD-ROM technology, DVD-ROM uses a laser beam to read microscopic spots that represent data. But DVD technology uses a laser with a shorter wavelength, permitting it to read more densely packed spots, thus increasing the disk capacity.

(ii) DVD – RAM (Digital Video Disk - Random Access Memory)
Is a recordable and rewritable version of DVD – ROM, which allows items to be erased and recorded on it multiple times.

(iii) DVD – R (Digital Video Disk - Recordable)
Is a recordable and rewritable version of DVD – Rom which can be written once
and read (played) for many times.

(iv) DVD – RW (Digital Video Disk - Rewritable)

Is a recordable and rewritable version of DVD – ROM which can be written and read (played) for many times

(v) **A Blu-ray Discs-ROM (BD-ROM)**

This is a newer competing DVD format with higher capacity and better quality than the standard DVDs.

It has storage capacities of 100 GB, with expectations of exceeding 200 GB in the future.

(vi) **HD (high-density) DVD-ROM**

It is also a newer competing DVD format with higher capacity and better quality than the standard DVDs.

It has storage capacities up to 60 GB with future projections of 90 GB capacities.

(vii) **HD VMD (Versatile Multilayer Disc)**

Another high density format, called **HD VMD (Versatile Multilayer Disc)**, recently emerged as a competitor to Blu-ray and HDDVD.

Current HD VMDs have capacities of 40 GB and more.

With future technology, an HD VMD potentially will contain up to 20 layers, each with a capacity of 5GB.

(viii) **UMD (Universal Media Disc),**

It is a mini-DVD that has grown in popularity.

It works specifically with the PlayStation Portable handheld game console.

The UMD has a diameter of about 2.4 inches, and can store up to 1.8 GB of games, movies, or music.

2.4.2.3. *Semi – Conductor storage devices (Solid state storage devices)*

These are storage devices which consist entirely of electronic components and contain no moving parts.

Examples of storage devices;

(i) Punched Cards [solid state]

- These were flat cards which consisted of rows of numbers and letters neatly arranged in columns.
- To store data, the card was inserted in a computer drive and then the computer punched a series of holes in the rows of characters to represent the data stored.
- They had a very low transfer rate
- Had much access time
- Data access was sequential

Fig; A punched card

Disadvantages of punched cards

- The cards were made of papers which could easily be damaged by weather.
- They have a very small storage
- One needed many cards to store relatively large volumes of data, hence becoming bulky.
- They had limited shelf life because papers easily depreciate.

(ii) Flash memory cards

These are a type of solid-state media, which means they consist entirely of electronic components and contain no moving parts.

Types of flash memory cards
  - o *CompactFlash (CF),*
  - o *SmartMedia,*
  - o *Secure Digital (SD),*
  - o *MicroSD*, *miniSD*,
  - o *xDPicture Card*, and
  - o *Memory Stick.*

Depending on the device, manufacturers claim these storage media can last from 10 to 100years.
Transfer rates range from about 1 MBps to 20 MBps or more.

*(iii)*A *USB flash drive*

This is a flash memory storage device that plugs in a USB port on a computer or mobile device.

USB flash drives are convenient for mobile users because they are small and lightweight enough to be transported on a keychain or in a pocket.

Current USB flash drives have data transfer rates of about12 MBps and storage capacities ranging from 256 MB to 64 GB.

USB flash drives have become the mobile user's primary portable storage device, making the floppy disk nearly obsolete because they have much greater storage capacities and are much more convenient to carry.

If a computer has one internal hard disk (drive C) and a DVD drive (drive D) and no other disk drives, the USB flash drive probably will be drive E.

(iv)Microfilm and Microfiche
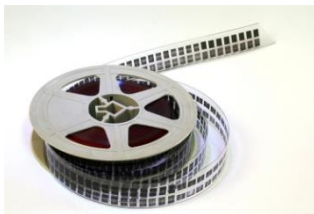
These are used to store microscopic images of documents on roll or sheet film.

Microfilm is a 100- to 215-foot roll of film.
Microfiche is a small sheet of film, usually about 4×6 inches.

The images are recorded onto the film using a device called a *computer output microfilm recorder*.

The stored images are so small they can be read only with a microfilm or microfiche reader.

Microfilm and microfiche have the longest life of any storage medium.

Figure 5-63 A comparison of different types of storage media and memory in terms of relative speed and uses
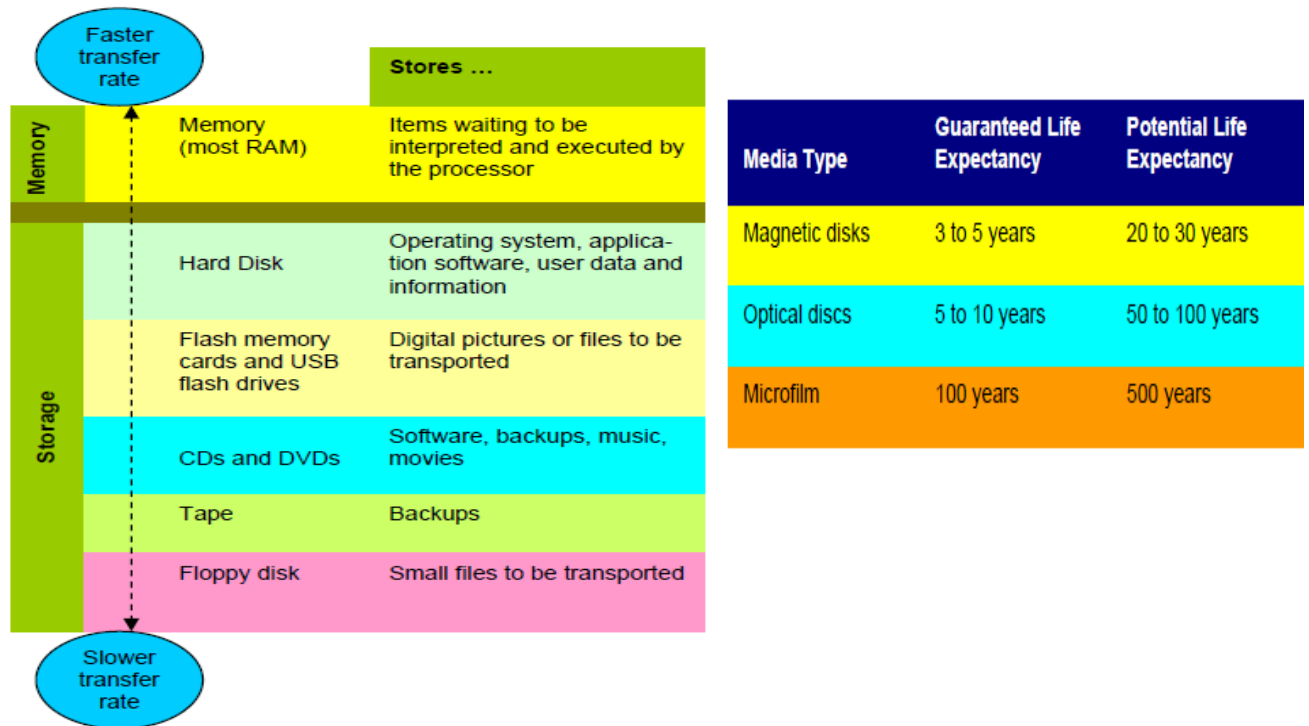
Applications of microfilm and microfiche

↗ Libraries use thesemedia to store back issues of newspapers, magazines, and genealogy records.

↗ Some large organizations use these media toarchive inactive files.

↗ Many banks use them to store transactions and canceled checks.

↗ The U.S. Army uses them to store personnel records.

Other Types of Storage Media

A PC Card

This is a thin, credit card-sized removable flash memory device that fits into a PC Card expansion slot on a personal computer.

An Express Card module

This is a removable device, smaller than a PC Card that fits in an Express Card slot.

Different types and sizes of PC Cards and Express Card modules are used to add storage, additional memory, communications, multimedia capabilities, and security capabilities to a computer.

PC Cards and Express Card modules are commonly used in notebook computers.

Some digital cameras also use PC Cards called *picture cards*.

A smart card

This is similar in size to a credit card.

It stores data on a thin microprocessor embedded in the card.

A smart card contains a processor and has input, process, output, and storage capabilities.

When the smart card is inserted into a specialized card reader, the information on the smart card is read and, if necessary, updated.

Applications of credit cards

↗ One popular use of smart cards is to store a prepaid dollar amount, as in prepaid telephone calling card.

↗ Many hotels issue smart cards instead of keys to hotel guests which enables the guests to gain access to their rooms and other hotel services.

↗ They can also be used in storing patient records, vaccination data, other health-care information.

↗ They are also used in tracking information such as customer purchases or employee attendance; storing a prepaid amount, such as electronic money; authenticating users such as for Internet purchases or building access.

↗ Some organizations use smart cards as an ID card.

i) Magneto – optical disk (MO) [magneto optic]
ii) Online Storage.

STORAGE MEDIA DRIVES

DRIVE TYPE	DRIVE LETTER
3.5"	A:
5.25"	B:
Hard disk	C:
CD – ROM	D:
Tape/Zip drive	E:
System drives (network drives non – movable)	F: - Z:

2.4.3. COMPUTER MEMORY

Memory refers to the area or space in the computer where programs and data reside during computer operations.

• It is a temporary store or space where instructions to be executed by the processor and the data to be processed are placed while performing the processing operation.

• A computer's *memory* in the system unit, located physically close to the CPU (to decrease access time), provides the CPU with a working storage area for program instructions, data and information.

• Memory is also known as *primary storage* or *internal storage*.

• Memory usually consists of one or more chips on the motherboard or some other circuit board in the computer.

• It rapidly provides the instructions and data to the CPU.

• It stores three basic categories of items:
  ➢ the operating system and other system software that control or maintain the computer and its devices;
  ➢ application programs that carry out a specific task such as word processing; and
  ➢ the data being processed by the application programs and resulting information.

Types of computer memory
   i)   **Volatile memory**
   ii) **Non – volatile memory**

   i)   **Volatile memory**
            The contents of *volatile* memory are lost whenthe computer power is turned off.

            Examples of Volatile memory
            Random Access Memory (RAM)
            Cache memory
      -   This refers to the memory where data and instructions are temporarily held for
           immediate access and use by the computer's microprocessor.
      -   Primary memory is also called the "Main memory" or "Random Access Memory"

                    Characteristics of RAM
      o   It is a temporary memory.
      o   The user can read from it and write to it.
      o   Es It loses its contents when power goes off
           (i.e. it is volatile)
      o   It can be increased.

Types of RAM
      -   DRAM (Dynamic Random Access
           Memory)
      -   SDRAM (Synchronous Dynamic Random Access Memory)
      -   SRAM (Static Random Access Memory)
      Other terms related to RAM
   i.   **Cache memory**
      -   Is a kind of temporary memory which holds the recently or frequently used
           instructions and data.
      -   A cache is a relatively small block of very fast memory designed for speeding up the
           internal transfer of data and software instructions.
      -   It is used to speed up the computing process.
           Types of cache memory
                  L1 cache
                  L2 cache
                  L3 cache
   ii. **Virtual memory;**
      -   It is a type of memory allocated by the operating system to function as additional
           RAM.
      -   This portion of storage medium is usually got from the hard disk.
      -   The area of the hard disk used for virtual memory is called a **swap file.**

   Non – Volatile memory
   The contents of *non-volatile* memory are not lost when power is removed from the computer.
   Examples of Non-volatile memory
           Read Only Memory (ROM)
           Flash memory
           Complementary Metal Oxide Semi-conductor (CMOS)

ii) READ ONLY MEMORY (ROM)

- It is a non – volatile, permanent type of memory found in the computer.
- The items stored in ROM chips cannot be modified, hence the name **read-only**.
- The data, instructions, or information stored on ROM chips often are recorded when the chip is manufactured by the manufacturer.
- ROM chips that contain permanently written data, instructions, or information are called *firmware*.
- Firmware can be read and used, but cannot be changed by user.
- ROM contains the programs that direct the computer to load the operating system and other files when the computer is turned on.
- ROM chips in printers contain data for fonts.

Types of ROM

a) Programmable Read Only Memory (PROM)

- It is a kind of memory which can only be programmed once after it has been manufactured.
- Once the data and instructions are programmed into PROM chip, the chip functions like a regular ROM and cannot be erased or changed.
- It is common with CD – W (Compact - Disk Writable)

b) Electronically Programmable Read Only Memory (EPROM)

- Is a kind of memory on which instructions can only be erased once and then reprogrammed.
- Afterwards, the reprogrammed instructions can never be altered.
- It is common with compact disk re – writable.

c) Electronically Erasable Programmable Read Only Memory

- It is a type of memory that enables a user to store information on it as many times as one may desire.
- The instructions remain in memory until when one may wish to alter them.
- It is common in applications such as most color TVs to store TV settings such as color, contract, brightness, Mobile phones to store phone numbers etc

Characteristics of ROM

- The user can read the contents of ROM but can't make modifications or write to it.
- It is a permanent memory
- It is a non – volatile memory.
- It cannot be increased.

Other terms related to ROM

i. BIOS (Basic Input / Output System)

- It resides in the ROM.
- It is a sequence of instructions the computer follows to load the operating system and other files when the computer is turned on.

iii) CMOS (Complementary Metal Oxide Semiconductor)`

- It is used to store configuration information about the computer.
- This information includes;
  - ➢ the amount of memory installed,
  - ➢ types of disk drives, type of keyboard,
  - ➢ monitor,
  - ➢ current date and time e.t.c.

- CMOS technology uses a CMOS battery power to retain its information even when the computer is turned off.
- Its contents can be changed.
- It provides high speeds and consumes little power.

iv) Flash Memory

- Flash memory is a chip that keeps its memory when the power is shut off.
- It can be erased electronically and reprogrammed.
- Most computers use flash memory to hold their start-up instructions because it allows the computer easily to update its contents.
- Flash memory chips also store data and programs on many mobile computers and devices, such as;

- smart telephones,	- automotive devices,
- digital cameras,	- portable media players,
- pagers,	- digital voice recorders,
- PDAs,	- printers,etc.

2.4.4. Memory management

1. **A Buffer** is an area of memory or storage in which data and information is placed while waiting to be transferred to or from an input or output device.

Importance of the buffers
- They help the operating system to carefully monitor the contents in memory.
- It helps the operating system to clear these items from memory when they are no longer required by the CPU.

2. **Spooling print job**
   - With spooling, the print jobs are placed in a buffer instead of being sent immediately to the printer.
   - When the print job is placed in the buffer, the CPU is available to process the next instruction and the computer can be used for other tasks.

Measurement of Computer Memory
- In a computer system, data is represented using the binary coding system (i.e. combination of binary digits [Bits])
- There are only two binary digits; 1(on) and 0 (off).
- These digits can be arranged to represent characters, digits and other values.

Definitions;

i. Bit;
- Is the smallest unit of measurement of computer memory.
- Each 0 or 1 is called a "Bit"

ii. Nibble
- Is a group of four (4) binary digits.

iii. Byte;
- It is a group of eight binary digits.
- A byte represents one character or digit.
- It is the fundamental (basic) unit for measuring computer's memory.

iv. A kilo byte (KB);

- Is a group of 1000 bytes (or exactly 2^{10} or 1024 bytes)
  ## v. Megabyte (MB);
  - Is a group of 1,000,000 bytes (or exactly 2^{20} bytes)
  ## vi. Giga byte (GB);
  - Is a group of 1,000,000,000 bytes (or exactly 2^{30} bytes)
  ## vii. Terabyte (TB);
  - Is a group of one trillion bytes (2^{40} bytes)

Term	Abbreviation	Approximate Size	Exact Amount	Approximate Number of Pages of Text
Kilobyte	KB or K	1 thousand bytes	1,024 bytes	1/2
Megabyte	MB	1 million bytes	1,048,576 bytes	500
Gigabyte	GB	1 billion bytes	1,073,741,824 bytes	500,000
Terabyte	TB	1 trillion bytes	1,099,511,627,776 bytes	500,000,000

The binary coding (System) scheme

a) ASCII (American Standard Code for Information Interchange)
- It was developed by the American National Standards Institute to provide a standard code that could be used by many different computer manufacturers to make machinery compatible.
- It is usually used to represent data for **microcomputers**.
- It consists of asset of 256 characters represented by this code.
- It is the most commonly used code for information communication though some characters in the code do other purposes like the control of printing and system bell.
- Characters like E are represented as 01000101. Its decimal value is character 69.

b) EBCDIC (Extended Binary Coded Decimal Interchange Code)
- It was developed by IBM in the 1950s and represents character with 8 bits.
- EBCDIC is used in IBM and other **mainframe computers**.
- It employs the 8 – bit character.
- Character E would be represented as 11000101

c) Unicode
- Was been developed for more complex languages.
- Unicode allows twice as many bits as ASCII does.
- Unicode is implemented in several operating systems, including Windows XP, Mac OS, and Linux.
- Unicode-enabled programming languages and software products include Java, XML, Microsoft Office, and Oracle.

d) BCD (Binary Coded Decimal)
- It employs the 6 – bit combination
- Characters are represented with a 6 – bit combination; e.g. character E is represented as 110101.

Character	ASCII	EBCDIC
A	0100	11000001
B	0100	11000010
C	0100	11000011
D	0100	11000100
0	0011	11110000
1	0011	11110001

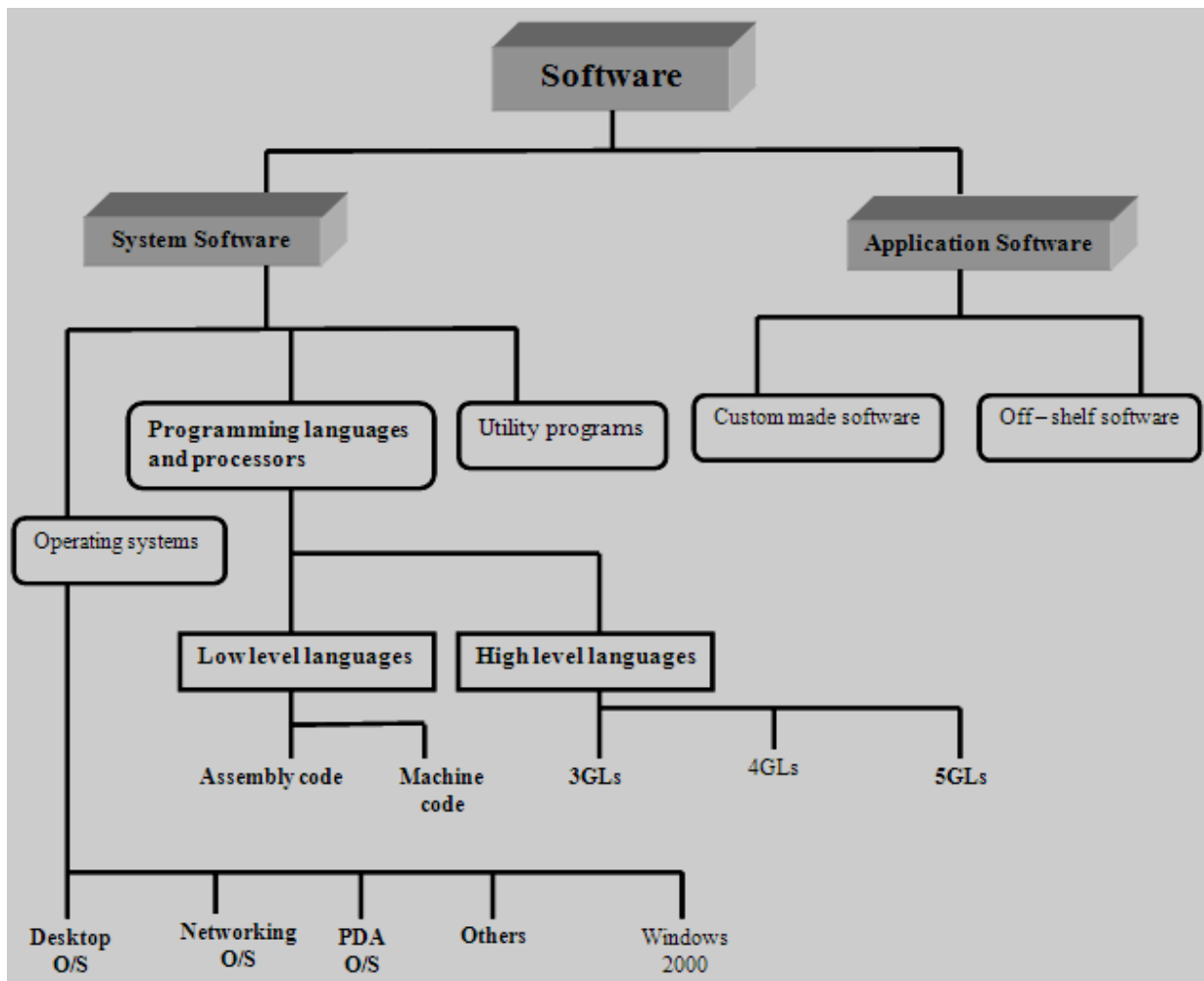| 2	0011	11110010
3	0011	11110011

3. COMPUTER SOFTWARE

SOFTWARE:

It is a program that consists of step by step instructions that tell the computer how to perform a given task.

NB:

A program;

A *computer program* is a sequence of instructions, written to perform a specified task with a computer.

3.1. Characteristics of software
- ➢ Computer software is intangible
- ➢ Computer software gives instructions/procedures to computers
- ➢ Computer software is copyrighted
- ➢ Computer software can be installed
- ➢ Computer software is executable
- ➢ Loads into Memory when running
- ➢ All software has a source Code written by a programming Language.

3.2. Types of computer software

3.2.1. SYSTEMS SOFTWARE
- These are a set of instructions that control the operation of the computer and its devices.
- It refers to the various computer programs that control the way a computer operates.

3.2.1.1.   Characteristics of system software
- It is machine dependent.
- It serves as the <u>interface</u> between the user, the application software and the hardware.
- They are written by computer programmers or professional system programmers.
- Some of these programs stay / reside in ROM (permanently) hence known as <u>firmware.</u>
- It is usually supplied by the manufacturers of the computer

3.2.1.2.   Types of system software
a)   Operating system
b)   Utility software
c)   Programming languages

a) OPERATING SYSTEM;
It is a set of programs that coordinate the operation of all hardware and application software components of a computer

The operating system relies on **device drivers** to communicate with each device in the computer.

Definition;

A device driver is a small program that tells the operating system how to communicate with a device.

Functions of the Operating System
- ✓ Controls the hardware resources like accessing disk drives, printers and keyboard.
- ✓ Calling into memory programs and instructions when required.
- ✓ Protecting hardware, software and data from improper use e.g. when deleting a file.
- ✓ Provides error correcting routines e.g. when data is lost during transfer, it should be recovered.
- ✓ Communicating with the user e.g. reporting suspended program due to error, request for operation e.g. insert disk.
- ✓ Manages files and memory thereby saving the user from knowing where in memory his files are to be stored.
- ✓ Scheduling and loading programs so as to provide a continuous sequence of operation.
- ✓ Enables application software to interface with the hardware.
- ✓ Provides an interface between the user and the application software and the hardware.
- ✓ Manipulating data
- ✓ Managing the processor
- ✓ Providing security
- ✓ Managing multitasking

- Provides basic working environment/interface.
- Controlling the use of peripherals.
- Controlling the loading and running of application programs.
- Organizing the use of memory/Memory management
- Booting

- File management
- Protecting hardware and software
- Configuring devices
- Processor management e.g multitasking and time sharing.

Examples of operating system software

i)   Disk Operating System (DOS)
- This is a single user interface which was developed in the early 1980 for personal computers.
- It uses a command line interface (CLI)
- It is the main system control program that enables the computer to operate.

Examples of DOS
- PC DOS developed by Microsoft for IBM
- Ms DOS which was sold to makers of IBM compatible PCs by Microsoft

NB;

USER INTERFACE

This controls how users enter data and instructions into the computer and how information is displayed on the screen.

Types of User Interfaces

a) Command Line Interface (CLI)

This is a kind of interface which allows a user to type key wards or press special keys on the keyboard to enter data and instructions into a computer.

Advantages of CLI
- ✓ Takes up little space
- ✓ Doesn't require a very fast processor.
- ✓ Operation is quite fast because commands can be entered directly through the key board.
- ✓ Many commands can be grouped together as a batch file so that repetitive tasks can be automated.

Disadvantages of CLI
- A command language has to be learnt and memorized.
- It is not user friendly.
- The interface may vary from application to application.

b) Graphical User Interface (GUI)

This is the kind of interface that allows a user to use menus and visual images such as icons, buttons and other graphical objects to enter commands into the computer.

Advantages of a GUI
- ✓ It is user friendly
- ✓ No need to type or memorize any command language
- ✓ The interface is similar for any application.

Disadvantages of a GUI
- Requires more memory
- Requires a very fast processor.
- It is difficult to automate functions for expert users.
- Occupies more disk space to hold the files for all the different applications.

ii)   Windows Operating System

- This is an operating system that uses icon – based graphical user interface that simplifies working on a computer.

Versions of windows;

- Windows 3.0
- Windows 95
- Windows 98
- Windows NT workstation
- Windows 2000 professional
- Windows 2000 server

- Windows M.E (Millennium)
- Windows Xp Home
- Windows Xp Professional
- Windows Vista

iii)   Networking Operating Systems (NOS)

It is a system software that organizes and coordinates the activities on a LAN.

These O/S are designed to be used on several computers that exist on a network.

They include;

- Novell Netware
- Sun Solaris
- Windows NT
- Microsoft windows 95, 98, ME, NT, 2000 server, XP, etc.

- UNIX
- Linux
- IBM OS/2 wrap

Tasks performed by NOS

- Administration of network users
- System maintenance tasks such as backup
- File management tasks

- Prioritizing print jobs on the network
- Monitoring security on network resources

iv)   UNIX

- It is a multi user O/S.
- It can run multiple applications at the same time (multitasking)
- It was developed in 1970s by scientists at Bell laboratories.
- It has a command line interface and most of its commands are difficult to remember.

v)   Linux

- It is an "Open Source" software i.e. its code is made available to the public.
- It is a popular, free UNIX – like multitasking operating system.

vi)   Palm O/S

Is an operating system designed for the hand – held computers (Personal Digital Assistants – PDAs)

Examples of palm O/S;   Pocket PC 2002

vii)   Windows CE

Is a windows operating system designed for use on wireless communication devices and hand – held computers.

Utility programs

A *utility program* is a type of system software that allows a user to perform maintenance-type tasks, usually related to managing a computer, its devices, or its programs.

Utility programs included with most operating systems provide the following functions:

- ✓ Managing files, searching for files,
- ✓ Viewing images,

- ✓ Securing a computer from unauthorized access,
- ✓ Uninstalling programs,
- ✓ Scanning disks,
- ✓ Defragmenting disks,
- ✓ Diagnosing problems,
- ✓ Backing up files and disks,
- ✓ Setting up screen savers .etc

Examples of utility programs

i)   A file manager;

It is a utility that performs functions related to file and disk management.

Windows Vista and XP include file managers called *Explorers* (Documents Explore, Pictures Explore, and Music Explore).

Functions performed by file managers

- ↗ Formatting and copying disks
- ↗ Organizing files in folders
- ↗ Displaying a list of files on a storage medium
- ↗ Checking the amount of used or free space on a storage medium
- ↗ Organizing, copying, renaming, deleting, moving, and sorting files; and
- ↗ Creating shortcuts.

NB: A *folder* is a specific named location on a storage medium that contains related documents.

A *shortcut* is an icon on the desktop that provides a user with immediate access to a program or file.

Formatting is the process of preparing a disk for reading and writing.

ii)   A search utility

Is a program that attempts to locate a file on your computer based on the criteria you specify.

The criteria could be a word or words contained in a file, date the file was created or modified, size of the file, location of the file, file name, author/artist, and other similar properties.

iii)   An image viewer

Is a utility that allows users to display, copy, and print the contents of a graphics file.

With an image viewer, users can see images without having to open them in a paint or image editing program.

iv)   A personal firewall

Is a utility that detects and protects a personal computer from unauthorized intrusions.

Personal firewalls constantly monitor all transmissions to and from a computer.

When connected to the Internet, your computer is vulnerable to attacks from hackers (people who tries to access a computer or network illegally).

v)   An uninstaller

Is a utility that removes a program, as well as any associated entries in the system files.

In Windows Vista and Xp, you are able to access the uninstaller for many installed programs through the "Uninstall a program" command in the Control Panel.

You also are able to access the uninstaller for some programs through that programs folder on the Start menu, or on the program's installation media.

The uninstaller deletes files and folders from the hard disk, as well as removes program entries from the system files.

Examples of uninstallers;
McAfee's uninstaller

vi)   A disk scanner

Is a utility that searches for and removes unnecessary files from the hard disk.

Windows Vista and XP includes a disk scanner utility, called **Disk Cleanup**, which searches for and removes unnecessary files such as temporary files.

It is used to detect and correct both physical and logical problems on a hard disk or floppy disk and searches for and removes the unwanted files.

A physical problem is one with the media e.g. any scratch on the surface of the disk.

A logical problem is one with the data e.g. corrupted File Allocation Table (FAT)

Examples of disk scanner

- Scan Disk
- Disk Clean Up.

vii)   **A disk defragmenter**

Is a utility that reorganizes the files and unused space on a computer's hard disk so the operating system accesses data more quickly and programs run faster.

When an operating system stores data on a disk, it places the data in the first available sector on the disk. It attempts to place data in sectors that are contiguous but this is not always possible.

When the contents of a file are scattered across two or more noncontiguous sectors, the file is *fragmented*. Fragmentation slows down disk access and thus the performance of the entire computer.

Disk defragmentation enables data to be accessed more quickly and programs to be run faster.

Examples of defragmenter in windows is the **Disk defragmenter**

NB;

Defragmentation

Is the process of reorganizing the disk so that the files are stored in contiguous sectors.

viii)   **A diagnostic utility**

- This compiles technical information about your computer's hardware and certain system software programs and then prepares a report outlining any identified problems.
- For example, Windows Vista includes the diagnostic utility **Problem Reports and Solution**, which diagnoses problems as well as suggests courses of action.
- Information in the report assists technical support staff in remedying any problems.
- Windows Xp has **Dr. Watson** as a diagnostic utility.

ix)   **A backup/Copy utility**

- This allows users to copy, or *back up*, selected files or an entire hard disk to another storage medium. During the backup process, the backup utility monitors progress and alerts you if it needs additional media, such as another CD or tape.
- Many backup programs compress, or shrink the size of files during the backup process.
- Because they are compressed, you usually cannot use backup files in their backed up form. In the event you need to use a backup file, a **restore program** reverses the process and returns backed up files to their original form.
- Backup utilities include restore programs.
- You should back up files and disks regularly in the event your originals are lost, damaged, or destroyed.

x)   **A screen saver**

This is a utility that causes a display device's screen to show a moving image or blank screen if no keyboard or mouse activity occurs for a specified time.

When you press a key on the keyboard or move the mouse, the screensaver disappears and the screen returns to the previous state.

Importances of screen savers

- Screen savers originally were developed to prevent a problem called **ghosting**, in which images could be permanently etched on a monitor's screen.
- Screen savers also are popular for security. They prevent unwanted lookers from accessing information or data from your computer.

  To secure a computer, users configure their screen saver to require a password to deactivate.
- Business – advertisements on the screen.
- Entertainment- in which digital photos can be put on your screen as moving pictures.

xi) *Debuggers*
- These are utility programs used during the testing of a program.
- They help in tracing and removing of errors from newly installed programs.

xii) *Sorting Utility*
- These are utility programs used to take in data and re – arrange it in any order as specified by the user.
- The order can be ascending or descending order.

xiii) *Merging Utility*
- These programs are used to combine two or more files to produce one file.

xiv) *Antivirus Software*
- This is used to prevent, detect and remove viruses from a computer's memory or storage devices.
- Examples include; **Norton Antivirus, Avira, Panda, Pc – Cillin, Dr. Solomon, McAfee, Avast antivirus, AVG antivirus, Kaspersky antivirus, Escan antivirus, F – secure antivirus, Netqin antivirus, Eset – Nod 32 antivirus, e.t.c.**

xv) *A file compression utility;*
- It is used to reduce or shrink the size of a file.
- A compressed file takes up less storage space on a hard disk than the original file.
- Compressing files frees up room on the storage media and improves system performance.
- In order to reduce transmission time, email attachments, and files to be uploaded or downloaded should always be compressed.
- When you receive or download a compressed file, you must uncompress it.
- Some operating systems such as Windows XP and Vista include uncompress capabilities
- Compressed files are sometimes called *zipped files* because they have a *.zip* extension.
- Examples of compression utilities; **PKzip, WinZip, Winrare.t.c.**

xvi) *A media player;*
- Is a program that allows you to view images and animation, listen to audio, and watch video files on your computer.
- Media players may also include the capability to organize media files, convert them to different formats, connect to and purchase media from an online media store, download podcasts and vodcasts, burn audio CDs, and transfer media to portable media players.
- Windows Vista and XP include Windows Media Player.
- Three other popular media players are iTunes, RealPlayer, and Rhapsody.

xvii) *CD/DVD burning software;*
- This writes files on a recordable or rewritable CD or DVD, including Blu-ray and HD DVD.

- This software enables the home user easily to back up contents of their hard disk on a CD/DVD and make duplicates of uncopyrighted music or movies.
- When you buy a recordable or rewritable CD or DVD, it typically includes CD/DVD burning software.

xviii) *A personal computer maintenance utility;*
- Identifies and fixes operating system problems, detects and repairs disk problems, and includes the capability of improving a computer's performance.
- Some personal computer maintenance utilities continuously monitor a computer while you use it to identify and repair problems before they occur.
- Norton System Works is a popular personal computer maintenance utility designed for Windows operating system.

xix) *file viewer utility program*

A file viewer utility program is the one that displays and copies the contents of a file.

An operating system's file manager often includes a file manager.

xx) *Disk checkers*

These can scan the contents of a hard disk to find files or areas that are faulty.

xxi) *Disk cleaners*

These can find files that are unnecessary to computer and can decide to delete.

xxii) *Disk compression*

These utilities can transparently compress / uncompress the contents of a disk, increasing the capacity of the disk.

xxiii) *Disk partitions*

These utilities can divide an individual drive into multiple logical drives.

xxiv) *Disk space analyzers*

These are used to get the size for each folder/ sub folders & files in folder or drive, showing the distribution of the used space.

xxv) *Disk storage utilities*

These help to manage storage of data onto a disk.

xxvi) *Archive utilities*

These help to output a stream or a single file when provided with a directory or a set of files. Archive utilities, unlike archive suites, usually do not include compression or encryption capabilities.

xxvii) *File managers*

These provide a convenient method of performing routine data management tasks, such as deleting, renaming, cataloging, uncataloging, moving, copying, merging etc.

xxviii) *Cryptographic utilities*

These are used to encrypt and decrypt streams and files.

xxix) *Hex editors*

These directly modify the text or data of a file.

xxx) *Memory testers*

These help to check for memory failures.

xxxi) *Network utilities*

These analyze the computer's network connectivity, configure network settings, check data transfer or log events.

xxxii) *Registry cleaners*

These utilities clean and optimize the Windows registry by removing old registry keys that are no longer in use.

xxxiii) *System monitors*

These utilities are for monitoring resources and performance in a computer system.

xxxiv) System profilers

These provide detailed information about the software installed and hardware attached to the computer.

b) PROGRAMMING LANGUAGES

A programming language is a set of instructions used to direct the operation of a computer.

Characteristics of programming languages

- Every programming language has instructions for input and output.
- Has instructions for calculations.
- Instructions for transfer of control instructions for data storage and retrieval.
- Instructions for data movements.

Categories of programming languages

There are two categories of programming languages;

1. Low Level Languages
2. High Level Languages

1. Low Level Languages

   (i)   Machine Code (First generation Language or 1GL)

- It consists of binary numbers that represent instructions, memory locations and data.
- Information is stored in computer circuits as electrical "ONs" and "OFFs" which can be represented in the binary system by 1 and 0 respectively.
- This is the only language that can be directly used by a computer.

Examples of binary codes

VALUE	BINARY CODE
A	01000001
B	01000010
C	01000011
1	00000001
2	00000010
3	00000011

Advantages of machine code

✓ It is efficient
✓ Allows control of each operation

Disadvantages of machine code

- It is very difficult to learn and very unfamiliar to humans.
- It is not user friendly
- Each type of processor had its own set of codes. Therefore, machine code programs written for one processor could not be used on another.
- It is very tiresome to program in machine code language and many errors are likely to occur.

   (ii)   Assembly language (Second generation Language or 2GL)

- This kind of low level language used English – like tags such as "ADD" or "SUB" for the codes to add or subtract values.

- These tags were called **Mnemonics.** They could stand for zeros and ones of machine language.
- An assembly language program has to be translated into machine language by an **assembler.**

Advantages of assembly language
✓ Programs could be written more easily that with machine language.
✓ Had a closer control over the computer hardware and executes very efficient.
✓ It is useful for writing operating systems and game programs which require fast and efficient CPU.

Disadvantages of assembly language
• They are also designed for specific machines and specific processors.
• Programming in these languages is tiresome because programs cannot be moved from one computer architecture to another without re – writing the code.

2. High Level Languages (Third generation Languages or 3GLs)
- A high level language is a language which consists of statements that resemble human language or mathematical notations.
- They are machine independent.
- Fewer instructions are written and therefore a lot is done in less time.
- It has a wide vocabulary of valid words, symbols and sentences.
- Translation of high level program into machine code is done by language <u>translators</u> (**Compilers and interpreters**)

LANGUAGE PROCESSORS (TRANSLATORS)
These are programs used to translate high level programming languages to low level languages that processors can understand.

i) Compilers
- These translate a program written in a high level language into machine code language.
- The entire program is translated into machine code at once.

ii) Assemblers
- These translate a low level language (assembly language) into machine code.

iii) Interpreters
- These translate source program, line by line while the program is running.
- This is done each time a program is executed. As a result, a program running under an interpreter runs very slowly compared to a compiled program.

iv) Linkers
- These programs combine compiled programs and determine where the program will be located in memory.

Examples of high level languages
a) COBOL
- It is an acronym for Common Business Oriented Language.
- It was a high level language widely used in business
- It was produced to enable efficient software to be produced for business applications.
  Examples of programs written in COBOL include; **payroll, accounting and stock control.**
- It uses English – like statements.

Advantages of COBOL

- ✓ It is fairly easy to understand.
- ✓ It can be used on different types of computers.
- ✓ It enables programmers to easily re – arrange records within a file.
- ✓ It enables programmers to easily produce reports.

Disadvantages of COBOL

- Coding is lengthy and tiresome to make.
- It takes longer to learn

b) BASIC (Beginners All Purpose Symbolic Instruction Code)

It was developed in 1964 by John Kemeny and Thomas Kutz to teach students how to use computers.

Advantages of BASIC

- ✓ It is easy to learn and use.
- ✓ It is so popular
- ✓ Several books exist that are used as self – teaching manuals.

Disadvantages of BASIC

- It is not a standard language
- There are many different versions of BASIC with so little compatibility between them.

c) FORTRAN (Formula TRANslation)

It was developed in 1956 by IBM to provide an easier way of writing scientific and engineering applications because of its simplicity, conciseness, standardization, efficiency and numerical precision.

Advantages of FORTRAN

- ✓ It is widely accepted and understood.
- ✓ It is easy to write a simple FORTRAN program.
- ✓ It includes mathematical functions that are good for solving problems.

Disadvantages of FORTRAN

- It is difficult to use it for other applications other than scientific and engineering applications.
- Input and output operations cannot be accomplished easily.
- Difficult to read reports and screen displays.

d) PASCAL

- It was named in remembrance of the inventor of the **mechanical adding calculator, Pascal Blaise.**
- It was developed to teach the concepts of structured programming.

Advantages of Pascal

- ✓ It reinforces the principles of structured programming.
- ✓ It is not limited to business or scientific applications.

e) ADA

- It was developed and named in honor of **Lady Augusta Lovelance Ada.**
- It was developed for the U.S department of defense to improve software reliability, portability and maintainability.

f) LISP (List Processing)

- It was developed in the late 1950s by John McCarthy of M.I.T.
- It is the prominent language used in artificial intelligence.
- Both programs and data are sorted as lists.

- Not suitable for commercial data processing.
- It is not widely available or known by many programmers.

g) LOGO
- It was developed for educational use.
- It could allow children to explore and develop concepts through programming the movement of a "turtle" or pen.
- It has no commercial purpose.

h) ALGOL (Algorithmic Language)
   It is suitable for scientific and engineering computations.

i) C
- It is a high level language
- It is the most portable general purpose language
- Derivatives of C are; C^+, C^{++}

j) PL/1 (Programming Language 1)
- It was developed for mainframe computers
- It is suitable for both scientific and commercial work.

k) PL/M (Programming Language Microcomputer);
- It was developed purposely for use with the Intel Microcomputers.
- It has a compiler.

l) APL (AProgramming Language)

3. Fourth generation Languages (4GLs / Application generators / program generators)
- Are languages designed to make the process of creating a computer – based application easier by doing the programming themselves.
- The user defines certain tasks and then the application generators will create the program code that will perform the tasks that have been defined.

   Examples of 4GLs
   - **Structured Query Language**

4. Artificial Intelligence Languages (Fifth Generation Languages / 5GLs)
- These are languages used in intelligent knowledge based systems (IKBs) such as robots.
- They "think" and reason like human beings because of the programs installed on them.
- They are extremely used in artificial intelligence projects like space exploration.

5. Web development languages
- These include HTML and JAVA
- HTML (Hypertext Markup Language) is one of the programming languages used to create web pages for the internet and intranets.
- JAVA is an Object Oriented Programming (OOP) language that resembles a simplified form of C^{++}.
- Object Oriented Programming (OOP) uses objects which combine data and behavior.
- OOP enables rapid program development. Examples include; **Visual Basic.**

3.2.2. APPLICATION SOFTWARE
Application software are programs that perform specific tasks for users.
Or
They are programs designed to enable a computer to do a particular job.
   Types of Application software
   1. Off - shelf software (general purpose software)
   2. Customized software (special purpose software)

1. **OFF – SHELF SOFTWARE (general purpose software)**
   These are software programs ready to run when purchased.
   Examples;
   - ✓ **MS-Office suite**, e.g. word processors, spreadsheets, presentation software etc.
   - ✓ **Computer games** e.g. chess, cross word puzzle, etc.
   - ✓ **Education software** e.g. Encarta,
2. **CUSTOMISED SOFTWARE (specialized software)**
   These are **tailor made** software which are developed at a user's request to perform specific functions.
   Examples;
   - ✓ Locally made school management systems(SMS),
   - ✓ Inventory management systems.
   - ✓ Payroll management systems
   - ✓ Library management system

NB:

A cross platform application

Is one that runs identically on multiple operating systems.

An Application Service Provider (ASP)

Is a third party organization that manages and distributes software and services on the web

Other terms related to application software

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

CHARACTERISTICS OF APPLICATION PACKAGES

i. They are targeted to a wide range of users.
ii. They are user friendly (easy to use)
iii. They are generally developed for flexibility.
iv. They should be machine independent (they are designed to work on a range of computers and can be transferred from one computer to another with ease)
v. They are menu driven i.e. the user takes a choice out of a number of options.

EXAMPLES OF APPLICATION SOFTWARE

- Word processing software
- Spreadsheet software
- Database software
- Presentation software
- Desktop publishing software
- Accounting software
- Paint and image editing software
- Web page authoring software
- Video and audio editing software
- Educational software
- Entertainment software
- Communications software
  e.t.c.

1. WORD PROCESSING SOFTWARE

Word processing:
Is the process of creating text based documents such as reports, letters, brochures, memos, mailing labels and newsletters.

Word processor
Is a software used to create, edit, format, save and print text based documents

Examples of word processing software
- Microsoft word
- Corel word perfect
- Lotus Word pro
- Word pad
- Word star
- Abi word.
- Mac write
- Ami pro.
- Magic wand.
  e.t.c

Functions of word processing software
- Allow text to be edited easily e.g. insert, delete and move text anywhere in the current document
- It can be used in mailing documents
- Mail merge.
- It can be used in graphics creating and handling e.g. frames, shapes
- It has inbuilt mathematical formulae especially in tables which can be used in manipulating data easily.
- It is used in creation of tables which are used to present data in a more organized way.
- It can be used in sharing of documents.
- It can be used by researches to compare data using graphs and charts.
- It has a word count feature which can be used in counting if words easily.
- It can be used in creating web pages for organizations.
- They are used by researchers and managers to create foot notes and cross references.
- They are used in creation of letters, document, memos etc
- Helps in saving on a storage device.
- Word processors are used in formatting and designing of simple office publications.

Features of a word processor;
i. Editing
It is the process of making changes to the existing content of a document

Common editing features
These include;
- *Copying*
- *Cutting*
- *Pasting*
- *Inserting*
- *Deleting*
- *Undo*
- *Redo*
- *Selecting*
- *Find*
- *Replace, etc.*

➢ **Undo**
It is the feature that allows actions that have been performed to be reversed such that if some text was accidentally deleted, then the action can be undone.

➢ **Redo**
It is the feature that allows actions that have been undone to be reversed.

➤ **Inserting**

It is an editing feature that allows adding text or graphics to a document.

➤ **Deleting**

Is the process of erasing text or graphics from a document.

➤ **Cutting**

Is the process of removing the original text from its original position onto the clipboard

➤ **Copying**

Is the process of duplicating and storing text on the clipboard.

NB; When text is cut, the original text is removed from its place while when text is copied, the original text remains in its original place.

➤ **Pasting**

Is the process of removing the text from the clipboard into the document.

➤ **Find**

This feature allows the user to locate all occurrences of a particular character, word or phrase.

➤ **Replace**

It is a feature that allows a user to substitute existing characters, words or phrases with new ones

ii. **Formatting**

It is the process of making changes to the appearance of a document.

Levels of formatting

- **Character formatting;**

This involves changing the **font, font size, or font style** of the text.

It involves applying the **boldface**, *italics* and <u>underline</u> text.

- **Paragraphs formatting;**

Involves changing the alignment of text, line spacing, indenting text, tab settings and boarders.

- **Section formatting;**

It lets you specify page numbers, headers and footers for different sections or chapters of a document.

- **Document formatting;**

It helps you specify the overall page layout for printing.

It involves choosing the paper size (letter, legal, A4, A3), page orientation (portrait or landscape), changing page margins (top, down, left or right) and the distances between the main body of text and the edges of the paper.

Other features of word processing software

iii. **Saving**

It is the process of transferring data / information from memory to a storage medium such as a floppy disk or a hard disk.

iv. **Printing**

Is the process of sending a file to a printer to generate output on medium such as paper.

v. **Word wrap**

This is an Ms word feature which allows a user to type continually without pressing the enter key at the end of each line.

vi. **Spelling checker**

Allows a user to check the spelling of a whole document at one time or check and correct the spelling or individual words as they are typed (Autocorrect).

vii. Grammar checker

It helps to report grammatical errors and suggests way to correct them.

viii.   Character map

Is a group of symbols not found on the keyboard

ix. Thesaurus

Helps to suggest alternative words with the same meaning (synonyms) for use in the document.

x. Mail Merge

Create form letters, mailing labels, and envelopes.

Used when similar letters have to be sent to several people.

The names and addresses of each person can be merged with one single standard document and then printed out.

xi. Automatic page numbering

Numbers the pages automatically in a document

xii. Tables

This is an Ms Word feature which allows a user to organize information into rows and columns.

xiii.   Multi columns

Arranges text in two or more columns that look similar to a newspaper or magazine.

xiv.   Macros

Allows a user to record or save frequently used keystrokes and instructions which can be executed later by running the corresponding macros.

xv. Clip art gallery

Clip art gallery allows a user to insert drawings, diagrams and photographs into a document.

xvi.   Mathematical formulae typesetting

Allows a user to typeset complex mathematical formulae with the program

xvii.   Templates

Allows a user to create documents which are frequently used

xviii.   Footnotes and endnotes

- Are used in printed documents to explain, comment on, or provide references for text in a document.

- You might use footnotes for detailed comments and endnotes for citation of sources.

xix.   Headers;

A header is the area in the top margin of each page where text can be entered.

xx. Footers;

A footer is the area in the bottom margin of each page where text can be entered.

xxi.   Line spacing

Line spacing - refers to the vertical distance between lines of text.

This feature allows a user to select a vertical or horizontal spacing between the characters depending on his need.

The default line spacing is single spacing. This type accommodates the characters in a text leaving a small extra space between lines.

Character spacing on the other hand refers to the space between thecharacters in the text.

xxii.   Changing Case

It is a feature that allows a user to type text in different cases.

These cases are:

(1.) **Sentence case**: All the first characters in a sentence are in uppercase(capitalized)

(2.) **Lowercase**: All characters appear in lowercase.

(3.) **Uppercase**: All characters appear in uppercase (all capitalised).

(4.) **Title case**: All the first characters of each word in a sentence appear inuppercase.

(5.) **Toggle case**: It changes upper case to lowercases and vice versa.

ADVANTAGES OF WORD PROCESSING SOFTWARE OVER THE ORDINARY TYPEWRITER

a. Easy and fast to make changes to the document.

b. Has many features to create documents that look professional and visual appealing.

c. Documents can be previewed before being printed.

d. Documents can be saved for future reference and editing.

e. It is convenient in making letters and mailing labels.

f. It is possible to move blocks of text to different positions in the same document.

g. One can insert and delete lines of text.

h. The layout of the document can be altered before printing.

i. All typing mistakes can be corrected.

j. The document can be printed many times.

k. Text can be added to a document without having to type it again.

l. It can be used to mail documents unlike the ordinary typewriter.

m. It can create graphics such as shapes, frames etc.

n. It can be used to create web pages.

o. One can easily count the words in the document using the word count feature.

p. It allows automatic insertion of footnotes and endnotes.
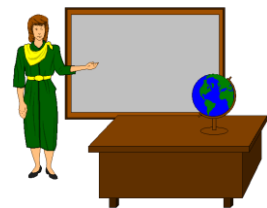
2. PRESENTATION SOFTWARE

This is the type of software used to create presentations which can communicate ideas and other information to a group or audience

Or

It is a software program that helps you to organize and present information to an audience.

The presentation can be viewed as a slide show on a large monitor or a projection screen.

Examples of presentation software;

- ✓ Microsoft power point
- ✓ Corel presentations
- ✓ Lotus Freelance graphics
- ✓ Harvard Graphics
- ✓ Micro media Director etc.

NB;

- **A presentation;** this is a collection of slides, handouts, speaker's notes and outlines in a single file.
- **A slide;** is an individual page in a presentation

Microsoft power Point

Presentation Elements

1. **Slides**
   - A slide is an individual page in a presentation.
   - They are normally viewed using projectors

2. **Slide Master**
   - This is a single slide that controls all other slides in a given presentation.
   - Any changes made to it affect the rest, respectively.
3. **Handouts**

   A handout is a combination of 2 to 6 slide images on a single page.
4. **Speaker's notes**
   - These help in the actual delivery of a presentation.
   - Power point lets you enter and print a notes page for each slide
5. **Outlines**
   - They help in brainstorming and organizing one's thoughts.
   - In the outline form, the headings and the main body text appears without the slide's background, colors and graphics.
6. **Templates**
   - Power point provides over 100 professionally designed templates containing proven layouts, color schemes and background textures.
   - **NB: A template** defines what your presentation will look like, where text and other objects will appear the foreground and the background colors to be used, etc.
7. **Auto features**
   - These make it easier for one to perform his or her work.
   - They include the clip art commands which enable the user to include clip arts in his or her presentation.

8. **Slide Layout**
   - This is the given design of a slide showing divisions/areas or sections of a slide where work can be done. E.g. title only and blank slide layouts.
9. **Wizards**
   - Power point employs many wizards to help in simplifying work.
10. **Transitional looping**
   - It is a facility which sets up the presentation to run continuously until it is stopped by the presenter.
   - It is got through slide show – setup show – then loop continuously until Esc. under show

options

Features of Microsoft Power Point;

(i) Auto correct
   - It helps to correct any typing errors and capitalization mistakes.

(ii) Auto clip art;
   - It provides clip art suggestions that relate to the presentation topic.

(iii) Style checker;
   - Allows the user to scan the presentation for design problems such as spelling errors, incorrect and inconsistent use of capitalization or punctuation and inconsistent use of font sizes and other related style attributes.
   - It can be customized to match the design rules you want your presentation to follow.

(iv) The pack and Go wizard;

   This feature helps in leading you step by step through preparing your presentation for delivery on another computer.

(v) Ability to present onscreen presentation in color;

- It enables the user to design his presentations in any color he / she want.
- It also provides different background colors which make the presentations appear nice and attractive.

(vi) Animations

It enables the user to put "Life" and impact to the presentation by adding motion and sound effects to objects in the presentation.

(vii)   Meeting minder

- It can help to improve communication during and after meetings.
- It can enable you to take the meeting's minutes and export them directly to a word processor for printing.

(viii)   Presentation conferencing;

Allows you to deliver a presentation or run a meeting from your computer onto a network of computers.

Viewing a presentation

Power point provides five different presentation views i.e.

- Slide show
- Outline view
- Slide sorter view
- Notes page view
- Slide show view

a) Slide view

- It shows you how the slide will appear when printed or displayed.
- It is similar to page layout in a word processor for windows
- All text, graphics and other media elements appear in slide view.

One can perform the following in slide view;

- Insert, edit and delete text.
- Add a clip art, charts, scanned photographs and other media elements.
- Draw lines, squares, ovals, polygons and other objects.
- Add graphs, charts or data from other applications.
- Change the appearance of text and objects.
- Change a template's style or color scheme.

b) Outline view

- It enables one to outline content much as you would in a word processor to enter, arrange and edit textual information.
- It is useful in organizing one's thoughts and developing textual content for a presentation.

One can perform the following in outline view;

- Insert, arrange and edit textual information.
- Display a slide's title with or without formatting.
- Show a slide's title only or show titles and full text.
- Promote and /or demote textual content in your outline.

c) Slide sorter view

- It provides a light table for viewing multiple slides.
- When selected, this view arranges small thumbnail presentations of your slides, complete with text and graphics, rows and columns.

One can perform the following with the slide sorter view;
- Manipulate the order of the slides
- Add transition effects from one slide to another.
- Incorporate special "build effects" for a particular slide such as high lighting each point in turn.
- Hide slides from being displayed in a computer – based slide show.
- Set timing options for rehearsing your presentation.

d) Notes page view
- This allows you to insert, edit and delete reminder notes for yourself on each slide.
- It allows you to use a slide's notes page for creating extended notes as an audience handout.
- It lets you enter text and graphics in a notes place holder located below the image of the slide.

It can allow you to perform the following;
- Insert, edit and delete text.
- Add a clip art, charts, scanned photographs and other media elements.
- Draw lines, squares, ovals, polygons and other objects.
- Add graphs, charts or data from other applications.
- Change the appearance of text and objects.
- Change a template's style or color scheme.

e) Slide show view (Also called on-screen presentation)
- It is a view that takes up the full computer screen, like an actual presentation. It lets you see how your graphics, timings, movies, animated effects, and transition effects will look during the actual presentation to the audience.

Advantages of presentation software
- ✓ It provides a wide variety of presentation formats and layouts for the slides.
- ✓ Allows addition of multimedia components such as clipart images, video clips and audio clips.
- ✓ Allows setting of timing for the slides so that the presentation automatically displays the next slide after a predetermined period of time.
- ✓ Allows application of special transition effects on each slide.
- ✓ The presentation can be viewed and printed in different formats.

3. SPREADSHEET SOFTWARE
A spreadsheet is an electronic worksheet that is used to organize data in rows and columns and perform calculations on the data.
Or
It is an electronic worksheet that is used to organize, manipulate and graph data.

Uses of spreadsheets

- ✓ It can be used by business men to record sales
- ✓ It can be used by business men to produce invoices
- ✓ It can be used to compile statements (e.g. Bank statements)
- ✓ Managers use them to keep track of the current payments from customers.
- ✓ It helps researchers to compile and analyze their results quickly
- ✓ Teachers can use them to create tables of figures and manipulate them quickly as required.

ADVANTAGES OF USING SPREADSHEES
- ✓ Handle a variety of applications
- ✓ Easy organizing and processing of information
- ✓ Automatic calculations
- ✓ Enables easy formatting & editing of work
- ✓ Speedy, flexible and efficient
- ✓ Can be stored and retrieved at a later time
- ✓ Reduces inventory (storage) costs
- ✓ Easy sharing over the network
- ✓ Neat work with various illustration like charts

Disadvantages of using Spreadsheets
- Needs resources like computers which are expensive
- Training personnel needs resources
- Limited to power availability. It can't work without power.
- The whole work is lost in case of Virus attacks
- Data hackers can change the data with ease
- Mobility and transportation of data may be difficult especially with limited resources

Advantages of using electronic spreadsheets over manual worksheets
- ✓ It is easy to make changes and corrections to data on the worksheet.
- ✓ The rest of the worksheet is recalculated whenever data on a worksheet changes.
- ✓ It is fast with the help of built-in functions and macros.
- ✓ Calculation is always accurate, provided that data and formulae entered are correct.
- ✓ It is easy to create different kinds of charts or to change chart types.
- ✓ Information on charts is updated automatically whenever related data on the worksheet changes
- ✓ Spreadsheets are much larger than manual worksheets
- ✓ They can perform mathematical, statistical and financial calculations quickly and accurately.
- ✓ Cells in electronic spreadsheets can use information from other cells
- ✓ Electronic spreadsheets can be stored and retrieved for repeated use.

Examples of spreadsheet programs
- Microsoft excel
- Corel Quattro Pro
- Lotus 1-2-3
- Super Calc
- VisiCalc

MICROSOFT EXCEL (Ms Excel)
It is an electronic spreadsheet that can be used for practically manipulating of data and figures.

Parts of Ms Excel document

i) **A cell**

This is the intersection of a column and a row.

ii) **A cell address**

Is a unique address which defines the location of a cell in a worksheet (e.g. A1, A2, Q7, etc)

iii) **Range**

Is a rectangular selection of a worksheet containing two or more cells

iv) **Worksheet**

This is the biggest range consisting of all the cells in one sheet.

v) **Workbook**

It is a collection of various worksheets

vi) **Range address**

It is a range reference which has a format of top-left cell address: bottom-right cell address (e.g. D12:F19)

vii) **Labels**

Labels are text that identify the data and help to organize the worksheet
All label entries are left aligned by default.

viii) **Values**

These are numbers to be used for calculations.

ix) **Cell reference**

This is the location of a cell on a worksheet.

Types of cell references

a) **Relative cell reference**

It is a cell reference in which the cell address (e.g. B1 + C1) will be self adjusted when the formula is moved or copied to another cell (e.g. B2 + C2)

b) **Absolute cell reference;**

It is a cell reference in which the cell address (e.g. B2) is always fixed.

c) **Mixed cell reference**

Is a cell reference that uses absolute column and a relative row reference.
Example $A2 and A$2

x) **Formulae and operators**

- A formula is a set of instructions for performing a calculation and displaying the resulting value in the cell that contains it.
- Formulae normally begin with (=) or (+)

Types of formulae

(a) **Numeric (Arithmetic) formulae**

These perform calculations on values and use +, -, *, ^ and % numeric operators for calculation.
Examples
=25+5, =A15*B1/B5

(b) **Text formulae**

- These are used to manipulate text.
- The text is normally enclosed in "" (quotation marks) and to combine strings of text, use & (ampersand)

Example

A3	B3	C3
Term one	Term two	Term three

Enter =B3&"and"&C3 in B10 to have Term one and Term two.

Or

=A3&"Marks" in A10 to have student marks.

(c) Logical formulae

- These are statements that evaluate a condition.
- They result into 1 if true and 0 if false.
- They use =, <,>,>=, <= and <>, AND, OR, and NOT to calculate various conditions.

Example

Entry	Results
=5>4	- Results in true or 1
=5<A1	- Result in 1 or true if A1 has a value less than 5
=AND(A1=1,A2=2)	- Result in 1 or true (if A1 contains 1 and A2 contains 2
=OR(A1=1,A2=2)	- Result in 1 or true (if A1 contains 1 or A2 contains 2)
=NOT(A1=0)	- Result in 1 or true (if A1 contains any value but not zero)

Basic mathematical operators used in spreadsheets

Symbol	Description	Example
()	Parentheses	=B2*(C4+D5)
*	Multiplication	=B2*C4
/	Division	=B2/C4
+	Addition	=(B2+C4)
-	Subtraction	=(B2-C4)
%	Percentage	=C5*60%
^	Exponential	=C4^2

xi) Functions;

- A **function** is a predefined formula that helps to perform common mathematical functions.
- Each function has a specific order, called a **syntax** which must be strictly followed for the function to work correctly.
- Functions include; **SUM, AVERAGE, SQRT, LOG, ROUND, MAX, MIN** etc.

Syntax order

a. All functions begin with the = sign.

b. After the = sign, define the function name (e.g. **SUM**)

c. One or more arguments, numbers, text or cell references enclosed in parentheses.

   If these are more than one argument, separate each by a comma.

   An example of a function with one argument that adds a range of cells B2 through B12

   =SUM (B2:B12)

   = (equal sign)

   SUM (Function)

   :(Argument)

An example of a function with more than one argument that calculates the average of numbers in a range of cells, B2 through B12 and C2 through C12

=AVERAGE (B2:B12, C2:C12)

= (equal sign)

AVERAGE (Function name)

, (Argument)

Examples of functions used in spreadsheets

a) Mathematical functions	
ABS (number)	Returns the absolute value of a number
INT (number)	Rounds a number down to the nearest integer
LN (number)	Calculates the natural logarithm of a number
LOG (number)	Calculates the logarithm of a number to a specified base
ROUND	Rounds a number to a specified number of digits
SQRT (number)	Calculates the square root of a number
SUM (range)	Calculates the total of a range of numbers
b) Statistical functions	
AVERAGE (range)	Calculates the average value of a range of numbers
COUNT (range)	Counts how many cells in the range have entries
MAX (range)	Returns the maximum value in a range of numbers
MIN (range)	Returns the minimum value in a range of numbers
STDEV (range)	Calculates the standard deviation of a range of numbers
c) Logical functions	
IF (logical test, value if result of the test is true, value if false	Performs a test and returns one value if the result of the test is true and another value if the result is false)
d) Financial functions	
FV (rate, no. of periods, payments)	Calculates the future value of an investment
NPV (rate, range)	Calculates the net present value of an investment
e) Date and Time functions	
DATE	Returns the current date
NOW	Returns the current date and time
TIME	Returns the current time

Errors in Microsoft excel

ERROR	DESCRIPTION
##### error	This error occurs when a column is not wide enough, or a negative date or time is used.
#DIV/0! error	This error occurs when a number is divided by zero (0).

#N/A error	This error occurs when a value is not available to a function or formula.
#NAME? error	This error occurs when Microsoft Office Excel doesn't recognize text in a formula.
#NULL! error	This error occurs when you specify an intersection of two areas that do not intersect. The intersection operator is a space between references.
#NUM! error	This error occurs with invalid numeric values in a formula or function.
#REF! error	This error occurs when a **cell reference** is not valid.
#VALUE! error	This error occurs when the wrong type of **argument** or **operand** is used.

Features of spreadsheet programs

❖ **Recalculation;**

Recalculates the rest of the worksheet whenever data in worksheet changes

❖ **Built – in functions;**

Allows the user to use functions to add, multiply, get percentage, count and perform other basic statistical functions.

❖ **Adjusting columns;**

Allows the user to adjust columns

❖ **Data sorting;**

Allows the user to sort (organize) data either in ascending or descending order.

❖ **Data validation;**

Allows a user to ensure that correct data is entered in the spreadsheet

❖ **Printing;**

Allows the user to print the entire worksheets, portions of a worksheet and several worksheets

❖ **Templates and wizards;**

Allows the user to use the basis of other similar workbooks

All formulae and formatting for similar invoices can be saved as templates and then used to automate a task without having to create a new workbook again.

❖ **Summarizing data**

Allows the user to summarize data using consolidation and pivot tables

Consolidation allows the merging of several workbooks into a summary sheet.

❖ **Ability to perform what – if analysis;**

Allows the user to perform what – if analysis which can be used to find out effects of performances of companies.

❖ **Charting;**

Allows a user to display data in a graphical, rather than a numerical form

❖ **Macro**

Allows a user to record or save a sequence of keystrokes or instructions that can be run later

4. DATABASE SOFTWARE

A database

It is a collection of related information stored for a particular purpose.

Examples of databases
- Telephone books (directories)
- Customer address books
- Employee information forms
- Dictionaries
- Television guides e.t.c.

A software one needs to create a database is called a **Database Management System(DBMS)**

<div style="text-align:center">**Database Management System**</div>

- It is the software which allows a user to create, access and manage a database.
- It facilitates creating and maintaining a collection of information and producing reports from it.

Examples of DBMS

- Dbase I, II, III, IV, V
- Microsoft access
- Oracle
- Lotus Approach
- SQL (Structured Query Language)

- Microsoft Visual FoxPro
- Lotus Approach
- Borland dBase
- Corel Paradox
- Claris File Maker pro e.t.c.

MICROSOFT ACCESS

It is one of the most common database applications on the market today.

Features of a Microsoft Access Document

i. A table

It is a primary element for collecting data that relates to a particular subject.

Tables are organized into rows (records) and columns (fields) similar to an electronic worksheet.

Consider the table below

ID No	Name	Sex	District	Allowance
1	Mary	F	Kampala	10,000/=
2	Martin	M	Masaka	20,000/=
3	John	M	Mubende	10,000/=
4	Peter	M	Tororo	30,000/=

ii. A record

Is a row in a table that contains information about a given person, product or event.

E.g. one which contains 1, Mary, F, Kampala, 10,000/=

iii. A field

It is a column in a able that contains a specific piece of information within a record.

E.g. Sex, F, M, M, M.

iv. The table structure

Is the number of fields, field names, field lengths and data types in the database table.

v. Field name (Field Labels)

Is a title of a particular column (field).

E.g. titles like ID No, Name, Sex, District, Allowance.

vi. Field Length

Is the maximum number of characters that can be stored for data in a particular field.

vii. Data type (Field Type)

It specifies the type of data that the field can contain

The common data types

- **Auto Number**

Is a number that is automatically assigned randomly to a particular record and never changes again.

- **Currency**

Is a numeric field automatically assigned a currency sign.

- **Date / Time**

Can hold month, day and year information.

- **Text type**

May hold letters, numbers or special characters.

- **Numbers**

Holds any figure that need to be used for calculations.

- **Memo type**

May hold text of any type or length.

Holds whole sentences up to 64,000 characters including spaces

- **Hyperlink**

Stores data types that are internet addresses

- **Look up**

Stores values that are from an external table, query or a list of specified values.

- **OLE Object (Object Linking and Embedding)**

Holds any linked object e.g. a picture, sound or a photograph.

- **Boolean type**

This may hold values that are either true or false.

viii.   Field properties

It refers to specific characteristics of a particular field.

It includes;

- Field size
- Caption
- Input mask
- Format
- Decimal places

- Required input mask
- Default value
- Allow zero length e.t.c

ix. Queries

These are tools used to locate specific records within the table or ask questions to your database.

x. Forms

These are tools that enable one to enter and display records from the database tables easily.

They can be used to enter data in many tables at the same time.

xi. Reports

Are tools that enable one to preview and print data in a meaningful format.

xii. Macros (Mini programs)

These are tools used to automate the way one uses his database.

Macros can be used to instruct the computer to print specific reports at a given time.

xiii.   Modules

These do the same work as a macro.

They enable one to automate work processes.

CHARACTERISTICS OF DATABASES

✓ The data is arranged in columns (fields) and rows (columns)
✓ Each column has similar data items.
✓ Each row contains information belonging to a single individual.

Qualities of a good database

- Should make use of the computer resources
- Should be fast
- Should interface smoothly with existing facilities
- Should be updatable
- Should provide easy access to authorized users
- Should preserve data integrity
- Should ensure the privacy of data

Functions of databases

i) **Sorting**

It involves organizing a set of records in a particular order

The order can ascending or descending order and by alphabetic or numeric order.

ii) **Browsing (searching)**

It involves the ability to extract information of general interest from a database

iii) **Report generation**

A report generator allows one to create formatted reports which include headings, sub – headings, columns of data from the database, columns of data that are compiled from existing fields in the database and final totals e.t.c.

iv) Databases are powerful and easy to use when creating information.

v) They are used to organize and manage a collection of related information (data)

vi) They provide the user with the means of managing and manipulating large amounts of data.

Factors to consider when designing a database

- The number of tables needed.
- The number of fields and the field names.
- Unique identifiers of fields with unique vales.
- Relationships between the tables if any.
- Practicability of the database.

Types of databases

1. **Flat file database**

- It is a database made up of only one table
- It is easy to set up and use

2. **A relational database**

- It is a database which can take information from two or more database tables and combine them into a new table or report.

    NB: **A relationship**

    It determines the way in which the details in one table are related to the details in another table.

    It can be a one to one relationship, one to many or many to many relationship.

3. **Hierarchical database**

    It uses a structure in which records are divided into segments.

    Each record contains one root segment and a variable number of subordinate segments that define a field within a record.

4. The network databases (Online databases)

- It uses a linked list structure
- Combines records with links which are called pointers
- The pointers physically establish the relationships between records.

Other terms related to databases

i. Validation

Is the process of checking of input data for errors (e.g. data type) before processing

Examples of data validation techniques;

- **Range check;** is to make sure that the data entered lies within a certain rage
- **Type check;** is to make sure that the data entered is of the correct type(e.g. numeric or alphabetic)
- **Length check;** is to make sure that the numbers of characters entered is within the limit
- **Presence check;** is to make sure that data is actually present
- **Check digit;** is an extra digit appended to a code consisting of a series of numbers or character to detect errors arising from transcription

ii. Data verification

Is the checking for mistakes when data is copied from one place to another.

Examples of data verification techniques

- Visual check
- Enter the data twice by the same person or by two different persons.

iii. Data redundancy

Is the repeating of data in more than one file.

Advantages of database system

✓ **Reduction of data redundancy**

Databases allow storing most of the data in one place. This leads to less duplication and memory needed.

✓ **Ensures data integrity**

Since data is centralized, fewer updating errors can occur and greater accuracy can be maintained

✓ **Ensures data independence**

- Data is entered, stored, modified and accessed by methods that are not affected by application programs.
- Changes made to data structures usually do not require changes in programs that access the database

✓ **Data sharing and integration**

Database systems offer users the ability to combine data in many ways.

✓ **Centralization of security**

It is easier to limit access to information if it is grouped together instead of being kept in several scattered files.

✓ **Improvement in access of data**

They allow users to query the database directory without necessarily using an application program.

✓ **Reduction of costs**

- Data entry, data storage and development of new application programs are made more economical
- Also elimination of data duplication minimizes costs of maintenance.

Disadvantages of database system

- **Complexity**
  - They include sophisticated software packages that may require special hardware
  - They are also difficult and time consuming to develop

- **Initial expense**
  Because of their complexity and efficiency, database systems can be expensive to set up.
- **Vulnerability**
  Data in a database may be more susceptible to sabotage, theft or destruction
- **Need for substantial conversion effort**
  - Changing from a traditional file oriented system to a database system can often involve large scale reorganization of data and programs.
  - This normally creates user resistance.

5. DESKTOP PUBLISHING SOFTWARE (DTP)
- It is a software used to design and produce complicated documents that contain text, graphics and brilliant colors.
- It is ideal for creating high – quality colored documents such as
  - Newsletters
  - Catalogs
  - Textbooks
  - Banners
  - Annual reports
- It normally requires a powerful microcomputer, graphics display, mouse, laser printer.

Advantages of DTP over word processors
- ✓ It is specifically designed to support page layout of arranging text and graphics in a document on a page – by – page basis.
- ✓ It includes color libraries to ensure that colors will print exactly as specified.
- ✓ It supports color separation for producing the master copies used in the final presswork.

ELECTRONIC PUBLICATION

Electronic Publishing

Electronic Publishing is the use of electronic publishing software to create sophisticated documents that contain text graphics and many colours.

Examples of electronic publishing software

- Microsoft Publisher
- Adobe PageMaker
- Adobe InDesign
- QuarkXPress
- Broderbund Print Shop Pro.

Uses of electronic publication software

- ↗ It is ideal for the production of high quality colour documents such as text books, corporate newsletters, marketing literature (adverts), product catalogues, business cards, gift certificates, flyers, brochures and annual reports, etc.
- ↗ It is used in creating of web pages.

↗ It is also used to share the above documents over the internet.

Starting Microsoft Office Publisher

From the *Start* menu, select ***All Programs » Microsoft Office » Microsoft Office Publisher 2003.***
Publisher opens and the *New Publication* task pane appears, offering many pre-formatted designs to
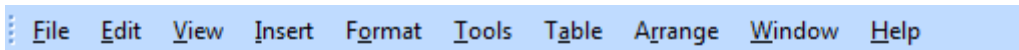use in creating your publication.

Parts of Microsoft Office Publisher document
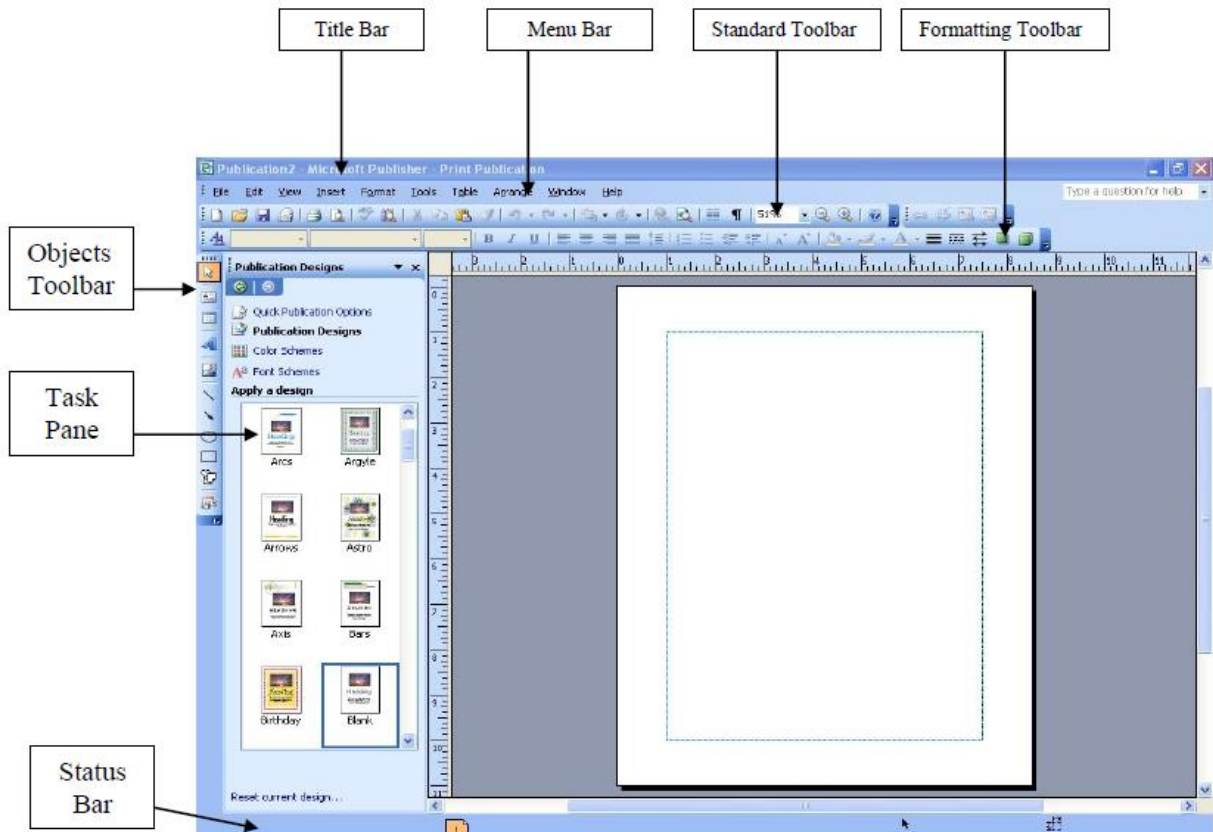
<u>***Title Bar***</u>The Title Bar displays the document's name, and contains the Close, Restore and Minimize
buttons.
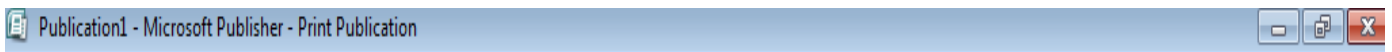
<u>***Menu Bar***</u>The Menu Bar contains menus with additional commands in the form of a drop-down list.


<u>***Standard Toolbar***</u>The Standard Toolbar contains frequently used buttons that are common functions
in Publisher and throughout Microsoft Office. This toolbar is similar in most Office 2003 programs.
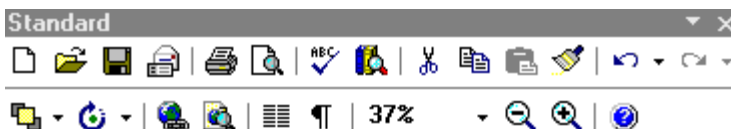
<u>***Formatting Toolbar***</u>The Formatting Toolbar contains buttons for common text formatting options in
Publisher and throughout Microsoft Office. This toolbar is similar in most Office 2003 programs.
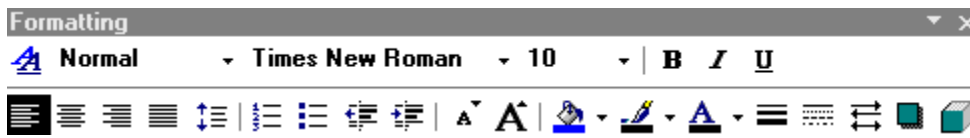
Object Bar The Object Bar contains each of the tools you will use to create and manipulate text and graphics in Publisher.
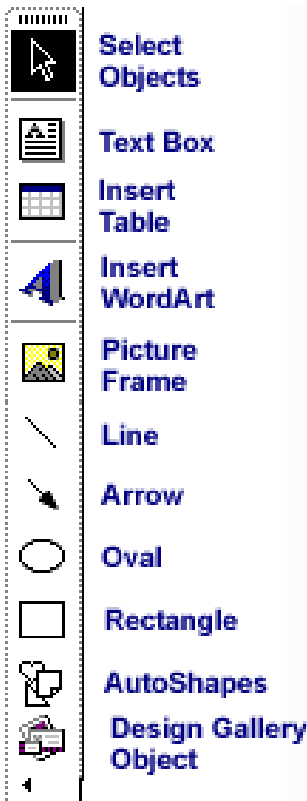
Tool	Function
Select Objects	Selects lines, shapes, graphics, and text boxes. Selected items can be resized and have their attributes changed.
Text Box	Creates text boxes.
Insert Table	Creates tables.
Insert WordArt	Adds _WordArt_ to your publication.
Picture Frame	Creates a frame in which a picture may be inserted.
Line Tool	Creates a line.
Arrow Tool	Creates an arrow.
Oval Tool	Creates circular and oval shapes.
Rectangle Tool	Creates rectangular shapes.
AutoShapes	Creates a variety of different shapes EXAMPLE: Hearts, lightning bolts, thought boxes
Design Gallery Object	Inserts a wide array of different objects from the _Microsoft Publisher Design Gallery_

Task Pane The task pane provides quick access for complicated functions and can include _Help_, _Clip Art_, _Find and Replace_, _Graphics Manager_, _Publication Designs_, _Styles and Formatting_, and many others.
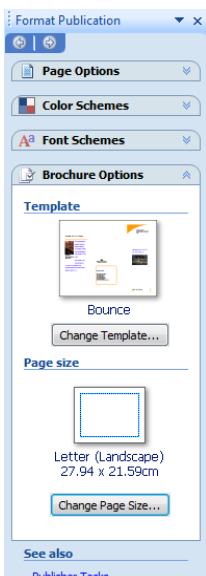
Status Bar The Status Bar shows the size and position of the object on the Work Pane.

OTHER TYPES OF APPLICATION SOFTWARE

6. **SOFTWARE SUITE**

- **Software suite;** this is a collection of individual application software packages sold as a single package.

  Examples of software suite;
  - ✓ Microsoft office
  - ✓ Lotus smart suite
  - ✓ Corel word perfect suite

  Advantages of software suite
- Its cost is relatively less than purchasing each of the application packages separately.
- It is easy to use because applications within the suite usually have the same interface and share common features.

7. **INTEGRATED SOFTWARE**
- It is a software the combines applications such as word processing, spreadsheet and database into a single, easy to use package.
- Applications in the integrated software use a similar interface and share some common features.
- Unlike a software suite, applications in the integrated software cannot be purchased individually.

  Examples of integrated software
  - o Microsoft works

  Advantages of integrated software
- ✓ Costs less than a software suite or each individual application.
- ✓ It is easy to use because all applications have a similar interface and share similar features.

  Disadvantages of integrated software
- ▪ Applications within the integrated software normally do not have all the capabilities of a stand – alone application software of the same kind.

  Applications may share some resources.

8. **COMPUTER AIDED DESIGN SOFTWARE (CAD)**
- It is a software which is mainly used for creating engineering, architectural and scientific drawings.
- It can be used in drawing plans for buildings, etc.

  Examples of CAD software;
  - o AutoCAD
  - o Autodesk
  - o Microsoft Visio Technical

9. **PROJECT MANAGEMENT SOFTWARE**

  It is a kind of software used to plan, schedule, track and analyze the events, resources and costs of a project.

  It helps people such as a publisher or general contractors to complete projects on time and within budget.

  Examples of this software;
  - o **Microsoft Project**

10. **PERSONAL INFORMATION MANAGERS (PIM)**

  This software helps to organize Personal information such as appointments and to do lists.

  Most PIMs include an appointment calendar, web browsing and e-mail capabilities.

  Examples;

- Microsoft outlook
- Lotus organizer.

11. WEB PAGE AUTHORING SOFTWARE

This is a specially designed software for creating web pages that contain text and multimedia elements.

Some web page authoring software such as Micro media Dreamweaver have capabilities of organizing, managing and maintaining websites.

Examples;
- Micro media Dreamweaver.
- Adobe GoLive
- Adobe Pagemill
- Microsoft Front page

12. ACCOUNTING SOFTWARE

This is a software used by companies to record and report their financial transactions.

It normally handles activities concerned with ledgers, accounts receivable, accounts payable, purchasing, invoicing, job costing, payroll functions, etc.

Examples;
- Peachtree complete accounting
- Intuit Quick Books

13. PAINT AND IMAGE EDITING SOFTWARE

This is a software used in creating and modifying graphical and photo images.

Paint software allows a user to draw pictures, shapes and other graphical images.
They use tools such as pen, brush, paint bucket, etc.

Image editing software allows a user to retouch photographs, adjust image colours and add special effects such as shadows and glows.

Examples;
- Paint Shop pro
- Adobe Photoshop
- Corel Draw
- Adobe Illustrator
- Micro media Freehand
- Meta creations Painter
- Microsoft Photo draw.

14. VIDEO AND AUDIO EDITING SOFTWARE

Video and audio editing software is used to modify video e.g. through reducing the length of video clips, reordering a series of video clips, adding special effects to video clips, etc.

NB;

Video consists of images that are played back at speeds that provide the appearance of full motion.

Audio refers to any music, speech or any other sounds.

Audio editing software is used to modify audio clips.

Examples;
- Adobe Premier
- Ulead VideoStudio
- Ulead MediaStudio Pro
- Fruity loops V – station (FLV)
- Adobe audition

15. COMMUNICATIONS SOFTWARE

This software consists of programs that help to establish a connection to another computer or network.

It manages the transmission of data, instructions, and information between computers and other devices.

Features of communications software
- Dialing feature
- File transfer feature
- Terminal emulation feature
- Internet access feature

   Examples;
   - E-mail software
   - Web browsers
   - Chat room software
   - News reader
   - Instant messenger
   - Groupware
   - Videoconferencing software

16. EDUCATION SOFTWARE

It is a software designed to teach a particular skill about any subject

They normally use computer based training (CBT) approach which enables students to learn by using and completing exercises with the software.

17. REFERENCE SOFTWARE

This is a software which provides valuable and thorough information for reference purposes.

It can be encyclopedias, dictionaries, health and medical guides.

   Examples;
   - Microsoft Encarta
   - Mosby's Medical Encyclopedia
   - Webster dictionary
   - Thesaurus

18. ENTERTAINMENT SOFTWARE

This software includes interactive games, videos and other programs designed to provide amusement and enjoyment.

NB;

Edutainment software is a software that are both educational and entertainment.

19. MULTIMEDIA AUTHORING SOFTWARE

These are software that combines text, graphics, animations, audio and video into an application.

   Examples;
   - Micro media Authorware
   - Micro media Director
   - Micromedia Flash

Applications of Multimedia
- Video games
- Electronic newspapers
- Electronic books
- Magazines
- Simulations
- Virtual reality
- Computer Based Training (CBT), etc.

Definitions
- ✓ **Simulations;**

   These are computer based models of real – life situations
- ✓ **Virtual reality (VR)**

This is the use of computer to create an artificial environment that appears and feels like a real environment
- ✓ **Computer Based Training (CBT)**
  Allows students to learn and complete exercises with instructional software.

4. SYSTEM START – UP AND CONFIGURATION

COMPUTER BOOTING
Powering on the computer
- Most microcomputers are switched on by the switch on the system unit and the monitor.
- As the computer is switched on, it does the Power – On Self Test (POST) before it starts.
- The POST consists of RAM check, CMOS check, HDD controller check (Disk Drive controller check)
- In case one of the checks fails, then an appropriate error message is displayed on the screen or
- An abnormal number of beeps are sounded.
- The whole process is called BOOTING.

Definition
Booting is the process of starting or restarting a computer which involves loading an operating system into memory.

Types of booting
There are two types of booting;
- a. Cold booting
- b. Warm booting

a. Cold booting
It is the process of starting a computer which has been totally off which involves loading the operating system into memory.

b. Warm booting
It is the process of restarting (resetting) a computer that is already turned on.
In the windows environment, it is normally performed by pressing Ctrl+Alt+Del keys on the keyboard.

Application of booting
Booting is done in the following cases;
- Cold booting is done always when one is starting up the computer which has been totally off.

Warm booting is done;
- Whenever the computer devices such as keyboards, mouse, etc.stop responding to commands issued to them.
- After installing a software or hardware onto your computer.
- After scanning for viruses.

NB;
Booting can be done from a booting diskette or a hard disk.

Steps that occur during a cold boot using the windows operating system
- The power supply sends an electrical signal to the motherboard and other devices located in the system unit.
- The CPU resets itself and looks for the ROM that contains the BIOS.

- The BIOS executes the Power On Self Test (POST) to ensure that all the computer hardware is connected properly and operating properly.
- The results of the POST are compared with the data in the CMOS chip on the motherboard.
- If the POST is completed successfully, the BIOS looks for the boot program that loads the operating system.
- Once located, the boot program is loaded into memory and executed, which then loads the kernel of the operating system into RAM.
- 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.
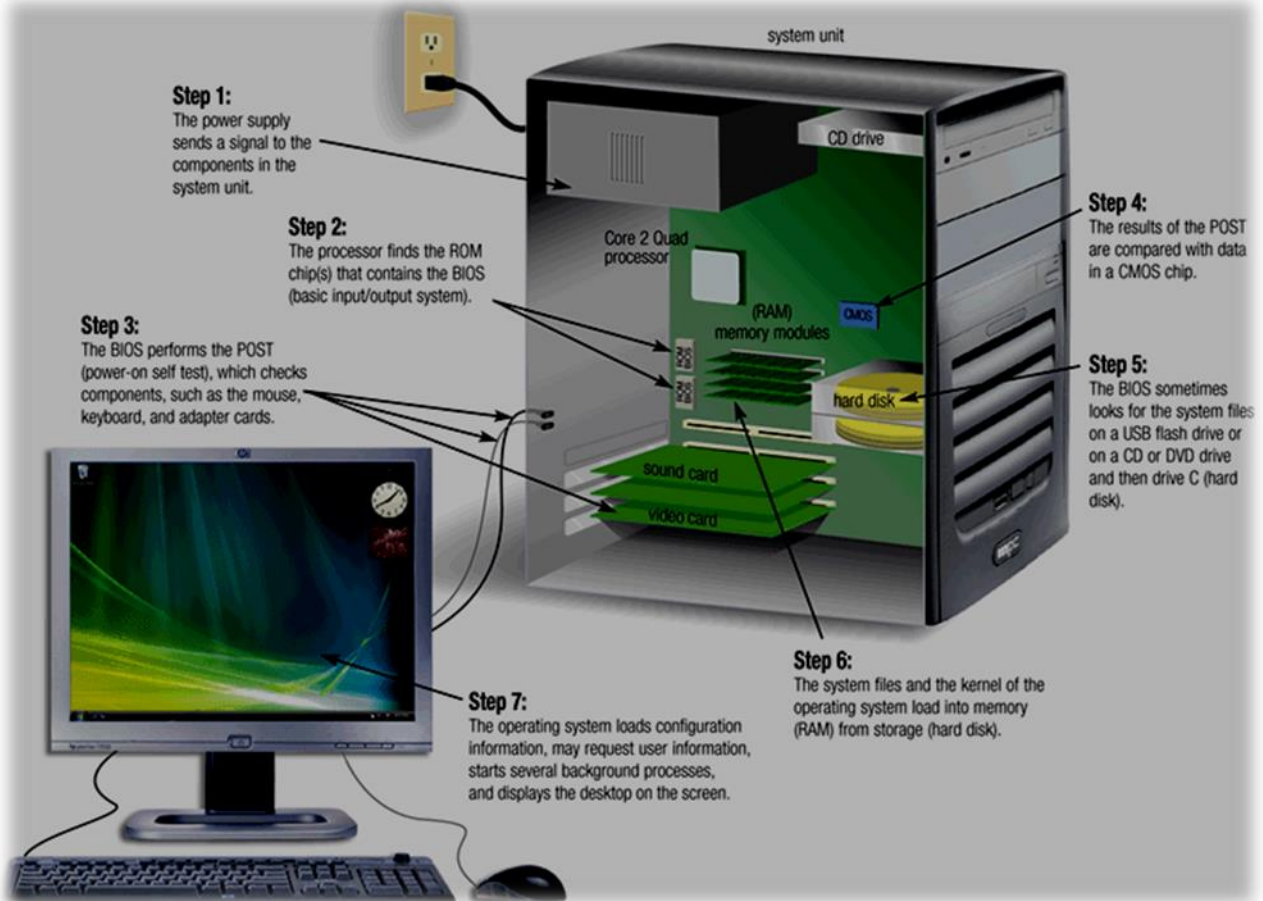
NB:

1. Kernel

This is the core of an operating system responsible for;
- managing memory,
- Managing files and devices,
- maintaining the computer's clock,
- starting applications and
- assigning the computer's resources such as printers, scanners, etc.

The kernel is referred to as a memory resident because it remains in memory while the computer is running.

SYSTEM CONFIGURATION

System (Computer) Configuration refers to the hardware and software specifications required for a PC or any other type of a computer.

Below is a typical system configuration;
- ❖ Microprocessor of Pentium series type

- ❖ Hard disk in range of gigabytes
- ❖ Floppy disk drive 3.5", 1.44MB
- ❖ 104 Qwerty Keyboard
- ❖ 15" or 17" color digital monitor
- ❖ Desktop version of inkjet or laser jet printer
- ❖ Multimedia kit with the following;
  - ✓ CD ROM drive or DVD drive
  - ✓ Speakers and a sound card
  - ✓ A 3-button mouse with a wheel
  - ✓ System software with the latest windows version
  - ✓ Application software with the latest Ms. Office version.

THE SYSTEM UNIT

The *system unit* is a box-like case that houses the electronic components such as the processor, memory and other electronic components of the computer that are used to process data.

All other computer system devices, such as the *monitor*, *keyboard*, and *mouse*, are linked either directly or indirectly into the system unit.

Components found in the system unit

- Power Supply
- Motherboard
- CPU
- System Clock
- RAM chips

- Expansion slots
- Bus lines
- Ports
- PC slots and Cards
- Peripherals

(i)   The power supply

It is the component in the system unit used to convert the wall outlet AC power into DC power to run the computer.

Power Supply

(ii)   Motherboard

The *motherboard*, is a single circuit board that provides the path through which the processor communicates with memory components, other components, and peripheral devices.
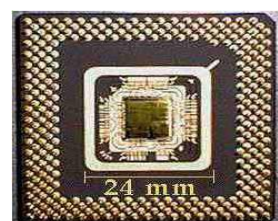
- It is the main circuit board in the system unit.
- It houses the CPU chip, Main memory chips and expansion slots into which other circuit boards can be inserted for the expansion of the computer system.
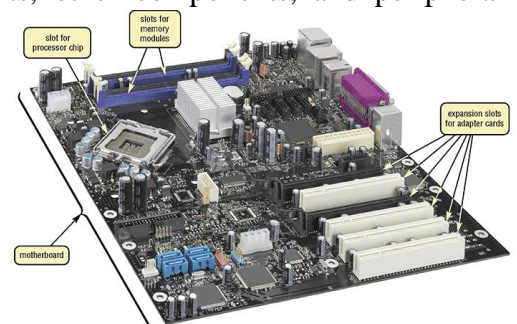
Fig; The Motherboard

(iii)   Central Processing Unit (CPU)

-It is an electronic device that interprets and carries out the basic instructions that tell the computer how to work.
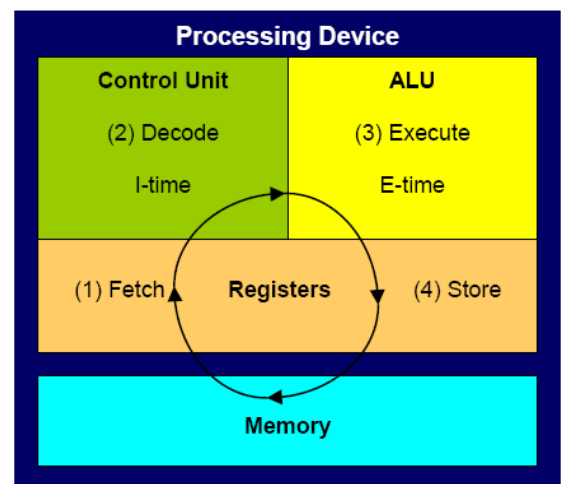
-It is the "**Brain"** of the computer.

Parts of a CPU

24 mm

(d)   Control Unit
-The *control unit* is the component of the processor that directs and coordinates most of the operations in the computer.
-It interprets each instruction issued by program and then initiates the appropriate action to carry out the instruction.
-It directs data from storage to memory.
-It sends data required for mathematical operations from the memory to the ALU.
-It sends the data processed to the printer or a storage device.
-It erases/deletes/rubs data from memory when instructed to do so.

For every instruction, the control unit repeats a set of four basic steps:
- **Step 1: Fetching the instruction.** The instruction to be executed is obtained from memory by the control unit.
- **Step 2: Decoding the instruction.** The instruction is translated into commands the computer understand. Relevant data is moved from memory to the register, and the location of the next instruction is identified.
- **Step 3: Executing the instruction.** The commands are carried out. This could involve making either an arithmetic computation or a logical comparison in the ALU.
- **Step 4: Storing results.** The results are stored in registers or memory.

(e)   Arithmetic Logic Unit (ALU)
It is a part of the CPU that performs the execution step of a machine cycle.
Specifically, the ALU performs the *arithmetic*, *comparison*, and *logical* operations.
Arithmetic operations include;
  ➢ Addition,
  ➢ Subtraction,
  ➢ Multiplication, and
  ➢ Division.
Examples of arithmetic operations include;
- The payroll deduction for social security,
- The day-end inventory level, and
- The balance on a bank statement.
Examples of Comparison operations;
- comparing one data item to another to determine if the first item is greater than, equal to, or less than the other item.
Logical operations work with conditions and logical operators such as AND, OR, and NOT.
Examples of logical operations
If you wanted to search a student database for senior in the Business School, you would search for any students classified as senior AND listed under business school.

(f)   Program registers (or simply registers)

Registers are high-speed working storage areas in the CPU that temporarily hold instructions and data.

Registers are part of the processor, not a part of memory or a permanent storage device.

They are additional storage locations that offer the advantage of speed.

Types of registers and their roles

- **instruction register**, which contains the instruction being executed;
- **address register**, which keeps track of where a given instruction or piece of data is stored in memory.
- **storage register**, which temporarily holds data taken from or about to be sent to memory.
- **accumulator**, which collects the result of computations;
- **general-purpose register**, which is used for several functions, such as arithmetic operations.

(iv)   The computer clock

Every computer contains two types of clocks;

- ➢ Hardware clock (Real-time clock, RTC)
- ➢ System clock / Virtual Clock.

Hardware Clock

- It is a clock that maintains the time and date.
- It is from this clock that the system clock is set when a computer is switched on.
- It runs continuously whether the computer is on or off.
- It is maintained by use of a CMOS (Complementary Metal Oxide Semi-conductor) battery.

System Clock

The *system clock* is a small quartz crystal chip that is used by the CPU to synchronize the timing of all computer operations.

It generates electronic pulse or ticks at a fixed rate, which set the operating pace of components in the system unit.

Each tick is called a *clock cycle*, which affects machine cycle time.

The faster the clock, the more instructions the CPU can execute per second.

The speed at which a processor executes instructions is called **clock speed** which is measured by the number of ticks per second.

Note:

- *   A *hertz* is one cycle or tick per second.
- *   *Megahertz (MHz)* equates to one million ticks of the system clock per second.
- *   *Gigahertz (GHz)* equates to one billion ticks of the system clock.
- *   Current personal computer processors have clock speeds in the gigahertz range.
- *   Some computer professionals measure a processor's speed according to the number of MIPS (millions of instructions per second) it can process.
- *   However, no real standard for measuring MIPS exist, because different instructions require varying amounts of processing time.

(v)   RAM chips

- These are chips that temporarily hold data and instructions that will be needed shortly by the CPU.
- These chips are normally plugged into the motherboard.

Fig; RAM chip

-They can be mounted in a small circuit board e.g. SIMM (Single Inline Memory Module) or DIMM (Double Inline Memory Module)

(vi)   ROM chips

-These are chips that contain programs that are built into the computer at the factory.

-They contain data, instructions or information which is recorded permanently by the manufacturers.

-These programs can't be edited hence called **Firm ware.**

(vii)   Expansion slots

- These are sockets on the motherboard into which one can plug expansion (adapter) cards.

- These cards may be expanded memory, display/graphical adapter cards, Network Interface cards (NIC), Sound Cards etc.

Fig; Some of the Expansion slots

(viii)   *Buses*

These are electrical channels along which electronic bits of data in a computer travel.

Each bus allows the various devices inside and attached to the system unit to communicate with each other.

Buses are used to transfer bits;

- from input devices to memory,
- from memory to the CPU,
- from the CPU to memory, and
- from memory to output or storage devices.

Parts of bus

Each bus consists of two parts, i.e.

- *data bus* which transfers the actual data.
- *address bus* which directs information about where the data should go in memory.

A bus is measured by its size.

The size of a bus, called the ***bus width***, determines the number of bits that can be transmitted at one time.

For example, a 32-bit bus can transmit 32 bits (4 bytes) at a time.

On a 64-bit bus, 64 bits (8 bytes) are transmitted from one location to another at a time.

The larger the number of bits handled by the bus, the faster the computer transfers data.

Every bus also has a clock speed.

Just like the processor, the clock speed for a bus is measured in megahertz.

The higher the bus clock speed, the faster the transmission of data, which results in applications running faster.

Most of today's processors have a bus clock speed of 400, 533, 667, 800, 1066, or 1333 MHz.

Types of buses

- ***System bus*** which is part of the mother board and connects the CPU to main memory.
- ***Expansion bus*** which allows the CPU to communicate with peripheral devices

Examples of expansion buses

- ***ISA (Industry Standard Architecture) bus***.

   This is an old and slowest expansion bus.

It connects devices such as
- *A mouse,*
- *modem card,*
- *sound card,*
- *low-speed network card*

- *PCI (Peripheral Component Interconnect) bus*

  It is a high-speed expansion bus that connects higher speed devices.

  The PCI bus transfers data about four times faster than the ISA bus. Most current personal computers have a PCI bus

  Types of cards inserted into a PCI bus expansion slot include;
  - *video cards,*
  - *sound cards,*
  - *SCSI cards,*
  - *high-speed network cards etc.*
  .

- *PCI Express (PCIe) bus*

  It is an expansion bus that expands on and doubles the speed of the original PCI bus.

  It is the most commonly used bus today.

  It connects devices such as;
  - *Video cards*
  - *Hard disks*
  - *Network cards*

- *The Accelerated Graphics Port (AGP)*

  It is a bus designed by Intel to improve the speed with which 3-D graphics and video are transmitted.

  When an AGP video card is inserted in an AGP bus slot, the AGP bus provides a faster, dedicated interface between the video card and memory.

  Newer processors support AGP technology.

- *Universal Serial Bus (USB)*

  It is a bus that eliminates the need to install expansion cards into expansion slots.

  A USB enables USB devices to be connected to each other outside the system unit and then a single cable attaches to the USB port.

  The USB port then connects to USB, which connects to the PCI bus on the motherboard.

  The USB hot plug feature allows peripheral devices to be connected to or removed from the USB port while the PC is running.

- *FireWire bus*

  It is also a bus that eliminates the need to install expansion cards into expansion slots.

  The FireWire bus works in a similar fashion like USB.

- *PC Card bus*

  It is an expansion bus for a PC Card.

  With a PC Card inserted into a PC Card slot, data travels on the PC Card bus to the PCI bus.

(ix)   Ports

A port is a socket on the outside of the system unit that is connected to an expansion board on the inside of the system unit.

It is the interface or point of attachment to the system unit.

Peripheral devices, such as;
  - a keyboard,

- ➢ monitor,
- ➢ printer,
- ➢ mouse,
- ➢ digital camera,
- ➢ microphone, etc. often attaches by a cable to a port on the system unit.

Most of the time, ports are located on the back of the system unit, but they also can be placed on the front.

Types of ports

(a) Serial port
- It is a type of interface that connects a device to the system unit by transmitting data one bit at a time.
- Serial ports are usually used to connect devices that do not require fast transmission rates such as a **mouse, Keyboard, or a modem.**
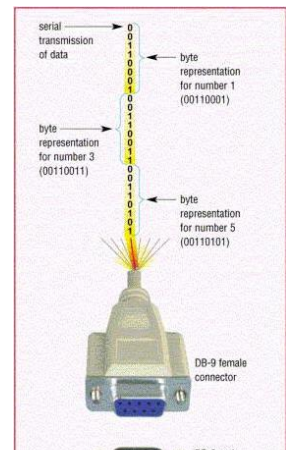
(b) Parallel port
- It is a type of interface that connects a device to the system unit by transmitting several bits of data simultaneously.
- It allows parallel transmission of data.
- These ports provide the interface for devices such as *high-speed printers*, *external magnetic tape* or *disk backup units*, and other computers.

Examples include: **25-pin female port.**

Some newer computers do not havea serial or parallel port.
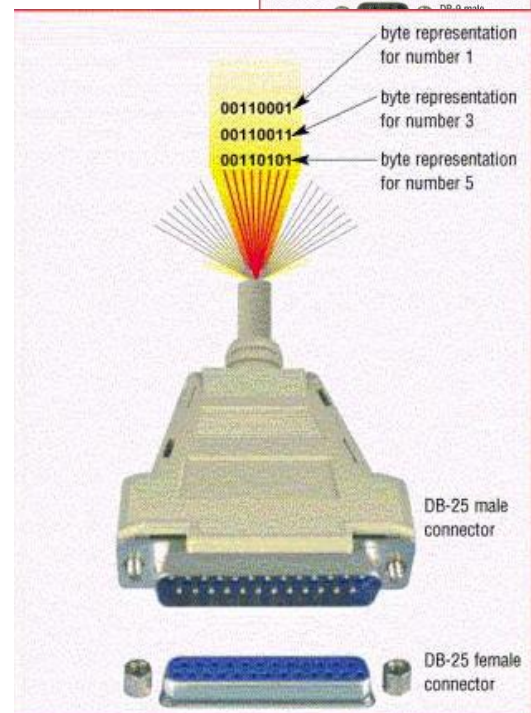
(c) USB (Universal Serial Bus) ports
- Theseare used in high-speed device interfaces.
- Modern devices such as keyboards, mouse, scanners, game controllers, MP3 music players, removable hard disk, PDA, Smart phones, high speed modems and digital cameras connect to the system unit using a USB.
- Up to 127 peripheral devices can be daisy chained to a single USB port.
- Many system units have six to eight USBports.
- To attach multiple peripherals using a singleUSB port, you can use a USB hub.
- A *USB hub* is a device that plugs in a USB port on the system unit and contains multipleUSB ports in which you plug cables fromUSB devices. Some USB hubs are wireless.
- USB ports have replaced mouse, keyboard, serial, audio, and parallel ports.
- USB supports hot plugging and plug and play.

   NB: Hot plugging / Hot Swapping is the ability to add or remove devices while a computer is running.

   Plug and Play is the ability of the computer to recognize a new device and assists in the installation of the device by downloading the necessary drivers automatically and checking for conflicts with other devices.

(d) SCSI (Small Computer System Interface)

- Is a special high – speed parallel port used to attach peripheral devices such as printers and disk drives to the system unit.
- It can transmit up to 32Bits of data at a time.

(e)   Fire Wire port (IEEE 1394 port)
- It is also called *IEEE 1394 port*,
- They are similar to the USB ports and can connect multiple types of devices that require faster data transmission speeds such as *digital video cameras*, *digital VCRs*, *color printer*, *scanners*, *digital cameras*, and *DVD drives* to a single connector.
- It can connect up to 63 devices together.
- The latest Fire-Wire version, called *FireWire 800*, is much more advanced than its predecessor, FireWire 400.
- The FireWire also supports Plug and Play.
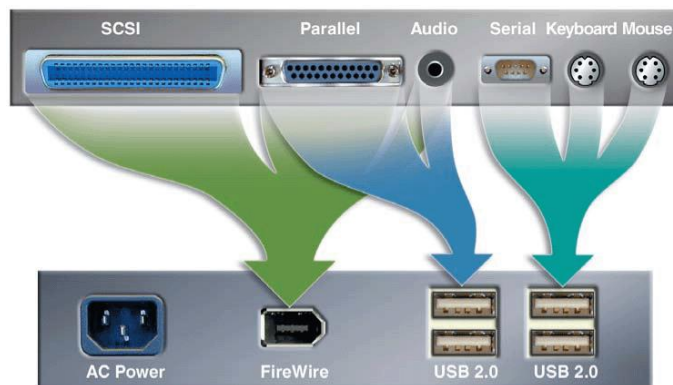- FireWire has replaced parallel and SCSI ports.

Figure shows how USB and FireWire are replacing other ports completely.

Special purpose ports

There are five special-purpose ports available:
  ➢ **MIDI,**
  ➢ **eSATA,**
  ➢ **SCSI,**
  ➢ **IrDA, and**
  ➢ **Bluetooth.**

These portsare not included in typical computers.

For a computer tohave these ports, you often must customize thecomputer purchase order.

(f)   MIDI (Musical Instrument Digital Interface) port
- It is designed to connect the system unit to a musical instrument such as an electronic keyboard.
- It is connected to the sound card inside the system unit to enable one play and manipulate computer sounds that were originally created on another computer.

Sound card

(g)   eSATA (external Serial Advanced Technology Attachment) port,
- This allows you to connect an external SATA hard disk to a computer.
- SATA hard disks are popular because of their fast data transmission speeds.
- eSATA connections provide up to six times faster data transmission speeds than external hard disks attached to a computer's USB or FireWire port.

(h) SCSI (Small Computer System Interface) ports
- These are special high-speed parallel ports that provide a parallel interface that enables faster data transmission than serial and parallel ports.
- Also up to 15 SCSI peripheral devices can be daisy-chained to a single SCSI port; i.e. they are connected along a single cable.
- The first SCSI device connects to the computer; the second SCSI device connects to the first SCSI device, and so on.
- *SAS (serial-attached SCSI)* is a newer type of SCSI that transmits at much faster speeds than parallel SCSI.

(i) IrDA (Infrared Data Association) port
- It allows wireless devices to transmit data via infrared light waves.
- It can be used to connect devices such as **PCs, Smart phones, PDAs, Pagers, keyboards, mouse, and printers.**
- For these wireless devices to transmit signals to a computer, both thecomputer and the device must have an IrDA port.
- As long as thedevices are within a few feet and nothing obstructs the path of theinfrared light wave, data can be transferred without the use of cables

IrDA port

(j) Bluetooth port
- This is an alternative to IrDA port.
- Bluetooth technology uses radio waves to transmit data between devices.
- Unlike IrDA, the Bluetooth devices do not have to be aligned with each other but they do have to be within about 33 feet of each other.
- Many computers, peripherals, smart phones, PDAs, cars, and other consumer electronics are Bluetooth-enabled.
- They contain a small chip that allows them to communicate with other Bluetooth-enabled computers and devices.
- If you have a computer that is not Bluetooth enabled, you can purchase a Bluetooth wireless port adapter that will convert an existing USB port or serial port into a Bluetooth port.

(k) VGA (Video Graphics Adapter)
It is used to connect video display monitor outside the computer to the video adapter card inside the computer system.

(l) Game port
Allows one to attach joysticks or similar game playing devices

Video Card

to the system unit
   (m) PCMCIA (Personal Computer Memory Card International Association) port
      - It is used t connect PC cards onto notebooks, sub notebooks and PDAs.
      - PC cards can be memory disk storage, modem or a Local Area Network Adapter
         (Network Interface Card).
      - These cards are used to add capabilities to a laptop computer.

(x) Peripheral Devices;
   Peripherals is the generic name given to all input, output, and secondary
   that are part of a computer system.
   These are any external devices that attach to the system unit.
   They include keyboard, mouse, printers, scanners etc.

   - **Software installation**

      The learners should be guided on how to install and uninstall computer software, both
      application and system software
   - **Computer troubleshooting**
      The learners should be guided on how to identify and explain software and hardware
      problems, and how to provide solutions to the problems.

5. COMPUTER NETWORKS & COMMUNICATIONS

DATA COMMUNICATION
Is the process of transferring data, instructions and information from one computer to another
computer.

Elements of data communication
   1. **A sending device;**
      Is the device that initiates an instruction to transmit data, information, or instructions.
      It can be a computer system, aterminal, a cellular telephone, a GPS receiver, an Internet-
      enabled PDA, or another device that originates themessage.
   2. **A communication device;**
      Is a device that connects the communications channel to a sending device.
      It converts the data, instruction or information from the sending device into signals that can be
      carried by a communications channel
      It can be a modem
   3. **A communications channel;**
      It is a path over which the signals are sent. It can be a standard telephone line.
   4. **A communications device**
      Is a device that connects the communications channel to a receiving device.
      It converts the signals from the communications channel and converts them into a form
      understood by the receiving device.
      It can also be a modem.
   5. **A receiving device;**
      It is the device that accepts the transmitted signals from the sending device.

They include computers, fax machine, digital cameras, cellular telephone, smart phone, PDA,Internet appliances, and Web-enabled devices.

6. **Communications software;**

This software consists of programs that manage the transmission of data, instructions and information between the sending and receiving computers.

It controls and manages the activities and functions of the communications network.

COMMUNICATION DEVICES

- These are devices which enable one or more computers to exchange data, instructions and information with each other.
- They are used to convert or format signals so that they become suitable for the communications channel or a receiving device.

Types of communications devices

i) Dial – up modems

ii) ISDN and DSL modems

iii) Cable modems

iv) Network interface cards

Devices that handle the movement of data in a computer network

They include;

- Modems
- router,
- hub,
- switch
- gateway
- Bridge
- Repeaters
- network interface cards,
- multiplexer,
- host computer

a. **Modem**

A modem is a communications device that converts between analog and digital signals.

Computers process data as digital signals.

Data, instructions, and information travel along a communicationchannel in either analog or digital form, depending on the communications channel.

NB: An *analog signal* consists of acontinuous electrical wave.
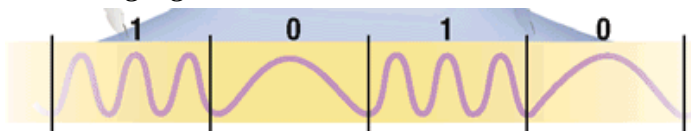
A *digital signal* consists of individual electrical pulses that represent bits grouped together intobytes.
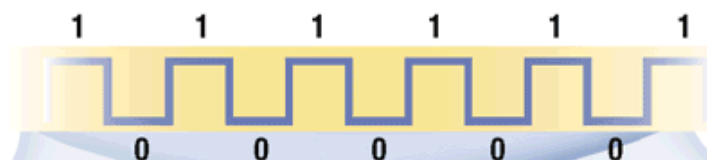
For communications channels that use digital signals, the modem transfers the digital signals between the computer andthe communications channel.

If a communications channel uses analog signals, however, the modem first converts betweenanalog and digital signals.

i.Dial – up modem

- This is the communications device that performs the function of modulation/demodulation.
- The word modem comes from two words i.e. "MOdulation" and "DEModulation"

Modulation: Is the process of converting digital signals into analog signals

Demodulation: Is the process of converting analog signals into digital signals.

- A dial-up modem usually is in the form of an adapter card that one inserts in an expansion slot on a computer's motherboard.
- Dial-up modem can automatically dial telephone numbers, originate message sending, and answer incoming calls and messages.
- Both the sending and receiving ends of a standard telephone line must have a dial-up modem for data transmission to occur.

One end of a standard telephone cord attaches to a port on the modem card and the other end plugs into atelephone outlet.

Examples of devices that use modems

- Computers
- Fax machines
-

ii. PC Card Modem

- This is normally inserted into a PC Card slot of notebook and other mobile computers which don't have built – in modems.
- The PC Card modem attaches to a telephone outlet with a standard telephone cord.
- Mobile users without access to atelephone outlet also can use a special cable to attach the PC Card modem to a cellular telephone, thus enabling them totransmit data over a cellular telephone.

iii. ISDN(Integrated Services Digital Network) and DSL(Digital Subscriber Lines) modems

- A DSL or ISDN modem sends digital data and information from a computer to a DSL or ISDN line and receives digital data and information from a DSL or ISDN line.
- ISDN and DSL modems usually are external devices, in which one end connects to the telephone line and the other end connects to a port on the system unit. Most include built in connectivity.

A DSL Modem

iv. Cablemodem

- This is a kind of modem which sends and receives digital data over the cable television (CATV) network
- They can transmit data at speeds (500Kbps – 2Mbps) much faster than the dial – up or ISDN modems.
- Cable modems typically include built-in Wi-Fi connectivity.

v. Wireless modem

- Some mobile users have a wireless modem that allowsaccess to the Internet wirelessly from a notebookcomputer, a PDA, a smart phone, or other mobile device.
- Wireless modems, which have an external orbuilt-in antenna, typically use the same waves used bycellular telephones.
- These modems are available as PC Cards, ExpressCard modules, and flash cards.

b. *Network interface cards (NIC)*
- It is also called **LAN adapter.**
- It is an expansion card that enables a computer or a device to connect to a network.
- Ethernet card is the most common type of NIC.
- Some NICs combine Ethernet and dial – up modem card.

c. *Multiplexer*
- Is a communications device that combines two or more input signals from various devices into a single stream of data and then transmits it over a single transmission medium.

d. *Hub*
   Is a device that provides a central point for cables in a network.

e. *Repeater*
- Is a device that accepts a signal from a transmission medium, amplifies it, and retransmits it over the medium.
- As Signals travel over long distances, they undergo a reduction in strength called <u>attenuation</u>.
- Hence repeaters are needed over the medium to boost up these signals.

f. *Bridge;*
   Is a device that connects two Local Area Network (LAN) using the same protocol such as an Ethernet.

g. *Gateway*
   Is a combination of hardware and software that connects networks that use different protocols.

h. *Router;*
   Is an intelligent communications device that sends communications traffic to the appropriate network using the fastest available path.

i. *Dial Up Modems;*
   A modem (modulation – demodulation) is a communications device that converts between analog and digital signals.
   They can be internal or external modems.

NETWORK COMMUNICATIONS STANDARDS AND PROTOCOLS

As data moves through the network from one program to another, it may use one or more of these standards.

Ethernet

Ethernet is a network standard that specifies no central computer or device on the network should control when data can be transmitted.

Each node attempts to transmit data when it determines that the network is available to receive communications.

If two computers on an Ethernet network attempt to send data at the same time, a collision will occur, and the computers must attempt to send their messages again.

Ethernet is based on a bus topology, but Ethernet networks can be wired in a star pattern.

It is relatively inexpensive

Ethernet networks often use cables to transmit data.

A more recent Ethernet standard, called *Fast Ethernet*, has a data transfer rate of 100 Mbps (million bits per second), ten times faster than the original standard.

Gigabit Ethernet provides an even higher speed of transmission, with transfer rates of 1 Gbps (1 billion bits per second).

The *10-Gigabit Ethernet* standard supports transfer rates up to 10 Gbps.

COMMUNICATION PROTOCOLS

Definition

A protocol is the set of rules and procedures that govern transmission of data across all computers in a network.

Functions of protocol in a communications network

- Identifying each device in the communication path.
- Securing the attention of the other device.
- Verifying correct receipt of the transmitted message.
- Determining that a message requires retransmission if it is incomplete or has errors.
- Performing recovery when errors occur.

Examples of communication protocols

i. **FTP (File Transfer Protocol)**

Is an internet protocol that allows users to upload and download files with other computers.

ii. **HTTP (Hyper Text Transfer Protocol)**

Is the standard or protocol that enables transfer of pages to the web.

iii. **IMAP (Internet Message Access Protocol)**

Is a protocol that allows access of electronic mails that are kept on a mail server.

iv. **POP (Post Office Protocol)**

Is a communications technology for retrieving e – mail from a mail server.

v. **SMTP (Simple Mail Transfer Protocol)**

Is a protocol designed to transfer electronic mail reliably and efficiently.

It transfers mail messages between systems and provides a notification regarding incoming mail.

vi. **TCP / IP (Transmission Control Protocol / Internet Protocol)**

- Is an internet protocol that enables a computer to function as a terminal working from a remote computer.
- It was developed in 1973 for use in the ARPAnet and later adopted as the internet standard in 1983.
- It manages the transmission of data by breaking it up into **packets.**
- It defines how to break the message into packets, provides routing information for message delivery and reassembles the message at the receiving end.
- An IP address is a number that uniquely identifies each computer or device connected to the internet.
- It consists of four group numbers
- Each number is separated by a period.

vii. **Ethernet**

- It was the first industry standard LAN protocol developed by Xerox in 1976.
- It uses the Career Sense Multiple Access / Collision Detection (CSMA/CD) to detect possible collision if two devices attempt to send data at the same time.

- A computer with data to transmit sense that data is already on the network, it waits a random amount of time before attempting to retransmit the data.
    Advantages of Ethernet
    - It is relatively cheap, easy to install and maintain
    - It is more efficient and economical than using a bridge to connect separate LANs
viii. **Token ring protocol**
    - It is a protocol which controls the network by requiring that a special signal called a **token** is shared or passed among network devices.
    - Only the device with the token can transmit data over the network
    - If a device has nothing to transmit, it passes the token to the next device
    - It's based on a ring topology but can also be used with a star topology.

FACTORS AFFECTING THE RATE OF TRANSMISSION OF A NETWORK

Several factors that can negatively affect latency include the distance between the two points, the type of transmission media, and the number of nodes through which the data must travel over the communications channel. For best performance, bandwidth should be high and latency low.

a) **Frequency and bandwidth of the medium; [rate of transmission]**
   The higher the frequency, the wider the bandwidth, the more data will be sent over a medium and vice versa.
   NB; Bandwidth; is the difference between the highest frequency and the lowest frequency.

b) **Line configurations;**
   - These are either **point – to – point** or **Multipoint**.
   - A **point – to – point** connects the sending and receiving devices such that a terminal with a central computer.
   - A **Multipoint** line is a single line that interconnects several communications devices to one computer.
   - Data moves faster in a point – to point than in a multipoint.

c) **Serial and parallel transmission**
   - In serial transmission, bits are transmitted sequentially, one after the other.
   - In parallel transmission, bits are transmitted through separate lines simultaneously.
   - Therefore, data transmission is faster in parallel transmission than in serial.

d) **Direction of transmission**
   This can be simplex, half duplex or full duplex.
   - In simplex, data can travel only in one direction.
   - In half duplex, data travels in both directions but only one direction at a time.
   - In full duplex, data travels back and forth at the same time.

e) **Transmission mode**
   This can be either asynchronous or synchronous
   - In asynchronous transmission, data is sent one byte (character) at a time.
   - In synchronous transmission, large quantities of data are transmitted at ago at regular intervals.

f) **Packet switching**
   - A packet is a block of data for transmission over a network.
   - Packet switching is a technique for dividing electronic messages into packets for transmission over a network to their destination through the most convenient route.
   - It can handle high volume of traffic in a network
   - It allows more users to share a network, thereby offering cost savings.

g) Protocols (rules for data transmission)

A protocol specifies the type of electrical connections used, the timing of message exchange, error detection techniques, specify how the receiving devices will acknowledge sending devices (handshaking) etc.

h) Network topology

There may be data collisions in a bus topology hence slowing down the network.
A star and ring topology has fewer collisions and usually runs faster.

i) Capacity of hardware in the network

The speeds of hubs, switches and NICs will greatly determine the speed of the network.

j) The server

The amount of RAM installed in the server and the speed of the hard disk greatly affects the speed of the network.

k) Location of software and files

If software is stored on the workstation hard disks, it increases (speeds up) performance and reduces network traffic.

COMMUNICATION CHANNELS AND

A communication channel is the communications path between two devices.

It is composed of one or more *transmission media* which consists of materials or techniques capable of carrying a signal.

Factors considered when selecting a communications channel

✓ The purpose of the overall information and organizational systems.
✓ The purpose of the telecommunications subsystems.
✓ Cost of the channel.
✓ Characteristics of the media.

TRANSMISION MEDIA

These are materials or techniques capable of carrying one or more signals.

NB:
Useful terms
Baseband transmission media
This is the kind of media that can only transmit one signal at a time.
Broadband transmission media
This is the kind of transmission media that can transmit multiple signals simultaneously.
Latency
This is the time it takes a signal to travel from one location to another on a network.

TYPES OF TRANSMISSION MEDIA

There are two types of transmission media, i.e.

i) *Physical transmission media*
ii) *Wireless transmission media*

i) *PHYSICAL TRANSMISSION MEDIA*

This is a kind of media which uses wires, cables or other tangible material to send communications signals.

(i)   Twisted pair cable

- It consists of one or more twisted pair wires bundled together.

- Each twisted pair wire consists of two separate insulated copper wires that are twisted together to reduce **noise**.

    NB: **Noise;** is an electrical disturbance that can degrade the transmitted

signals.
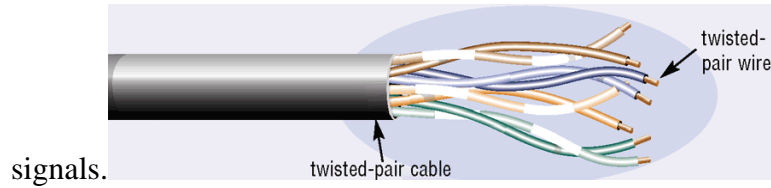
Types of Twisted pair cable

- **Shielded twisted pair cable (STP)**
- This has a metal wrapper around each twisted pair wire to further reduce the noise.
- This makes them more suitable for use in environments susceptible to noise such as in a LAN.

- **Unshielded twisted pair cable (UTP)**
- This doesn't have a metal wrapper for shielding noise.
- They are commonly used in telephone networks.
- It is inexpensive and easy to install.

(ii)   Coaxial cable;

    This is a cable which consists of a single copper wire surrounded by at least three insulating layers i.e.

    o   An insulating material
   o   A woven or braided metal &
    o   A plastic outer coating.
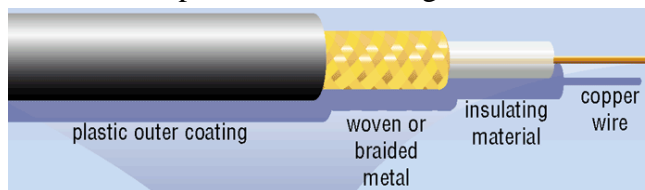
    It can be cabled over longer distancesthan twisted-pair cable.
    Coaxial cable also is insulatedmore heavily than twisted-pair cable, and thus is not assusceptible to noise.

(iii)   Fiber – optic cable;

- It consists of dozens or hundreds of thin strands of glass or plastic that use light to transmit signals.
- Each strand (optic fiber) is as thin as a human hair.
- Each strand is surrounded by an insulating glass cladding and a protective coating.
- The high-intensity light beams are generated by lasers and are conducted along the transparent fibers.
- They are used by many local and long distance telephone companies, cable TV and in high traffic networks.
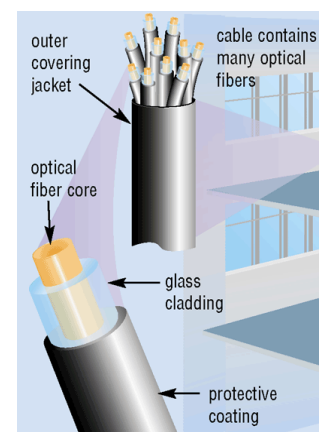
Advantages of fiber optic cables over wired cables

   ✓ Carry more signals that wired cables.
   ✓ They transmit data faster.
   ✓ They are less susceptible to noise from other devices
   ✓ Has a better security for signals during transmission
   ✓ They are small in size and lighter that wired cables.

Disadvantages of fiber optic cables over wired cables

   ▪ They are more expensive

- They are difficult to install and modify
- They are delicate.

ii) WIRELESS TRANSMISSION MEDIA

This is a kind of media that sends communications signals through the air or space using radio, microwave and infrared signals.

Wireless telecommunicationstechnologies transport digital communicationswithout wires between communications devices.

They are used when it isinconvenient, impractical, or impossible to installcables.

1. Broadcast radio

- It is a wireless transmission medium that distributes radio signals through the airover long distances such as between cities, regions, and countries and short distances such as within an office or home.
- A **transmitter** is needed to send the broadcast radio signal.
- To receive the broadcast radio signal, a**receiver**with an antenna that is located in the range of the signalis needed.
- Some networks use a **transceiver** which both sends and receives signals from wireless devices.
- Broadcast radio is slower and more susceptible to noise than physical transmission media but it provides flexibility and portability.
- Bluetooth, Wi-Fi, UWB, and WiMAX communications technologies use broadcast radio signals.
- Hot spots use Wi-Fi, WiMAX, and Bluetooth networks.

2. Bluetooth

- It is a kind of short range (~10 meters) broadcast radio communication which can transmit data at a rate of 1Mbps among Bluetooth enabled devices.
- Bluetooth devices include;
  - Desktop computers
  - Notebook computers
  - PDAs
  - Cellular phones
  - Printers
  - Mouse, keyboard, etc.

3. Microwaves

- These are high-frequency radio waves that are sent through the atmosphere and space.
- They provide a high speed signal transmission.
- Microwave transmission involves sending signals from one microwave station to another thus called *fixed wireless*.
- A microwave station is an earth-based reflective dish that contains the antenna, transceivers, and other equipment necessary for microwave communications.
- It is fast (~4500 times faster than dial – up modems) but it is limited to line – of sight transmission.
- Therefore, microwaves must transmit in a straight line with no obstructions between microwave antennas.

- To avoid possible obstructions, such as buildings or mountains, microwave stations often sit on the tops of buildings, towers, or mountains.
- Typically, microwave stations are placed in a series—one station will receive a signal, amplify it, and retransmit it to the next microwave transmission tower.
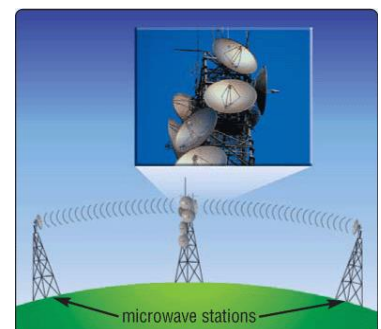
4. **Communications satellite**
- It is a device which is station in the outer space that receives microwave signals from an earth – based station, amplifies the relatively weak signals and broadcasts the signals over a wide area at different frequencies to many earth – based stations.
- These earth-based stations often are microwave station.
- Other devices, such as smart phones and GPS receivers, also can function as earth-based stations.
- Satellites are usually placed about 22,300 miles above the earth's equator and moves at the same rate as the earth.
- They are used in television and radio broadcasts, videoconferencing, paging and global positioning systems.
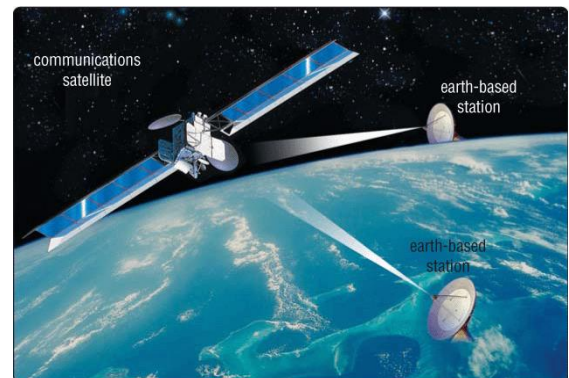
NB: Transmission from an earth-based station to a satellite is an *uplink*.
Transmission from a satellite to an earth-based station is a *downlink.*

Applications of satellites
They are used in applications such as;
- air navigation,
- television and radio broadcasts,
- weather forecasting,
- videoconferencing,
- paging,
- global positioning systems,
- Internet connections, etc.

Advantages of satellites
- ✓ They can receive and broadcast over larger geographical regions.
- ✓ Lots of data can be sent simultaneously.
- ✓ Allows high quality broadband communication across continents.

Disadvantages of satellites
- They are expensive to launch.
- The infrastructure needed to access satellite communications is also expensive.

5. **Cellular radio**
- Is a form of broadcast radio that is used widely for mobile communications, specifically wireless modems and cellular phones.
- Cellular transmission uses radio waves, therefore, it is possible for people with special receivers to listen to cell phone conversations.

Categories of cellular transmissions
- IG (first generation) transmitted analog data
- 2G (second generation) transmit digital data at speeds from 9.6 kbps to 19.2 kbps
- 3G (third generation) transmit digital data at speeds from 114 kbps to 2.4 Mbps
- 4G (fourth generation) transmit digital data at speeds up to 15 Mbps

3G technology allows users quickly to display multimedia and graphics, browse the Web, watch television or a video, have a video conference, and transfer data on a cellular device.

4G network is the most recent cellular network that uses the mobile wireless WiMAX communication standard.

6. **Infrared (IR)**
- Is a wireless transmission media that sends signals using infrared light waves.
- It also requires a line – of sight transmission.

- It works in a very short distance hence commonly used to allow handheld computers to transmit data and information to large computers within the same room.
- Devices which can use infrared include;
  - Mouse
  - Printer
  - Smart phones
  - Digital camera
- These devices have an IrDA port that enables the transfer of data from one device to another using infrared light waves.
- Infrared transmission can be used to establish a wireless network with the advantage that devices can be moved, removed, and installed without expensive wiring and network connections.

7. Personal Communications Services (PCS)
- Is a set of technologies used for completely digital cellular devices such as handheld computers (PDAs), cellular telephones, pagers and fax machines.
- These devices have voice mail, call forwarding, fax capability, caller ID, and wireless modems for Internet and email access.
  - ❖ **CDMA (Code Division Multiple Access)** is the most common popular PCS technology because of its fast transmission speed and low cost.
  - ❖ **3G** is a newer technology that provides faster rates than PCS that enables users can display multimedia, watch TV, conduct a videoconference, etc on a cellular device.
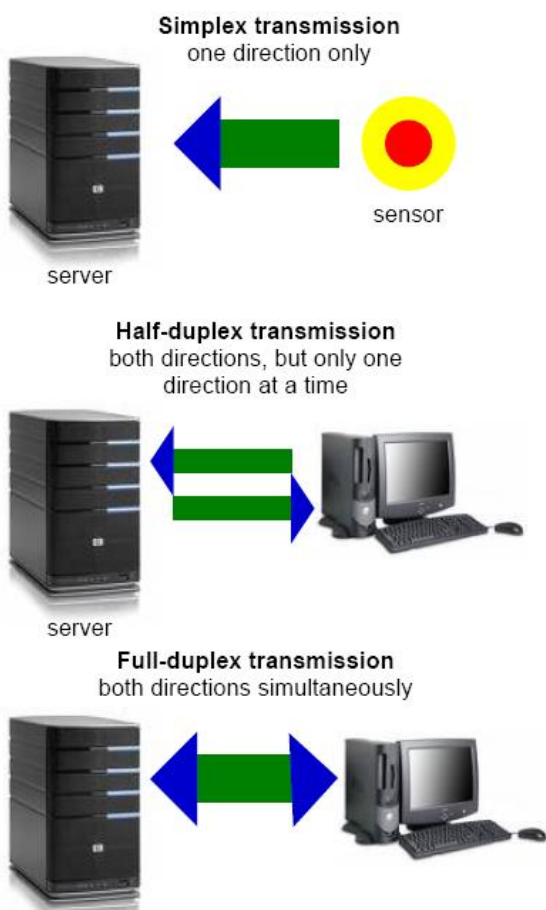
DATA TRANSMISSION

Modes of transmission

Note;
- **Broadband transmission** transmits only one signal at a time
- **Baseband transmission** transmits multiple signals simultaneously.

DIRECTION OF TRANSMISSION

Simplex transmission
one direction only

server

(i)   Simplex transmission
- Here, data flows in only one direction from the sending device to the receiving device.
- It is used only when the sending device doesn't require a response from the receiving device.
- It is applied in security alarms and fire alarms that contain sensors, television broadcasting, etc.

Half-duplex transmission
both directions, but only one direction at a time

server

(ii)   Half duplex
- Data can flow in either direction from the sending device to the receiving device and back but not simultaneously.
- It is used in radio calls, ATM machines, Fax machines, credit card verification systems, etc,

Full-duplex transmission
both directions simultaneously

(iii) Full duplex
- Data can flow in both directions at the same time.

- E.g. with modern telephone system, the sender can be able to talk while listening to the receiver on the other side.

MODES OF DATA TRANSMISSION

When two devices exchange data, the data flows between the devices as a continuous stream of bits. There are two basictransmission techniques for separating the groups of bits:
i.e
- *Asynchronous transmission and*
- *Synchronous transmission.*

These methods are necessary for devices to know when a byte begins or ends.
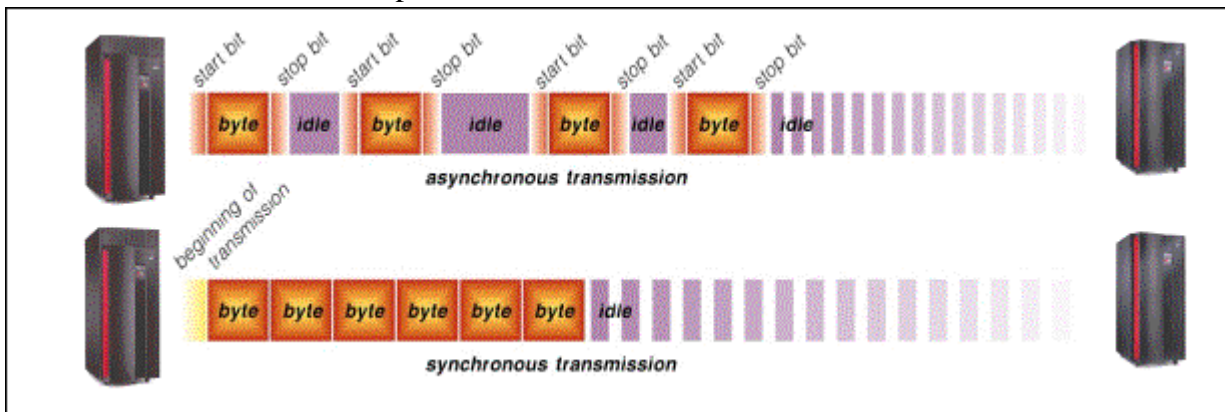
Asynchronous transmission

This is a mode in which data is transmitted one byte at a time over a line at random intervals.
Each byte is framed by controls—a*start bit*for marking the beginning of the byte, a *stop bit*for marking the end of the byte, and a *parity bit*for error checking.

NB:
- Asynchronous transmission is relatively slow and used for low-speed transmission e.g. in conversations over telephone lines.

Synchronous transmission

This is a mode of transmission in which data is transmitted as groups of bytes simultaneously at regular intervals.
The beginning and ending ofa block of bytes is determined by the timing circuitry of the sending device and receiving devices.

NB:
Synchronous transmission;
- Requires more sophisticated and expensive communications devices,
- Provides much higher speeds and greater accuracy than asynchronous transmission.

Uses of data communications

1.   Voicemail
- This functions like an answering machine
- It allows a caller to leave a voice message which is stored in a voice mail box for the caller party.
-       The called party can listen to the message, add comments to the message and reply or forward the message to another mail box in the voice mail system.

2.   Fax
-       A facsimile (fax) machine is a device that transmits and receives documents over telephone lines.

- Sent or received documents are called **faxes**.
- Fax capability can be added to a computer using a fax modem.

3.   E – mail

It is the transmission of messages via a computer network such as a LAN or internet.

4.   BBS (Bulletin Board System)

- It is a computer that maintains a centralized collection of electronic messages.
- They are declining because of the emerging of internet which can serve the same purpose.

5.   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.

6.   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.

7.   News groups

- Also called discussion groups.
- It is an online area where users conduct written discussions about a particular subject.

8.   Internet telephony

- It is also called a **Voice Over IP (VoIP)**
- It is a web based telephone that allows a user to talk to others for just the cost of the internet connection.
- A microphone, sound card and special internet telephony software are required for conducting internet telephony.

9.   Videoconferencing

It is a meeting between two or more geographically separated people who use a network or the internet to transmit audio and video data.

10.   Groupware

- It is a software application that helps groups of people to work together and share information over a network.
- It enables members of a workgroup to communicate, manage projects, schedule meetings and make group discussions.

11.   Telecommuting

Is a work arrangement in which employees may work away from the standard workplace of a company, but communicate with the office using some kind of communications technology.

Advantages of telecommuting
- ✓ Reduces time and expenses for travelling to and fro work.
- ✓ Eliminated travelling during bad weather conditions.
- ✓ Allows flexibility in the work schedule.
- ✓ Reduces air pollution by vehicles driven to and fro work.
- ✓ Employers reduce costs due to less office space and furniture required.
- ✓ Favors the disabled employees.

Disadvantages of telecommuting
- Reduces human face – to – face interactions among the working staff.
- If any device of the communications system fails, the work has to stop.
- Leisure time at home may be replaced by work.
- There is less security over the company's information.

12.   Global positioning (GPS)

It consists of one or more earth based receivers that accept and analyze signals sent by satellites in order to determine the receiver's geographical location.

Uses of GPS

- ✓ To locate a person or an object
- ✓ To find the best route between two points
- ✓ Monitor the movement of a person or object.
- ✓ Create a map
- ✓ To get weather information
- ✓ Used by cars and ships to provide directions.

COMPUTER NETWORKS

A network is a collection of computers and devices connected by telecommunications channels that allows users to facilitate communications, share data, information, software, and hardware with other connected users.

Advantages of using a network

- ✓ Enables sharing of resources such as printers, scanners, storage devices hence reducing costs.
- ✓ Enables sharing of data and information stored on other computers on the network.
- ✓ Facilitates communication between people via e-mail, instant messaging, chat rooms, telephony, videoconferencing, etc.
- ✓ Allows tight control over who has access to what data

Disadvantages of using networks

- ▪ The hardware, software and expertise required to set up a network are expensive.
- ▪ They are vulnerable to security problems
- ▪ If a server fails, the whole network may fail hence inconveniencing all the users
- ▪ They easily spread viruses which can damage information on the network.

Components of a network

Network Administrator;

This is the person who manages and troubleshoots the computer network.

Internet Service Provider (ISP);

Is a company that supplies connections to the internet usually for a monthly fee.

An **Internet service provider** (**ISP**, also called **Internet access provider**) is a business or organization that offers users access to the Internet and related services.

Many but not all ISPs are telephone companies or other telecommunication providers.

Services provided by Internet Service Providers

i) Internet access,
ii) Internet transit,
iii) Domain name registration and hosting,
iv) Dial-up access,
v) Leased line access and collocation.

Internet service providers may be organized in various forms, such as commercial, community-owned, non-profit, or otherwise privately owned.

The Internet was developed as a closed network between government research laboratories and relevant parts of universities. By the late 1980s, it was slowly moving towards commercial use; these restrictions would be completely removed by 1995, 4 years after the release of the World Wide Web to the general public.

In 1989, an ISP had appeared in Australia. In the US the same year, Brookline, Massachusetts-based The World became the first commercial ISP in the US. Its first customer was served in November of 1989.

Classification of service providers

Access providers

Access ISPs employ a range of technologies to enable consumers to connect to their network. They achieve this through technologies such as acoustic couplers, telephone lines, cable, wi-fi, fiber optics, etc.

Mailbox providers

A **mailbox provider** is a department or organization that provides email mailbox *hosting* services.

It provides email servers to send, receive, accept, and store email for other organizations and/or end users, on their behalf and upon their explicit mandate.

Many mailbox providers are also access providers, while others aren't.

They include;

- Yahoo! Mail,
- Hotmail,
- Gmail,
- AOL Mail,
- Pobox

Hosting ISPs

Hosting ISPs routinely provide email, FTP, and web-hosting services.

Other services include virtual machines, clouds, or entire physical servers where customers can run their own custom software.

Transit ISPs

Just as their customers pay them for Internet access, ISPs themselves pay upstream ISPs for Internet access.

An upstream ISP usually has a larger network than the contracting ISP and/or is able to provide the contracting ISP with access to parts of the Internet the contracting ISP by itself has no access to.

Virtual ISPs

A virtual ISP (VISP) is an operation which purchases services from another ISP (sometimes called a "wholesale ISP" in this context) which allows the VISP's customers to access the Internet using services and infrastructure owned and operated by the wholesale ISP.

It is akin to mobile virtual network operators and competitive local exchange carriers for voice communications.

Free ISPs

Free ISPs are Internet service providers who provide service free of charge.

Many free ISPs display advertisements while the user is connected; like commercial television, in a sense they are selling the users' attention to the advertiser.

Other free ISPs, often called freenets, are run on a non-profit basis, usually with volunteer staff.

Peering

ISPs may engage in peering, where multiple ISPs interconnect at peering points or Internet exchange points (IXs), allowing routing of data between each network, without charging one another for the

data transmitted—data that would otherwise have passed through a third upstream ISP, incurring charges from the upstream ISP.

Law enforcement and intelligence assistance

Internet service providers in many countries are legally required (e.g. CALEA in the U.S.) to allow law enforcement and intelligence agencies to monitor some or all of the information transmitted by the ISP.

Such monitoring is considered a violation of the Fourth Amendment by many. Modern ISPs integrate a wide array of surveillance and packet sniffing equipment into their networks, which then feeds the data to law-enforcement/intelligence networks and software such as DCSNet in the United States, or SORM in Russia, allowing them to monitor Internet traffic in real time. The program is opposed.

Uganda Internet Service Providers (ISP)

Internet Service Providers

The understanding of the types of the internet providers is not compulsory but by knowing them, you will be able to understand more about the advantages and the disadvantages of the services providers before purchasing any of it.

There are 4 main internet service providers;

> ➢ DSL satellite provider,
> ➢ cable satellite provider,
> ➢ satellite internet services and
> ➢ the wireless internet access.

DSL or digital subscriber line is a type of a technology that connects the computer to the internet through the existing copper phone line wiring in an area.

This connection is digital, hence you can use your phone while still connecting to the internet.

It is 50 times faster than the normal dial up connection and is widely used in the internet world.

It also offers more consistent bandwidth compared with the cable modems but it depends on the condition of the existing wiring in your area.

Cable service provider in the other hand is the fastest satellite provider among the rest.

This cable connection is the same connection with the television cable.

It is easily accessible if the area that you are living is covered by the major cable companies.

By comparison, this type of connection is actually 70 times much faster than the dial up connection.

We often hear the terms of WiFi, wireless internet broadband and EV-DO.

Those are the types of services under the wireless internet provider.

It is 35 times much faster than the dial up connection and the easiest service to get since it is the most popular service right now.

You can get direct access to any wireless internet services in your house, the hospitals, coffee shops or even in the libraries that have installed this service.

This is a good satellite internet provider if you are a frequent traveler and always need an internet connection.

The most expensive service provider would be the satellite services. The only reason for you to subscribe the satellite satellite provider is that; if there is no other connection available in that area that you are staying.
This could happen to a very remote area or a rural area that do not have cable or DSL connections.
It is much faster than the dial up connection; therefore the subscribers do not take the price as a major obstacle for them to get connected to the cyber world.

Internet service providers in Uganda include:
Orange Telecom
Plot 28 – 30 Clement Hill Road
P.O. Box 24144 KampalaUganda
+256 79 0792 000 (reception)
+256 79 0000 100 (customer care)

Datanet Ltd.
Crested Towers Ground Floor 680, Kampala
031-2263520/5

Uganda Telecom Ltd. (UTL)
2 & 4A Nakasero Road Nakasero Rwenzori Courts 7171, Kampala
041-4333504, 041-4333301

INFOCOM (Let's talk Internet)
26 Wampewo Avenue Bakwanye House 8373, Kampala
041-4562800

Jolis Intercom
22 Jinja Road Namanve Arkright III Estate 22930, Kampala
031-2280643, 041-4577227, 079-2567374

Silver Telecom & Computers Ltd.
Luwum Street Kizito Towers 31741, Kampala
041-4232474, 075-9494949

LSK IT Solution Ltd.
8 Kyagwe Road Kisozi Complex 16714, Kampala
041-4372993, 077-2378038, 078-2364390

Computer Frontiers International(CFI)
Plot 7/11 Buganda Road Suite B7. P.O. Box 7594, Kampala
0414255686

Uganda Home Pages Ltd.
2 Parliament Avenue Jumbo Plaza Suite M1.2 7482, Kampala
041-4503005/6, 031-2262290

Afsat Communications (U) Ltd
1 Colville Street Communications House 25745, Kampala

041-4343969, 041-4343780

Computeknology.com
3 Pilkington Road NIC Building 1st Floor 35628, Kampala
041-4232605

Africa Online
7 Kampala Road Commercial Plaza 5th Floor 29331, Kampala
041-4258143

MTN (U) Ltd.
22 Hannington Road MTN Towers 24624, Kampala
031-2212333, 031-2212444
Etc.

Clients;
These are independent computers connected to a server in a network.

Servers;
- ❖ A server is a computer that controls access to the hardware (e.g. printers, scanners) and software on the network and provides a centralized storage area for programs, data, and information.
- ❖ It provides shared services such as network security measures with other machines.
- ❖ The other computers (clients) on the network rely on the servers for these resources, such as files, devices, processing power, and storage.

Examples of servers;
- ▪ **DNS server (Domain Name Server)**
  It translates the domain name into its associated IP address so that data can go to the correct computer.
- ▪ **Dedicated Server**
  Is a server that performs a specific task independently in a network.
- ▪ **File server**
  It stores and manages files on the network
- ▪ **Print server**
  Manages printers and print jobs.
- ▪ **Database server**
  Stores and provides access to a database stored on the network
- ▪ **Network server (e.g. DNS)**
  It manages all the traffic on the network.

NETWORK ARCHITECTURES
i)   **Peer to Peer network**
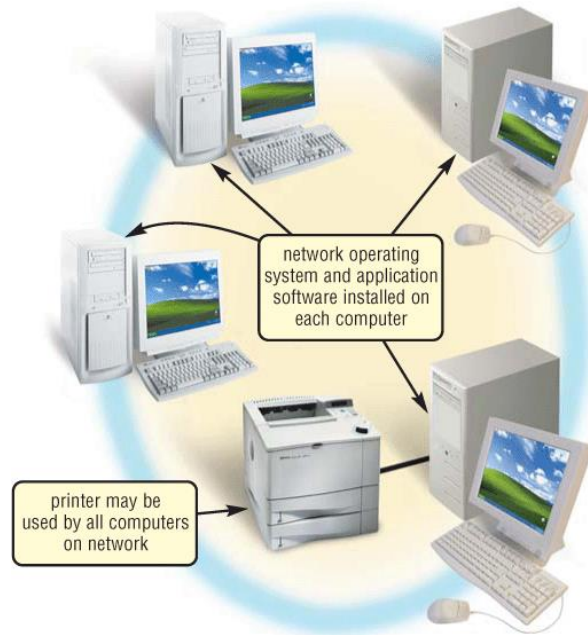
- ✓ In this architecture, several personal computers are connected together with each being able to access the resources of other computers.
- ✓ All computers access resources equally.
- ✓ Each computer stores files on its own storage devices.
- ✓ Each computer has its own network operating system and application software.
- ✓ It normally connects less than 10 computers together.
- ✓ It is suitable for home and small scale business users.

Advantages of a peer to peer network
- ✓ It is simple to set up
- ✓ It is inexpensive
- ✓ Do not require additional specialized network administration software
- ✓ Do not require a dedicated network administrator.

Disadvantages of a peer to peer network
- ▪ May not work well in large organizations
- ▪ They are not easy to administer
- ▪ Each user must be trained to perform administrative tasks
- ▪ Reduced performance because all the devices share resources equally.
- ▪ It doesn't allow remote installation of software

ii) Client – server network

- ✓ A client/server network is a network architecture in which one or more computers are designated as a server(s) and other computers on the network, (called clients) can request services and resources from the server, such as providing databaseaccess or queuing print jobs
- ✓ It can connect more than 10 computers.

✓ It requires a network administrator to manage the network
✓ The server controls communication and shared network resources.

Advantages of a Client – Server network
✓ It is more secure
✓ Easier to administer because the administration is centralized
✓ All data can be backed up on the server.
✓ Remote installation of hardware and software is very possible.

Disadvantages of a Client – Server network
▪ Requires expensive specialized network administrative and operational software
▪ Requires expensive, more powerful hardware for the server machine
▪ Requires a professional network administrator
▪ If the server fails, no user will be able to use the network.

NB:
The major difference between peer – peer and client – server network lies in how the data and information is stored.

TYPES OF COMPUTER NETWORKS
1. **Personal Area Network (PAN)**
   ➡ Is a computer network used for communication among computer devices, such as telephones and personal digital assistants in proximity to an individual's body.
   ➡ Its reach is typically a few meters.
   ➡ They can be used for communication among the personal devices themselves (interpersonal communication) or for connection to the internet.
2. **Local Area Network (LAN)**
   ➡ Is a network that connects computers and devices in a limited geographical area such as a home, school, computer laboratory, office building or closely positioned group of buildings.
   ➡ Each computer or device is a node.
   ➡ The most commonly used LANs are the wired ones which are based on the Ethernet technology.
   Components of a LAN
   ✓ Connecting or cabling system
   ✓ Microcomputers with interface cards
   ✓ Network operating system
   ✓ Shared devices such as printers, scanners, peripheral devices, fax machines, storage devices, etc.
   ✓ Bridges and gateways.
3. **Home Area Network (HAN)**
   ➡ Is a residential local area network.
   ➡ It is used for communication between digital devices in the home, usually a small number of personal computers and accessories such as printers and mobile computing devices.
4. **Campus Network**
   ➡ Is a computer network made up of an interconnection of Local Area Networks (LANs) within a limited geographical area.
   ➡ In case of a school campus based network, the network is likely to link a variety of campus buildings including; academic departments, school library and student residence halls.
5. **Metropolitan Area network;(MANs)**

➡ Is a network that connects two or more Local Area Networks or Campus Networks together.
➡ It doesn't extend beyond the boundaries of the immediate town / city.
➡ Routers, switches and hubs are connected to create a MAN.

6. **Wide Area Network; (WAN)**

Is a computer network that spans a large geographic area such as a country, two countries in the same geographical area, etc.
It normally use communication channels e.g. Telephone lines, cables and air waves.

7. **Global Area Network; (GAN)**

Is the network used for supporting mobile communications across a number of wireless LANs, satellite coverage areas e.t.c

8. **Virtual Private Network; (VPN)**

Is a computer network in which some of the links between nodes are carried by open connections or virtual circuits instead of physical wires.

9. **The internet**

Is a worldwide collection of networks linked together.
It is the largest Wide Area network in the World.

10. **Intranet**

It is an internal network of an organization whose resources are accessed by only people within that organization.
They are networks managed by a single organization.
The organization closes the intranet to specific users.
Intranets generally make company information accessible to employees and facilitate working in groups.

11. **Extranet**

An extranet is a network that is owned by a single organization but also has limited connections to the network of one or more other organizations.
It is an intranet that extends to authorize users outside the company.
Organizations allow customers and suppliers to access their intranets.
Package shipping companies, for example, allow customers to access their intranet to print air bills, schedule pickups, and even track shipped packages as the packages travel to their destinations.

NB; To prevent unauthorized access to data and information, intranets and extranets are often protected by **firewalls.**
Definition;
A FIREWALL is the hardware and software used to restrict access to data and information on a network.

NETWORK TOPOLOGIES
A network topology is the physical arrangement of the devices in a communications network.
Types of Network Topologies
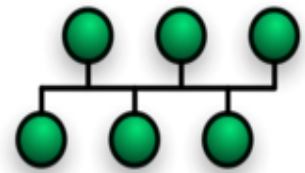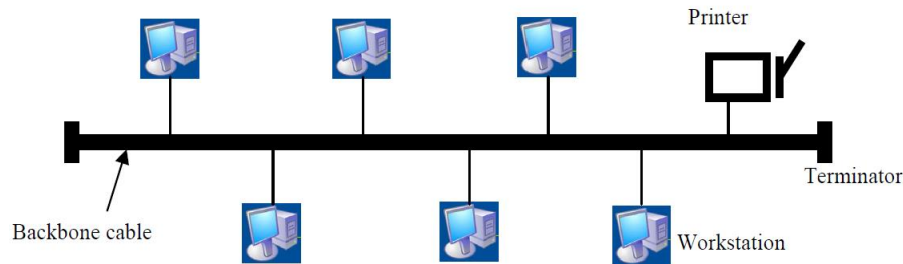i. Bus topology
ii. Ring topology
iii.   Star topology
iv.   Tree topology
v. Mesh topology

i. **Bus Topology**

- ✓ It consists of a single central cable (Backbone or Bus) to which all the network nodes are attached.
- ✓ The bus in a bus network transmits data, instructions, and information in both directions.
- ✓ When a sending device transmits data, address of the receiving device is included with the transmission so that the data is routed to the appropriate receiving device.

or

- ✓ Only one device can transfer items/data at one time.
- ✓ The address of data to be sent is added so that it is routed to the appropriate receiving device.
- ✓ It is commonly used for Local Area Networks.

Advantages of a bus topology
- ✓ It is in expensive to install.
- ✓ Easy to install
- ✓ Nodes can be attached and removed without disturbing the rest of the network.
- ✓ Failure of one device doesn't affect others.

Disadvantages of a bus topology
- ∗ If the bus fails, the whole network fails.
- ∗ Data collisions may occur during transmission especially if more than one device attempt to send at the same time.

ii. Ring Topology
- ✓ Consists of a cable forming a closed ring or loop with all the computers and devices in the network.
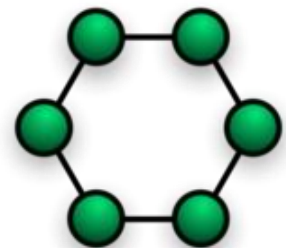
or

- ✓ Data travels from device to device around the entire ring in one direction only.
- ✓ The node examines any data that passes by to see if it is the addressee; if not, the data is passed on to the next node in the ring.
- ✓ If one device fails, all the devices before the failed device are not affected but those after the failed device cannot function.
- ✓ It can span a larger distance than a bus network, but it is more difficult to install.
- ✓ It is primarily is used for LANs, but also is used in wide area networks (WAN).
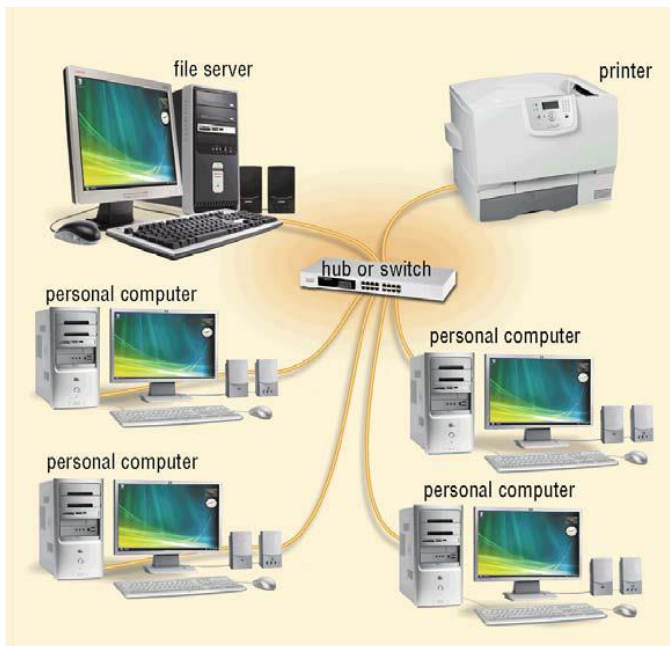
Advantages of ring topology

✓ Can span a larger distance than a bus network.
✓ Since data is only in one direction, no collisions can occur.
✓ Speed of data transmission is fast.
✓ Failure of one device only affects the devices after the failed node but doesn't affect the nodes before.

Disadvantages of ring topology
▪ Difficult to install
▪ If the cable fails, the whole network goes down.

iii. Star Topology
✓ Here, all the computers and devices are connected to a central device (hub or switch) thus forming a star.

 or

✓ All the data from one computer to another passes through the central point.

Advantages of a star topology
✓ Fairly easy to install and maintain.
✓ nodes can be added to or removed from the network with little or no disruption to the network.
✓ If one node fails, its only that node that is affected.
✓ Any connection failure between a node and the hub will not affect the overall system.

Disadvantages of a star topology
∗ A lot of cables are needed hence becoming expensive.
∗ If the central point fails, the entire network fails.

iv. Mesh Topology
✓ All devices are connected to each other.
✓ Data sent on a mesh network can take any of the several paths from the source to the destination.

 or

Computer
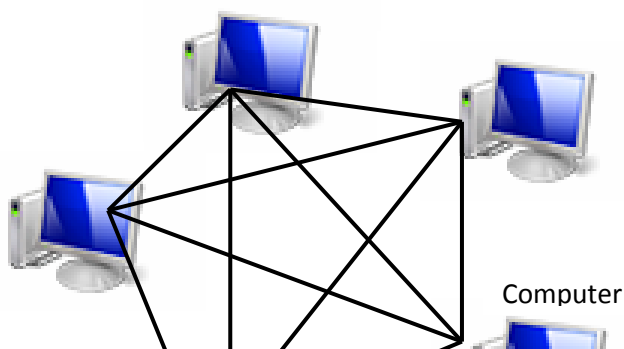
Disadvantages of the Mesh topology
- ✓ Much cabling is needed hence expensive
- ✓ Not easy to troubleshoot incase of failure
- ✓ Not easy to install.

v. Tree (Hybrid) Topology;
- ✓ It is a combination of star and bus networks.
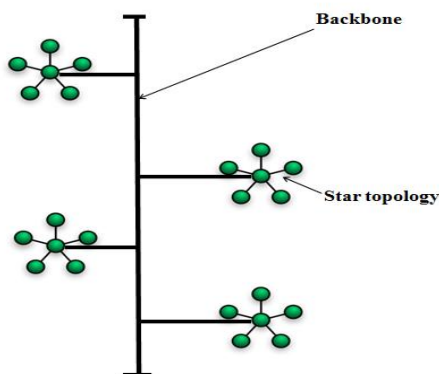
- ✓ Multiple star topologies are combined together onto a bus.
- ✓ It can be used to connect a bus network in buildings onto star topologies in different buildings.

Advantages of a tree topology
- ✓ It can connect many devices
- ✓ Gives a lot of room for future expansion.
- ✓ Failure of one star topology will not stop the entire network.
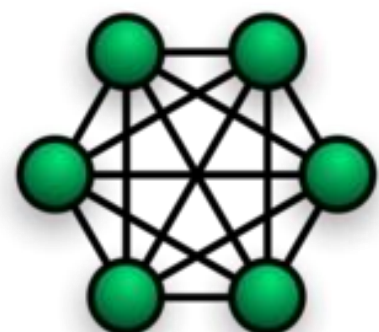
Disadvantages of a tree topology
- ▪ If the bus fails, the whole network may fail.
- ▪ It is expensive to install
- ▪ A lot of cabling is needed.

Factors to consider when choosing a network topology
- • The distance of connectivity.
- • Purpose of the network.
- • Number of computers and other devices to be connected.
- • Cost of installation.
- • Architecture of the building to be used.
- • Safety provisions of the network.
- • Personal provisions and other technicalities involved.
- • Ease in accessing the network.

6. THE INTERNET AND THE WORLD WIDE WEB

THE INTERNET;

Internet is a worldwide collection of networks that links together millions of business, governments,educational institutions, homes and individuals.

It is the largest computer network in the world, connecting millions of computers.

It is the largest Wide Area Network (WAN) in existence.

History of the internet

During the Cold War in the 1960s, The U.S. military decided it needed a bombproof communications system, and thus theconcept for the Internet was born.

The Internet began as a United States Department of Defence network to link togetherscientific and academic researchers around the nation in 1960s.

They built a network, called ***ARPANET (Advanced Research ProjectsAgency network)***, to;

- ➤ allow scientists at different locations to share information and collaborate on military andscientific projects.
- ➤ function even if part of the network were disabled or destroyed by a disaster such as a nuclear attack.

The network became functional in September 1969, linkingscientific and academic researchers across the United States.

This was the foundation of the internet.

Who governs the internet

The Internet is tied into a complex web of governing bodies, national legislatures, and international professionalsocieties.

There is no governing organization that controls activity on the Internet. Instead, there are several organizationsthat influence the system and monitor its operations.

These bodies include;

- o The ***Internet Architecture Board (IAB)***, which helps define the overall structure of the Internet.
- o The ***Internet Corporation for Assigned Names and Numbers (ICANN)***, which assigns IP addresses, and the *Internet Network Information Center (InterNIC)*, which assigns domain names.
- o The ***Internet Engineering Steering Group (IESG)***, which oversees standard setting with respect to the Internet.
- o The ***Internet engineering Task Force (IETF)***, a private-sector group which forecasts the next step in the growth of the Internet, keeping watch over its evolution and operation.
- o The ***Internet Society (ISOC)***, which is a consortium of corporations, government agencies, and nonprofit organizations that monitors Internet policies and practices.
- o The ***World Wide Web Consortium (W3C)***, a largely academic group that sets HTML and other programming standards for the Web.
- o The ***International Telecommunication Union (ITU)***, which helps set technical standards.

While none of these organizations has actual control over the Internet and how it functions, they can and do influence government agencies, major network owners,ISPs, corporations, and software developers with the goal of keeping the Internetoperating as efficiently as possible.

Items required to gain access to the internet

- ➤ Register with an ISP (Internet service provider)
- ➤ Network Interface Card (NIC).
- ➤ Transmission medium (cables or wireless)
- ➤ Network operating system (NOS)

➢ Browser software. E.g. Internet explorer or Mozilla Fire fox

Why people connect to the internet

- To access a wealth of information such as news, weather reports, and airline schedules
- To shop for goods and services through e – commerce
- To use online banking services and managing investments
- Very many people connect to the internet in order to do research across long distances.
- To take online courses most especially through Cyber Schools.
- There are a number of files, games and other programs which are very useful to human beings. Therefore, most people connect to the internet to download these files, programs, etc.
- To send and receive messages to and from other connected users
- To communicate with other uses around the world.
- To access sources of entertainment and leisure such as online games, magazines, etc.
- To share network resources such as printers, scanners etc.
- Getting new information such as news and information
- For electronic discussions through teleconferencing.
- To enjoy online employment system
- To use the online internet library which has a lot of useful academic material

Disadvantage of using the internet

- personal insecurity
- data insecurity across networks
- moral and cultural degradation such as pornography.
- high initial costs of setting up a network
- spread of terrorism and drug trafficking
- over reliance on networks
- spread of viruses
- addiction especially among the youth leading to laziness
- requires expensive skilled personnel to maintain the network which makes it costly.

Factors that affect the speed of an internet connection

i. **Computer Processor speed.** A person using a Computer with dual Pentium IV processor is most likely to get faster connectivity to the internet as compared to one with a Pentium III or Pentium II processor.

ii. **Distance the data travels.** Actual Internet speeds will vary, depending on the distance the data travels coupled with how many servers it has to go through and the different speeds of each server.

iii. Additionally, the shorter the cables or the closer the receivers are to the routers, the faster the connection speed.

iv. **Heavy traffic on the network.** The greater the number of computers on the network is, the more the internet speed reduces. ISPs are allocated a certain amount of **bandwidth** (the maximum amount of information (in bits/second) that can be transmitted along a channel) which is shared among all of the computers on the network.

v. **Malware, Spyware and Viruses.** Viruses hinder the operation of programs on the computer, regardless of its processor strength; this in turn slows down the speed of connectivity.

vi. **Modem speed.** If the modem is substandard with a low rating, or not compatible with the ISP's modem then this will slow down the speed at which data is transmitted.

vii. **Natural Conditions.** Instability in connection speed is also commonly caused by natural conditions such as stormy weather and thunder, which interfere with the transmission of signals.

viii. **Positioning of Routers.** Routers in wireless networking should be strategically positioned.

ix. The routers should not be put below or under tables but should be raised well to be able to send the signals directly to the receiving computers/ laptops

x. **Hardware problems.** A poor network card, video card or signal receiver can seriously reduce the speed of the data being processed by your system, slowing down the speed at which your computer can take the information coming in. Also, if your Internet service comes over the phone line and you have a faulty filter attached, the speed will be compromised.

xi. **Software problems.** You need a good updated web browser software to display the web pages efficiently. It is also good to have updated software and device drivers to newer versions for optimum performance.

xii. **RAM Memory available.** With each program you open on your computer, you are using up more RAM memory. Your computer has to write this data to the disk, and the more memory you are using up on open programs, the less memory there is available to receive the data.

xiii. **Computer internet settings.** Improper computer settings can also affect the speed of your internet connection. Setting your firewall, safe search and other options properly will improve the speed as well.

xiv. **Technological Circumstances.** Slow speed of an internet connection can be due to technical causes such as maintenance works being done by an ISP.

xv. **Cookies.** When surfing, the browser collects information, such as passwords and stores it on your local hard drive in a file known as a cookie. Over time, these cookies can compromise the speed of your Internet connection, particularly if you visit many websites during a browsing session.

THE ELECTRONIC MAIL (E – MAIL)

It is an Internet communication service which allows Internet users to create, send and receive mail messages electronically.

In order for any two users to receive or exchange E-mail messages online, they must have E-mail addresses

E – mail address

An email address is a set of characters that are required to send and receive emails
Parts of an email address

Consider the email address below; eyddie@yahoo.com

i)   Username: **eyddie**

      It helps to identify your account on the email server that handles the email.

ii)   **@:**

      Means "at"

      It separates your account name from the name of the mail server.

iii)   Domain name: **yahoo.com**

      It consists of;

- Email server name (**yahoo**) after @ and
- A top – level domain (**com**) usually a three letter extension which shows the type of organization.

      E.g.

Top-level domain name	Purpose of host
.com	a business or commercial enterprise (trying to make money)
.ac	an academic instutition or a university
.edu	host is an educational institution
.org	a non-commercial organisation
.mil	military
.net	for network(ISP)
.gov	government

For email addresses outside the United States, there is often a **[DOT]** followed by two letters representing the country.

Country-codes	Country
.ca	Canada
.au	Australia
.nz	New Zealand
.ug	Uganda
.uk	United Kingdom
.za	South Africa

Sending and receiving of an email

To send and receive emails, both the sender and the recipient must have the right tools.

- An internet connection
- An email client
- An email address.

Email Client (composer)

It is a software that runs on a personal computer and relies on an internet connection to perform some of its operations.

It works with ISP (Internet Service Provider) that uses standard internet email protocols that make it possible for people using different email client software to communicate with one another.

Parts of an email message
It comprises of the 3 parts, these are:-
- *Message Header*
- *Message Body*
- *Message Envelope*

The *Message Header* comprises of specified information which appears in the following fields:
From: Contains the E-mail address and in some cases the actual name of the sender of
the e-mail message.

To: Contains the E-mail address and in some cases the actual name of the recipient of
the e-mail message

Date: Contains the date and time when the E-mail message was sent.
This information is automatically generated by the e-mail client software on the server.

Subject: Contains a phrase or statement summarizing the main theme/topic of the mail message.
In some cases it is recommended that it is preceded by the prefix RE:
e.g, **RE: Mum's Health**

Cc: *Carbon Copy*
Contains another E-mail address (es)of recipients to whom the same copy of the E- mail
message is being sent.
The recipients of such an E-mail are able to view the e-mail addresses of all the other
recipients who have received the same mail.

Bcc: *Blind Carbon Copy*
Contains another E-mail address (es) of recipients to whom the same copy of the E- mail
message is being sent.
In this however, the recipients of such an E-mail are not able to view the e-mail addresses of
all the other recipients who have received the same mail.
That is why it is called a *Blind Copy*.

Advantages of email
- ✓ It is very quick in delivering files.You can communicate quickly with anyone on the Internet.
  Email usually reaches its destination in a matter of minutes or seconds.
- ✓ It is a cheap means of transferring files.
  The cost to you for email has nothing to do with distance, and in many cases, the cost doesn't
  depend on the size of the message. Most Internet access charges are based on the number of
  hours per month you access the Internet, or you pay a flat monthly fee.
- ✓ Other computer files can be attached to the email.
- ✓ Records and copies are kept automatically online.
- ✓ Can be picked up anywhere in the world.
- ✓ Can be sent at any time to its destination (it works 24-7)
- ✓ You can deal with your email at a convenient time. You don't have to be interrupted when
  email arrives, and you can read it or work with it when you have the time. Also, you can send it
  at a convenient time. It doesn't have to be written or sent at a time when you know the recipient
  will be available. This is what we mean by the term asynchronous communication.

- ✓ You can send letters, notes, files, data, or reports all using the same techniques. Once you learn how to use your email program, everything is sent the same way.
- ✓ You don't have to worry about interrupting someone when you send email. The email is sent and delivered by one computer system communicating with the Internet. Although it is put into someone's mailbox, the recipient isn't interrupted by the arrival of email.
- ✓ You don't have to be shy about using email to communicate with anyone. Email isn't anonymous-each message carries the return address of the sender-but you can write to anyone with an Internet address. All the messages appear the same to the person who gets the email. The messages are generally judged on what's in them, not where they're from.

Disadvantages of an email

- A computer and other hardware such as a modem are required.
- It is not secure
- It is easy to get on junk (useless) mail lists.
- **Email isn't necessarily private.** Since messages are passed from one system to another, and sometimes through several systems or networks, there are many opportunities for someone to intercept or read email. Many types of computer systems have protections built in to stop users from reading others' email, but it's still possible for a system administrator to read the email on a system or for someone to bypass the security of a computer system.
- **Some email systems can send or receive text files only.** Even though you can send and receive images, programs, files produced by word processing programs, or multimedia messages, some folks may not be able to properly view your message.
- **It's possible to forge email.** This is not common, but it is possible to forge the address of the sender. You may want to take steps to confirm the source of some email you receive.
- **It's difficult to express emotion using email.** The recipient doesn't have the benefit of seeing your facial expressions or hearing your voice. You have to be careful with humor or sarcasm, since it's easy for someone to take your message the wrong way.
- **You can receive too much or unwanted email.** You can receive "junk" email in the same way you receive other types of junk mail. On the Internet, junk mail is called **spam.** You may have to take active steps to delete the email you receive and try to stop it from being sent to you in the first place
- **You may not know about the person with whom you are communicating.** The communication is often al in text and it's possible for us to get an incorrect impression of the person sending us email. Also, some people misrepresent themselves.

  NETIQUETTE

  It is short form for Internet etiquette.

  It is thecode of acceptable behaviors users should follow while on the Internet.

  Netiquette includes rules for all aspects of the Internet,including the World Wide Web, e-mail, FTP, newsgroups and message boards, chat rooms, and instant messaging.

  Rules of Netiquette

  Golden Rule: Treat others as you would like them to treat you.

  a) In e-mail, chat rooms and news groups;
    - ✓ Keep messages brief. Use proper grammar, spelling and punctuation.
    - ✓ Be careful when using sarcasm and humor as it might be misinterpreted.
    - ✓ Be polite. Avoid offensive language.
    - ✓ Read the message before you send it.
    - ✓ Use meaningful subject lines.

- ✓ Avoid sending or posting flames, which are abusive or insulting messages. Do not participate in flame warms, which are exchanges of flames.
- ✓ Avoid sending spam, which is the internet's version of junk mail.
- ✓ Do not use all capital letters which is equivalent to SHOUTING!
- ✓ Use **emoticons** to express emotion. Popular emoticons include;

:)	Smile	**:|**	Indifference	**:O**	Surprised
:(	Frown	**:**	Undecided	etc.	

- ✓ Use abbreviations and acronyms for phrases:

BTW	By the way
FYI	For your information
FWIW	For what it's worth
IMHO	In my humble opinion
TTFN	Ta ta for now
TYVM	Thank you very much

- ✓ Clearly identify a spoiler, which is a message that reveals a solution to a game or ending a movie or program.

b) Read the FAQ (Frequently Asked Questions), if one exists. Many news groups and web pages have a FAQ.

c) Do not assume material is accurate or up-to-date. Be forgiving of other's mistakes.

d) Never read someone's e-mails.

THE WORLD WIDE WEB (WWW)

- It is also called the **Web**
- It consists of a worldwide collection of electronic documents.
- Each of these documents is called a **web page.**
- It emerged in the early 1990s but has grown rapidly to become the most widely used service on the internet.

Terms used:

i) **A web page**
- It is an electronic document or files of information stored on the web / website.
- It can contain text, animations, audio, and video (i.e. multimedia elements), as well as built – in connections (called hyperlinks) to other documents.

ii) **A website**
- It is a collection of web pages where information of a particular organization or company is stored.
- Or it is a group of files that are interconnected by hyperlinks that allow a user to jump from one page to another, usually by a mouse click.

Types of websites
- o News websites
- o Informational websites
- o Business / marketing websites
- o Wikis
- o Online social networks[e.g. facebook, twitter, etc]
- o Educational websites

iii) **Home page**
- It is the first page (starting page) of a web site.
- It is the table of contents for a website.
- It normally has a name "index.htm" or "index.html"

iv) **A web browser**

This is the software program used to access and view web pages.

Examples of web browsers

- Opera
- Google Chrome
- Mozilla Firefox
- Microsoft Internet Explorer
- Safari
- Netscape
- K-Meleon

- SeaMonkey
- Galeon
- Konqueror
- Camino
- iCab
- Mozilla Suite
- Sunrise

v) **A web server**

It is a computer that keeps and delivers web pages requested by users.

vi) **A web master**

Is the individual responsible for developing web pages and maintaining a website.

vii) **A search engine**

This is a software program that can be used to find websites, web pages and files on the internet and other information to a specific topic.

Examples of search engines

- Google
- Yahoo
- msn
- Dogpile
- Ask Jeeves

- Alta Vista
- Excite
- HotBot
- Lycos
- Web Crawler etc.

viii) **Web publishing software (HTML editors)**

It is specially designed software designed for creating web pages that contain text and multimedia elements.

Examples include:

- Microsoft FrontPage
- Macromedia Dreamweaver
- Adobe Go Live
- Adobe Page mill etc.

FACILITIES OFFERED BY THE INTERNET AND WORLD WIDE WEB

i) **News group**
- It is also called a discussion group
- It is an online area where users conduct written discussions about a particular subject.
- To participate in a discussion, a user sends a message to the news group and other users in the news group read and reply to the message.
- The entire collection of internet news groups is called **Usenet.**
- It is not a live conversation.

- The computer that stores and distributes newsgroup messages is called a <u>news server.</u>
- <u>A news reader</u> program is required to participate in a newsgroup. Most web browsers include a news reader.

ii) Message Board
- It is also called a discussion board
- It is a web based type of discussion group that doesn't require a <u>news reader.</u>

iii) Mailing list
- A mail list is a group of email names and addresses given a single name.
- When a message is sent to a mailing list, every person in the list will receive a copy of the message.

iv) Chat room
- A chat room is a location on an internet server that permits users to chat (converse) with each other by typing lines of text in the computer.
- Some chat rooms support voice chats and video chats.
- To start a chat session, a user must connect to a <u>chat server</u> through a chat program on his or her computer.

v) Instant Messaging (IM)
- It 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 (e.g. Yahoo messenger, Facebook messenger) from an instant messaging service must be installed in order to use instant messaging.

FacebookMessenger
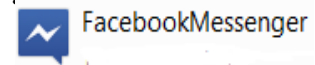
vi) Videoconferencing
- A videoconference is a real time meeting between two or more geographically separated people who use a network or internet to transmit audio and video data.
- It allows participants to collaborate as if they were in the same room.
- A videoconferencing software along with a microphone, speakers and a digital video camera attached to the computer are required to participate in a video conference.

vii) Electronic Commerce (e – commerce)
- It is the buying and selling of goods and services over the internet (Online)
- It is a financial business transaction that occurs over an electronic network such as the internet.
  - **E-business** is the conducting of business on the Internet, not only buying andselling, but also serving customers and collaborating with business partners.

  Examples of transactions conducted online
  ➤ Online shopping
  ➤ Online banking

NB: <u>E – Money:</u> it is a means of paying for goods and services over the internet.

Models of Electronic Commerce Business
i. **Business – to - Consumer (B2C)**

This model applies to any business that sells its products or services to consumers over the Internet.

This model usually includes**e-shops** and **e-malls.**

An **e-shop** or **e-store** is a version of a retail store where customers can shop at any hour of the day without leaving their home or office.

Such businesses include;

- o *Amazon.com*
- o *Gap and Best Buy*

An **e-mall**consists of a number of e-shops.

It serves as a gateway through which a visitor can access other e-shops.

ii. Consumer – to Consumer (C2C)

This model applies to sites primarily offering goods and services that assist consumers interacting witheach other over the Internet.

eBay, the Internet's most successful C2C online auction Web site, links like-minded buyers andsellers for a small commission.

iii. Business – to – Business (B2B)

Is the e – commerce which consists of businesses buying from and selling to each other over the internet.

iv. Consumer – to – Business (C2B)

Applies to any consumer thatsells a product or service to abusiness over the Internet

NB:

Intermediaries

These are agents, software, or businesses that bring buyers and sellers together that provide a trading infrastructureto enhance e-business.

They include;

- ➢ New York-based e-Steel Corp. and
- ➢ Philadelphia-based PetroChemNet Inc.

They bring togetherproducers, traders, distributors, and buyers of steel and chemicals, respectively, in Web-based marketplaces.

Advantages of e – commerce

- ✓ It operates 24 hours a day hence transactions can be conducted at any time.
- ✓ Information about a product can be changed and be available quickly (i.e. it is easy to update)
- ✓ It gives immediate feedback
- ✓ Allows manufacturers to buy and sell directly hence avoiding the cost of middle men.
- ✓ Customers can easily compare prices.
- ✓ It allows business to gather customer information, analyze it and react appropriately.
- ✓ Businesses have access to millions of people with internet connections.
- ✓ It widens the market easily. It can work globally hence saving time for participants on both ends.
- ✓ Distribution costs for information is reduced or completely eliminated.

NB: Netiquette; is the code of acceptable behaviors users should follow while using services on the internet.

MULTIMEDIA

It is the use of computers to integrate text, graphics, audio, animations and videos into one application in order to convey messages.

A web page can contain text, graphics, animations, audio, video, and hyperlinks to other documents.

These are called multimedia elements.

a) Graphics

A graphic is a digital representation of non-text information such as a drawing, a chart or a photo.

Graphics formats

i. JPEG (Joint Photographic Expert Group)

- It is aformat that compresses graphics to reduce their file size, which means the file takes up less storage space.
- Smaller file sizes result in faster downloading and uploading of Webpages because small files transmit faster than large files.
- It is often used for scanned photographs, art work, and other images that include smooth transitions of colors.

ii. GIF (Graphics Interchange Format)

- It is also saved using compression techniques to reduce its file size for downloading.
- It works best for images with only a few distinct colors, such as line drawings, logos, single-color borders, and simple cartoons

iii. PNG (Portable Network Graphics)

It's a newer graphics format which improves on the GIF format, and thusmay eventually replace the GIF format.

It is normally used in web graphics.

iv. BMP (Bit Map) and TIFF (Tagged Image File Format)

These graphical formats have large file sizes and may require special viewer software to display on the web.

Thus, these formats are not used on the Web as frequently as JPEG, GIF, and PNG formats.

NB:

Some Web sites use thumbnails on their pages to reduce downloading time.

A *thumbnail* is a small version of a larger graphical image you usually can click to display the full-sized image

b) Animation

- This is the appearance of motion that is created by displaying a series of still images in rapid sequence.
- Animation can make Web pages more visually interesting or draw attention to important information or links.
- Animation often is used in Web-based games; some animations even contain links to a different page
- Developers unfamiliar with Web page authoring programs can use computer animation and graphics software to create an animated GIF which combines several GIF images into a single GIF file.

c) Audio

On the Web, one can listen to audio clips and live audio.

Audio includes music, speech, or any other sound.

As with graphics files, these sound files must be saved ina certain format.

Common audio formats;

Format	Description	Format	Descriprion
ACC	Advanced Audio Coding	WAV	Windows Waveform
AIFF	Audio Interchange File Format	WMA	Windows Media Audio
ASF	Advanced Streaming (or Systems) Format	RA	RealAudio sound file (Supported by real player)
MP3	Moving Pictures Experts Group Audio Layer 3 (MPEG-3)	QT	QuickTime audio, Video, or 3-D animation

MP3

It is a popular technology that compresses an audio file to about one – tenth of its original file size while preserving the original quality of the sound.

d) Video
- On the Web, you can view video clips or watch live video.
- Video consists of full-motion images that are played back at various speeds.
- Most video also has accompanying audio.
- You can use the Internet to watch live and/or pre-recorded coverage of your favorite television programs or enjoy a live performance of your favorite vocalist.
- You can upload, share, or view video clips at a video sharing Web site such as You Tube. Educators, politicians, and businesses are using video blogs and video podcasts to engage students, voters, and consumers.
- MPEG (Moving Picture Experts Group) is a popular video compression standarda widely used one called ***MPEG-4***, or ***MP4***.

e) Hyperlink
- It's also called a link.
- It is a built – in connection to another related web page or part of a web page.
- A link can be a word, a phrase or an image.

f) Simulations
- These are computer based models of real life situations.
- They often replace costly and sometimes hazardous demonstrations in teaching and learning.

g) Virtual reality (VR)
- Is the simulation of a real orimagined environment that appears as a three-dimensional (3-D) space.
- On the Web, VR involves the display of 3-D images that you can explore and manipulate interactively.
- Using special VR software, a Web developer creates an entire 3-D environment that contains infinite space and depth, called a VR world.
- A VR worldmight show a room with furniture. Users walk through such a VR room by moving an input device forward, backward, or to the side.
- Science educators create VR models of molecules, organisms, and other structures for students to examine.

WEB DESIGNING

Terms used:

i) **A web page**
- It is an electronic document or files of information stored on the web / website.
- It can contain text, animations, audio, and video (i.e. multimedia elements), as well as built – in connections (called hyperlinks) to other documents.

ii) **A website**
- It is a collection of web pages where information of a particular organization or company is stored.
- Or it is a group of files that are interconnected by hyperlinks that allow a user to jump from one page to another, usually by a mouse click.

iii) **Home page**
- It is the first page (starting page) of a web site.
- It is the table of contents for a website.
- It normally has a name "index.htm" or "index.html"

iv) **Hypertext**
It is a text document containing links to other documents and pages

v) **HTML (Hypertext Markup Language)**
It is a language made up of text codes used to create web pages.

vi) **Favorites or Bookmarks**
These are features that are used to save addresses of your favorite web pages

vii) **History**
This is a feature that is used to find the recently visited sites

viii) **HTML Editors**
These are used to help in keeping the HTML tags or codes e.g. Microsoft FrontPage, Micro media Dreamweaver etc.

Qualities of a good web page
- ✓ Should have a feedback
- ✓ Should have good navigation buttons
- ✓ Should load quickly
- ✓ Should have fewer graphics. Too much graphics can make it to take too long to load, take up too much space and client computers may not support different colour depths.
- ✓ Should have a web page title and a summary about the page
- ✓ Should have dates of the latest updates
- ✓ Should have links to other pages or to sections within that page

Precautions a web designer should consider when designing a web page
Should use minimal graphics
Should use precious content
Avoid use of frames
Take into account different versions of client browsers

Should consider copyright

Should consider consumer requirements

COMPONENTS OF A WEB PAGE

a) **Page titles;**

These indicate the name of the website

b) **Buttons and icons**

These are tools used to navigate through the website

c) **Horizontal line separators**

These are parallel lines separating different sections of a web page

d) **Graphics (Images)**

These are pictures used during the designing of the website.

e) **Frames**

These are used to provide more flexibility to a website

f) **Sound buttons**

These are buttons used to provide access to sound clips, interviews, music extracts etc, in case a search engine is to produce sound.

g) **Animations**

These are components providing movement and actions in a web page.

They are used to make a web page more lively

h) **Hyperlinks**

These are colored and underlined text or graphics that one clicks and go to a file, a location in a file or an HTML page on the internet.

A hyperlink is a word, group of words or image that you can click on to jump to a new document or a new section within the current document.

i) **URL (Uniform Resource Locator)**

This is an internet or web address describing the location of the server where the website is located.

Consider the URL below;

http://www.yahoo.com/*household/stampcollecting/welcome.html*

Parts of a URL
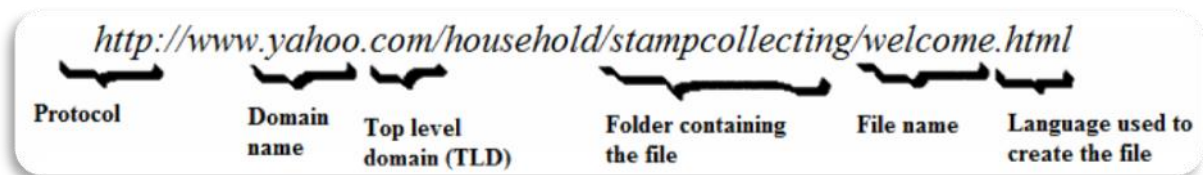
It consists of a _Protocol_, _a domain name_, Top Level Domain and the _path_ to a specific document file.

✓ **A protocol (http ://)**

This stands for **hypertext transfer protocol**. It is the communications protocol used to transfer pages on the Web.

✓ The location of the site (**www which means that the site is on the World Wide Web)**

✓ The domain name

  ✓ Top Level Domain (TLD)
    A suffix that identifies the kind of organization (e.g. .com for commercial organizations, **.com** for commercial institutions, .mil for military organizations, .educ for educational institutions etc.)
    NB; No spaces should be left in a URL

j) HTML lines

These are horizontal lines in an HTML page.

k) Comments

Comments can be inserted into the HTML code to make it more readable and understandable. They are not displayed by the web browsers.

l) Ordered lists

These are lists with items marked with numbers.

1. Coffee
2. Milk
3. Black tea

m) Unordered lists

These are lists with items marked with bullets (typically small back circles

e.g.

- Coffee
- Milk
- Black tea

n) Definition lists

It is a list of items with a description of each item.

o) Forms

These are used to select different kinds of user input.

They are used to pass data to a server.

They can contain elements like text fields, checkboxes, radio buttons, submit buttons etc.

p) Text field

It is an input field that a user can enter text into;

e.g.

First name: [_____]
Last name: [_____]

q) Password field

Is an input field that a user can enter a password into

e.g.

Password: [_____]

r) Radio buttons

These are buttons in a web page that lets a user to select **only one** of a limited number of choices.

They look like;

○ Female
◉ Male

s) Check box

This lets a user select **one** or **more** options of a limited number of choices. E.g.

I have ☑ a bike
I have ☐ a car

t) Submit button

This is a button used to send data to a server.

E.g.

Username: [......................]

u) Drop down arrows

▼ These are used to open dropdown menus.

Type of Web Sites

There are a number of types of Web pages i.e:

i) Portal,
ii) News,
iii) Informational,
iv) Business/marketing,
v) Educational,
vi) Entertainment,
vii) Advocacy,
viii) Blog,
ix) Wiki,
x) Online social network,
xi) Content aggregator,
xii) Personal websites.

Many Web pages fall into more than one of these categories.

i) Portal:

A *portal* is a Web site that offers a variety of Internet services from a single, convenient location. Most portals offerthe following free services:

➚ Search engine;
➚ E-mail;
➚ Instant messaging and
➚ Chat rooms;
➚ News;
➚ Free personal web pages;
➚ Shoppingmalls and auctions;
➚ Stock quotes,
➚ Reference tools such as yellow pages and maps.

Many portals have *online communities*that join a specific group of people with similar interests or relationships.

Popular portals include;

- Yahoo!,
- MSN,
- AOL,
- Lycos,
- Excite,
- HotBot,
- AltaVista,
- HotBot,
- GO.com,
- iGoogle,
- LiikSmart,
- Netscape, and many others.

A *wireless portal*is a portal designed for Internet-enabled mobile devices.

These portals offer services which may be required by mobile users such as search engines, news, stock quotes, weather, maps,email, calendar, instant messaging, and shopping.

ii) News:

A news Web page contains newsworthy material including stories, articles and videos relating to current events, life, money, sports, weather etc.

Many newspapers, magazines, television, and radio stations sponsor Web sites that providesummaries of printed articles, as well as articles not included in the printed versions.

They are normally maintained by Newspaper and television and radio stations.

iii) Informational:

An information Web page contains factual information.

These websites provide information such as census data, tax code and forms, governmentdocuments, public transportation schedules, government budget, and research reports.

iv) Business/Marketing:

A business/marketing Web page contains content that promotes or sells products or services.

Today,nearly every business has a business/marketing Web page. Many of these companies also allow you to purchase their productsand services online.

v) Educational:

An educational Web site offers exciting, challenging avenues for formal and information teaching and learning.

On the Web, you can learn how airplanes fly or how to cook a meal.

Some companiesprovide online training to employees and universities offer online classes and degrees.

Instructors often use the Web to enhance classroom teaching by publishing course materials, grades, and other pertinent class information.

vi) Entertainment:

An entertainment Web site offers an interactive and engaging environment.

Popular entertainment Web sites offer music, videos, sports, games, ongoing Web episodes, sweepstakes (Lottery), chats, and more.

vii) Advocacy:

An advocacy Web page contains content that describes a cause, opinion, or idea.

Their purpose is to convince the reader of the validity of the cause, opinion, or idea.

These Web pages usually present views of a particular group or association, such as the Democratic Party, the Republican Party, the Society to Protect Human Rights, the Royal Society for the Prevention of Cruelty to Animals etc.

viii) Blog:

A blog, (short for **Weblog**), is a Web site consisting of time-stamped articles, or posts, in a diary or journal format, usually listed in reverse chronological order.

They reflect the interests, opinions, and personalities of the author, called the blogger or vlogger, and sometimes site visitors.

Businesses create blogs to communicate with employees, customers, and vendors.

Home users create blogs to share aspects oftheir personal life with family, friends, and others.

Blogs have aninformal style that consists of s single individual's ideas (similarto a diary) or a collection of ideas and thoughts among visitors.

A blog that contains video clips is called a video blog, or vlog.

NB:

Blogosphere

Refers to the worldwide collection of blogs,

Vlogosphere refers to all vlogs worldwide.

ix) Wiki:

A wiki is a collaborative Web site that allows users tocreate, add to, modify, or delete the Web site content via theirWeb browser.

Most wikis are open for modification by thegeneral public.

Wikis usually collect recent edits on Web pagesof that someone can review them for accuracy.

The differencebetween a wiki and a blog is that users cannot modify originalposts made by the blogger.

A popular wiki is Wikipedia, a freeWeb _encyclopedia_.

x) **Online Social Network:**

An online social network, (alsocalled a ***social networking Web site***), is a Web site that encouragesmembers in its online community to share their interests,ideas, stories, photos, music, and videos with other registeredusers.

Most include chat rooms, newsgroups, and other communicationsservices.

They include**Facebook, Twitter**, **MySpace, Second Life**and very many others.

NB:

Media sharing Web site

A ***mediasharing Web site*** is a specific type of online social network thatenables members to share media such as photos, music, andvideos.

Photo sharing communities include;

- Flickr
- Fotki
- Webshots etc.

Video sharing communities

- **Eyespot**
- **GoogleVideo**
- **YouTube** etc.

xi) **Content Aggregator:**

A content aggregatoris a business website that gathers and organizesWeb content and then distributes, or feeds the content to subscribers for free or afee.

Examples of distributed content include**news**, **music**, **video**, and **pictures**.

Subscribersselect content in which they are interested.

Whenever the selected contentchanges, it is downloaded automatically(pushed) to the subscriber's computer ormobile device.

xii) **Personal:**

A personal Web page ismaintained by a private individual whonormally is not associated with any organization.

People publish their personal Webpages for a variety of reasons, for instance,hunting job or sharing life experiences withthe world.

NB:

Do not assume that information presented on the Web is correct or accurate. Any person, company, or organization canpublish a Web page on the Internet. No one oversees the content of these Web pages. Therefore, a lot of caution should be taken when acquiring information from the web.

Questions

1. *The internet has given rise to a number of developments, including blogs and wikis.*
    a. *Give two features of a blog.*   *[2]*

  b. Give two features of a wiki.   *[2]*

2. *Describe three ways to evaluate the reliability of information found on a website.*

Guidelines for evaluating the value of a Web site

Evaluation Criteria	Reliable Web Sites
Affiliation	A reputable institution should support the Web site without bias in the information.
Audience	The Web site should be written at an appropriate level.
Authority	The Web site should list the author and the appropriate credentials.
Content	The Web site should be well organized and the links should work.
Currency	The information on the Web page should be current.
Design	The pages at the Web site should download quickly and be visually pleasing and easy to navigate.
Objectivity	The Web site should contain little advertising and be free of preconceptions.

  GENERAL FUNCTIONS OF A WEBSITE

- It acts as a source of information. It can be used in research to get information on the internet about advertisements, entertainment, etc.
- It helps users or a particular organization to share knowledge and information over the internet
- It provides motivations to the users of an organization
- It encourages pride of ownership
- It enhances communication and collaboration
- It helps in storing important information for an organization.
- It helps organizations in easy and quick advertisement of their products.
- It enables organizations to upload and download information to and from the internet respectively.
- It helps organizations to easily maintain and update the information about them quickly.

Importances of a website to a school

1. Making of a website **quickens the publishing of information** to the community such as abrupt announcements, circulars, results, etc. Once uploaded, it will be already accessible to the targeted readers
2. Through a website, the school can **getfeedbacks** from the community through online user comments and questions.
3. If students are involved in the Website development process, this **enhances skill building** such as writing, editing, layout and design.
4. A school website provides **motivation and pride of ownership**. This can be evidenced through use of customized email. E.g. username@jinjacol.sc.ug instead of username @yahoo.com

5. Information listed on a school website **removes doubt**. Information such as school fees, and everything presented at the site appears in a positive light, as compared to information from other sites about the school which may be false.
6. If a school has a website, they can use the **web mail service** to send parents and other stake holders items such as newsletters, remainders etc.
7. A website **increases ways of contact**. Once you have a website you can list your website address on your business cards, report cards, and even the school signpost.
8. Internet today **is being used 24 / 7** and is accessible from every house. People are becoming highly dependent on the internet. By having a web presence, the market of the school expands significantly.
9. A school website helps students and parents to make a **wise academic choice** after using the vast quantities of information about a given college or university.

LIMITATIONS OF A WEBSITE
- Websites are expensive to be constructed. Therefore, some institutions may not be in position to come up with one.
- They require a lot of maintenance and update hence becoming expensive and time consuming.
- They limit customers from directly interfacing with the business men. This makes customers to sometimes be cheated.
- Very many people and organizations are creating websites with a lot of information which is not legitimate and some organizations lie the public through the websites.

7. COMPUTER SECURITY RISKS

A computer security risk is any event or action that could cause a loss or damage to computers, software, data or information.

NB:

Computer crime: is any illegal act involving a computer.

Cyber-crime: is the online or internet – based illegal acts.

Computer security risks include;
1. Internet and network attacks
2. Unauthorized access and use of comuputer systems.
3. Hardware and software theft
4. Information theft and information piracy
5. System failure.

7.1. Internet and network attacks
Information transmitted over networks has a higher degree of security risk than information kept on a company's premises.

On a vast network such as the Internet with no central administrator, the risk is even greater.

Below are the most common and most damaging forms of security threats to Internet users and site operators:
- ✓ Malicious code,
- ✓ Unwanted programs,
- ✓ Phishing and identity theft,

- ✓ Hacking and cybervandalism
- ✓ Credit card fraud/theft,
- ✓ Spoofing (pharming) and spam (junk) Web sites,
- ✓ Denial of Service (DoS) and Distributed Denial of Service (DDoS) attacks,
- ✓ Sniffing, insider attacks,
- ✓ Poorly designed server and client software.

7.1.1. Malicious Code:

Every unprotected computer is susceptible to the attack from malicious code.

Malicious code (also called *malware*) includes a variety of threats such as;

- *a)* viruses,
- *b)* worms,
- *c)* Trojan horses,
- *d)* Bots, etc.

a) *Viruses*

- A computer virus is a computer code or program specially designed to damage or cause irregular behavior in other programs in a computer.

  Or

  It is a program which attaches itself to the system and alters the normal functioning of a computer.

NB:

- Computer viruses are basically designed to carry out two tasks i.e.;
  - ➡ To be able to replicate themselves from one computer to another.
  - ➡ To be able to position themselves in a computer system and destroy software programs.
- Each virus code works independently of the "Mother" virus.

Classification of viruses

Viruses are classified according to their way of hiding.

Some viruses are **stealth** because of the way they hide while others are **polymorphic** because they camouflage themselves to avoid virus removers (antivirus) from detecting them.

(i) Boot Sector Viruses

- These execute when a computer starts up.
- These viruses alter the information in the boot sector of a diskette and this causes a computer to display messages like "Non System Diskette, please switch off and start again".

  NB: **A boot sector** is the first sector on a floppy diskette which contains vital information about the diskette's logical setup.

(ii) Partition Sector Viruses

These attack the partition sector (first sector on a hard disk which contains information about the disk specifications) of the hard disk and causes the computer not to boot fully.

(iii)File viruses

These are viruses that attach themselves to program files and are loaded into memory whenever the infected program is rum.

(iv)Overwriting Viruses

These viruses infect files by overwriting the entire or part of a file thereby causing the file not to execute or work as it is supposed to do.

(v) Macro viruses

- A macro virus uses the macro language of an application (e.g. Word processing, Spreadsheet) to hide the virus code.
- They can cause some tool bar icons to work differently.

(vi) Companion viruses

It is a virus that works by creating a different file name with an extension **.com**.

(vii)   Multipartite viruses

- These are viruses that use a combination of techniques to infect different executable files, boot sectors or partition sectors.
- They are normally difficult to trap.

b) Worms

- A worm is a computer program that sits in the computer's memory, rewrites itself continuously into the memory until the system runs out of memory and crushes.
- It differs from a virus in that the "reproduced" segments keep communicating with the "mother" code to function.

c) Trojan Horse

- It is a small program code hidden within legitimate software.
- Unlike a virus or a worm, a Trojan horse doesn't have the ability to replicate itself but it is often a way for viruses or other malicious code such as bots to be introduced into a computer system.
- They continue to operate as legitimate software until at such a time that they are activated to cause trouble.

d) Bots

Are a type of malicious code that can be covertly (secretly) installed on your computer when attached to the Internet.

Once installed, the bot responds to external commands sent by the attacker, and your computer becomes a "*zombie*," and is able to be controlled by an external third party.

NB: A *Botnet* is a group of compromised computers connected to a networks such as theInternet that are used for malicious activities such as sending spam, participating in a Distributed Denial of Service attack,stealing information from computers, andstoring network traffic for later analysis.

Other forms of malicious code include;

e) Time bomb

- It is a program code that is activated when it detects a certain condition or event.
- These events can be famous days like Valentine, Fools – day, etc.

f) Droppers

- These are programs that have been written to perform useful tasks like compressing files, previewing video clips, etc. and in the process of performing those tasks, they introduce viruses in the system.

g) Failedviruses

- These are viruses that have not met their would be goals.
- This may be due to poor programming by the authors.

h) Packagers

- These hide the existence of a virus from virus guards by masking some codes around the actual software programs.

- ● It is only when the virus has been triggered off that you realize that the software had a virus.

i) **Jokes**
- ● A joke is a harmless program that does amusing actions on the screen.
- ● They can display messages like "Your computer is about to explode in five minutes. Please run away".

j) **Test viruses**
- ● These are viruses written to test some virus guards (antivirus software)
- ● They are not harmful, just for learning purposes only.

k) **Bugs:**
- ● A bug is unintentional fault in a program that is normally misinterpreted as a real virus.
- ● Moat complex software in computer systemsnormally contain bugs.
- ● Minor bugs normally cause simple inconveniences while major bugs can cause loss of data.

How are viruses activated?

- ● By opening an infected file
- ● By running an infected program
- ● By starting up the computer with an infected floppy diskette.

Sources of viruses

- o **Fake games**
  Virus programmers utilize the ability of games spreading so fast to design fake games and attach viruses on them.
  These games keep infecting systems as they are installed.
  Such games are normally the irresistible like I LOVE YOU, HOTSEX.exe, JACKPOT.com, ROMANCE.exe etc.
- o Through use of contaminated diskettes on several computers.
- o Through using pirated software.
- o Through using freeware and shareware from the internet.
  Since these are free, they are good grounds for distributing viruses.
  They also in most cases contain **bugs** which may turn into viruses unintentionally
- o Through software updates most especially over the internet or other networks.
- o Through sharing of data in a network.

Symptoms caused by viruses to software and hardware
- ● Unfamiliar messages appearing on the computer screen.
- ● Programs taking longer to load than usual.
- ● Unusual error messages occurring more frequently.
- ● Reduction in memory than usual
- ● Flickering of the screen.
- ● Corrupted files
- ● File sizes becoming too big or too small than usual
- ● Computer system slows down.
- ● The whole computer system may fail to start up.

Precautions to prevent virus infection

- ✓ **Do not start a computer with removable media inserted in the drives or plugged in the ports**. CD and DVD drives should be empty, USB ports should not contain a USB flash drive, etc.
- ✓ Do not us media like diskettes, backup tapes, CDs from unknown sources.
- ✓ **Scan all foreign media for viruses.**
  Before using any removable media, use an antivirus scan program to check the media for infection.
- ✓ Isolate any media or computer suspected of having been attacked by viruses, disinfect it and investigate how it may have acquired the viruses.
- ✓ **Install antivirus software;**
  Ensure that reputable anti – virus software is installed on all computers.
  If employees use computers at home for business or to remotely access the network, these PCs should also have anti – virus software installed on them.
- ✓ **Ensure that the anti – virus software is up to date;**
  Every day, new computer viruses are being released and it is essential that business is protected from these viruses by keeping the anti – virus software up to date.
- ✓ **Employ a firewall to protect networks;**
  As computer viruses can spread by means other than email, it is important that unwanted traffic is blocked from entering the network by using a firewall.
  For users that use computers for business away from the protection of the company's network, such as home PCs or laptops, a personal firewall should be installed on them to ensure that the computer is protected.
- ✓ **Filter all email traffic**
  All incoming and outgoing email should be filtered for computer viruses.
  Emails with certain file attachments commonly used by computer viruses to spread themselves, such as .EXE, .Com and .SCR files, should also be prevented from entering the network.
- ✓ **Educate all users to be careful of suspicious e-mails;**
  Ensure that all users know to never open an email attachment they are not expecting.
  Even when the email is from a known source, caution should be exercised when opening attachments.
- ✓ **Scan internet downloads;**
  Ensure that all files downloaded from the internet are scanned for computer viruses before being used.
- ✓ **Don't run programs of unknown origin;**
  All users should be educated to never run a computer program unless the source is known or has originated from a person or company that is trusted and has been authorized by those responsible for managing the company's network.
- ✓ **Make regular backups of critical data**
  It is important to ensure that regular copies of important files are kept either on removable media such as CD-ROM discs or tape to ensure a trusted source for data in the event that the network is infected with a computer virus.
  A backup: is a duplicate of a file, program or disk that can be used if the original is lost, damaged or destroyed.

7.1.2. Unwanted Programs:

These are programs on the internet that install themselves on a computer without the user's consent.

They include;

- **Adware**

  It is a program that displays an online advertisement in a banner or pop-up window on Web pages, email, or other Internet services.

- **Browser parasite**

  It is a program that can monitor and change the settings of a user's browser.

- **Spyware**

  It is a program placed on a computer without the user's knowledge that secretly collects information about the user e.g. email address, instant messages, etc.

7.1.3. Phishing and Identity Theft:

Phishing is any deceptive (misleading/false), online attempt by a third party to obtain confidential information for financial gain.

Some phishing email messages ask you to reply with your information; others direct you to a phony Web site, or a pop-up window that looks like a Web site, that collects the information.

7.1.4. Hacking and Cybervandalism:

A **hacker** is an individual who intends to gain unauthorized access to a computer system.

Some hackers are satisfied merely by breaking into the files of an e-commerce site. Others have more malicious intentions and commit **Cybervandalism**, intentionally disrupting, defacing, or even destroying the site.

7.1.5. Credit Card Fraud/Theft:

Theft of credit card data is one of the most feared occurrences on the Internet.

Fear that credit card information will be stolen frequently prevents users from making online purchases.

7.1.6. Spoofing (Pharming) and Spam (Junk) Web Sites:

Spoofing a Web site is also called "**pharming**,"

It involves redirecting a Web link to an address different from the Intended one, with the site masquerading as the intended destination.

Spam Web sites are the sites that promise to offer some product or service, but in fact are a collection of advertisements for other sites, some of which contain malicious code.

7.1.7. Denial of Service (DoS) and Distributed Denial of Service (DDoS) attacks:

A **denial of service (DoS) attack** is an assault whose purpose is to disrupt computer access to an Internet service such as the Web or e-mail.

It may involve Perpetrators using an unsuspecting computer to send an influx of confusing data message or useless traffic to a computer network.

The victim computer network eventually jams, blocking legitimate visitors from accessing the network.

DoS attacks typically cause a Web site to shut down, making it impossible for users to access the site.

7.1.8. Sniffing:

A **sniffer** is a type of eavesdropping (spying) program that monitors information traveling over a network.

When used legitimately, sniffers can help identify potential network trouble-spots, but when used for criminal purposes, they can be damaging and very difficult to detect.

Sniffers enable hackers to steal proprietary information from anywhere on a network, including e-mail messages, company files, and confidential reports.

7.1.9. Back Doors and Insider Attacks:

A *back door* is a program or set of instructions in a program that allow users to bypass security controls when accessing a program, computer, or network.

Once perpetrators gain access to unsecure computers, they often install a back door or modify an existing program to include a back door, which allows them to continue to access the computer remotely without the user's knowledge.

How backdoors are installed into the computers

➢ Some warms leave back doors, which have been used to spread other worms.

➢ Programmers often build back doors into programs during system development which help them save development time because the programmer can bypass security controls while writing and testing programs.

➢ A computer repair technician may install a back door while troubleshooting problems on a computer.

Insider attacks

We tend to think the security threats to a business originate from outside the organization.

In fact, the largest threats to business institutions come from insiders.

Normally organizations tend to allow employees access to privileged information, and in the presence of sloppy internal security procedures, they may cause severe damage.

7.1.10. Spoofing:

Spoofing is a technique intruders use to make their network or Internet transmission appear legitimate to a victim computer or network.

Types of spoofing

- *E-mail spoofing*;
  This occurs when the sender's address or other components of the e-mail header are altered so that it appears the e-mail originated from a different sender.

- *IP spoofing*;
  This occurs when an intruder computer fools a network into believing that its IP address is associated with a trusted source.

  Perpetrators of IP spoofing trick their victims into interacting with the phony Web site.

  For example, the victim may provide confidential information or download files containing viruses, worms, or other malware.

7.1.11. Poorly Designed Server and Client Software:

Many security threats prey on poorly designed server and client software, sometimes in the operating system and sometimes in the application software.

Given their complexity and design objectives, all operating systems and application software have vulnerabilities or (flaw) weaknesses that hackers can exploit.

Defense against Internet and network attacks

✓ *Install a firewall;*
  A *firewall* refers to either hardware or software that filters communication packets and prevents some packets from entering the network.

  The firewall controls traffic to and from servers and clients, forbidding communications from untrustworthy sources, and allowing other communications from trusted sources to proceed.

✓ *Route information through a proxy server*

Proxy servers are software servers that handle all communications originating from or being sent to the Internet, acting as a spokesperson or bodyguard for the organization.

Large companies often route all their communications through a proxy server.

Proxies act primarily to limit access of internal clients to external Internet servers, although some proxy servers act as firewalls as well.

✓ *Install intrusion detection software;*

To provide extra protection against hackers and other intruders, large companies may use intrusion detection software to identify possible security breaches.

Intrusion detection software automatically analyzes vulnerabilities, identifies any unauthorized intrusions, and notifies network administrators of suspicious behavior patterns or system breaches.

✓ *Set of honey pots.*

A *honeypot*is a vulnerable computer that is set up to entice an intruder to break into it.

Some large organizations suchas Yahoo, AT&T*use honeypots* so that they can analyze any attack being perpetrated.

These computers, which appear real to the intruder, actually are separated safely from the organization's network.

Honeypots allow the organization to learn how intruders are exploiting their network and also attempt to catch perpetrators who have been doing damage elsewhere on their network.

7.2. UNAUTHORIZED ACCESS AND USE OF COMPUTER SYSTEMS

➢ *Unauthorized access* is the use of a computer or network without permission, e.g. an employee using a company computer to send a personal e – mail.

➢ *Unauthorized use* is the use of a computer or its data for unapproved or possible illegal activities.

a) *A hacker* refers to someone who accesses a computer or network illegally. Some hackers claim the intent of their security breaches is to improve security.

b) *A cracker:*

Cracker accesses a computer or network illegally but has the intent of destroying data, stealing information, orother malicious action.

Both hackers and crackers have advanced computer and network skills.

c) *Script Kiddie***:**

A script kiddie has the same intent as a cracker but does not have the technical skills and knowledge.

Script kiddies often are teenagers that use prewritten hacking and cracking programs to break into computers.

d) *Corporate Spies:*

They have excellent computer and network skills and are hired to break into a specific computer andsteal its proprietary data and information.

e) *Unethical Employees:*

They break into their employers computers for a variety of reasons.

Some simply want to exploit asecurity weakness. Others seek financial gains from selling confidential information.

Disgruntled employees may wantrevenge.

f) *Cyber-extortionist:*

A cyber-extortionist is someone who uses email as a vehicle for extortion.

These perpetrators send acompany a threatening email message indicating they will expose confidential information, exploit a security flaw, orlaunch an attack that will compromise the company's network - if they are not paid a sum of money.

g) *Cyber terrorist:*

A cyber terrorist is someone who uses the Internet or network to destroy or damage computers forpolitical reasons.

The extensive damage might destroy the nation's air traffic control system, electricity-generating companies,or a telecommunications infrastructure.

Cyber terrorism usually requires a team of highly skilled individuals, huge sums of money, and several years of planning.

Prevention of unauthorized access

Unauthorized access is prevented through use of *access controls*.

Definition

An **Access control** is a security measure that defines;

- Who can access a computer
- When the users can access the computer
- What actions the users can take while accessing the computer.

Access control is normally implemented using a two phase process;

i.e.

- **Identification**

This is the phase which verifies whether the user is a valid one.

- **Authentication**

This is the phase which verifies that the user is really the one he or she claims to be.

Methods of identification and authentication

i) ***User names and passwords***
ii) ***Possessed objects***
iii) ***Biometric devices***
iv) ***Callback systems***

i) *User names and Passwords;*

A *user name*, or *user ID*, is a unique combination of charactersthat identifies one specific user.

A*password* is a private combination ofcharacters associated with the user namethat allows access to certain computerresources or to a network.

Most multiuser (networked)systems require that users correctlyenter a *user name* and a *password*before they can access the data, computer, or a network.

NB: Some Web sites use a CAPTCHA *[Automated Public Turing test to tell Computers and Humans Apart (CAPTCHA)]* to further protect a user's password.

A CAPTCHA is a program to verifythat user input is not computer generated.

A CAPTCHA displays a series of distorted characters and requires theuser enter the characters correctly to continue using the Web site.

Characteristics of a good password

- Should be easy to remember but not too obvious.
- Should be longer, at least eight characters.

- Should have a combination of mixed case letters and digits.
- Should be easy to type without looking at the keyboard.

AVOID

× Using **your name**, birthday, ID card number or telephone number.
× A password of all digits or all the same letter.

Safeguarding your password
✓ Do not share your password with others
✓ Do not write down your password
✓ Change your password frequently

ii) **Possessed Objects**

A *possessed object*is any item that one must carry to gain access to acomputer or computer facility.

Examples of possessed objects
✓ Badges,
✓ Cards,
✓ Smart cards,
✓ Key, etc.

These objects are often used in combination with Personal Identity Numbers (PINs)

A *personal identificationnumber (PIN)* is a numeric password, either assigned by a company orselected by a user.

iii) **Biometric devices**

A biometric device authenticates a person's identity bytranslating a personal characteristic, such as a fingerprint, into a digitalcode that is compared with a digital code stored in the computerverifying physical or behavioral characteristics.

Examples of biometric devices

♦ **A finger print scanner**

This captures curves and indentations of a finger print.

♦ **A hand geometry system**

This measures the shape and size of a person's hand.

♦ **A face recognition system**

This captures a live face image and compares it with the stored image

♦ **A voice recognition system**

This device compares a person's live speech with their stored voice pattern.

♦ **A signature verification system**

This device recognizes the shape of a handwritten signature of a person.

♦ **An iris recognition system**

It reads patterns in the tiny blood vessels in the back of the eye which are as unique as a finger print.

Advantages of biometric devices
✓ Personal characteristics are unique to persons hence give reliable information.
✓ These characteristics cannot be lost, forgotten or misplaced.

✓ They cannot be copied, duplicated or stolen as the case with possessed objects.

Disadvantages of biometric devices

- Most of the devices are too expensive.
- A finger print scanner might reject a legitimate user if the user cuts his or her finger.
- Hand geometry readers can transmit germs.
- A signature might not match the one on file when the person is nervous.
- A voice recognition system might reject a legitimate user with a sore throat.

iv) Callback systems

A callback system connects a user to a computer only after the computer calls the user back at a previously established telephone number.

7.3. HARDWARE AND SOFTWARE THEFT

Hardware theft

This is the act of stealing computer equipment.

Vandalism

This is the act of destroying computer equipment.

Prevention of hardware theft

✓ Use physical access controls such as locked doors and windows.
✓ Use cables to lock the equipment to desk, cabinet or floor.
✓ Install alarm systems to warn you in case of any intrusion
✓ Use passwords, possessed objects and biometric devices.
✓ Install surveillance cameras to help you in easy monitoring of the hardware.

Software theft

Forms of software theft;

- **Physical stealing of the media** (e.g. floppy diskette, CD ROM e.t.c) that contains the software
- **Software piracy**
  This is the unauthorized and illegal duplication of copyrighted software.

7.4. SYSTEM FAILURE

This is a prolonged malfunctioning of a computer that can cause hardware, software, data or information loss.

Causes of system failure

i. Aging hardware
ii. Natural disasters (such as fires, floods, storms or earthquakes etc)
iii. Electrical power variations

Electrical power variations

These can cause loss of data or equipment (in case of fire outbreaks)

A single power disturbance can damage multiple systems in a computer network

Forms of power disturbances

a. **Noise**
   This refers to any unwanted signal which is mixed with the normal voltage entering the computer.

b. Under voltage

This is a situation which occurs when the electrical supply drops below the normal value (e.g. below 220V in Uganda)

c. Over voltage (power surge)

It is a situation which occurs when the incoming electrical power increases significantly above the normal voltage.

d. Brown out

Is a prolonged under voltage

e. Black out

Is a complete power failure

f. Spike

Is a momentary over voltage that occurs when the increase in power last for less than one millisecond.

NB: A surge protector such as Uninterruptible Power Supply is needed to protect the computer equipment against these disturbances.

7.5. COMPUTER ETHICS

Computer ethics are moral guidelines that govern the use of computers and information systems.

It encompasses the following areas;

a. Unauthorized access and use of computer systems.
b. Software piracy
c. Information privacy
d. Intellectual property rights
e. Codes of conduct

a. Unauthorized access and use of computer systems.

Definitions;

⊕ *Unauthorized access* is the use of a computer system or a network without permission of the owner.

⊕ *Unauthorized use* is the use of a computer or its data for unapproved or illegal activities.

These activities include;

- An employee using a company's computer to send personal email without permission from the managers.
- Gaining access to a bank's computer and perform unauthorized money transfer.

b. Software piracy

This refers to the unauthorized and illegal duplication of copyrighted software.

This may involve duplicating someone's movie, song, book, etc, without his/her permission.

NB:

Whenever a consumer purchases a software, he/she is only provided with a license agreement which gives him/her the right to use the software.

Types of license agreements

(i) Single user or end user license agreement

This is the most common license agreement provided to individual users after purchasing a software.

This agreement gives a user a right to;

- o Install the software on only one computer
- o Make one copy for backup.
  However, with such an agreement, a user cannot;
- ⊕ Install the software on a network
- ⊕ Give away copies of the software to other users.
- ⊕ Rent or lease the software.

(ii) *Software site license*
   This agreement gives the consumer the right to install the software on multiple computers at a single site.
   This site may be a school computer laboratory, a company's computer laboratory, etc.

(iii) *Network site license*
   This allows network users to share a single copy of the software which resides on the network server.

Dangers (risks) associated with software piracy
- o It increases the chance of spreading computer viruses because pirated software in most cases is a target for spreading viruses.
- o The consumer cannot receive any technical support for the software from the manufacturer.
- o It becomes expensive in the long run for all the illegal users.

Reasons why software piracy has persisted
- Legal protection for software doesn't exist
- Laws for prohibiting software piracy are rarely enforced.
- Most buyers believe that they have a right to copy the software they have paid for.

c. Information privacy
   Privacy is the moral right of individuals to be left alone, free from surveillance or interference from other individuals or organizations, including the state.
   *Information Privacy*refers to the right individuals, companies or organizations have to deny or restrict the collection and use of information about them.

Online tracking devices
   These are methods used by online advertisers, online communities and online businesses to keep track of their visitors' behavior.
   They include;

a) Cookies
   A **cookie** is a small text file that a Web server stores on your computer that allows a site to track the actions of its visitors.
   E-commerce, Webcasting, and other Web applications often rely on cookies to identify users and track information about viewers, customers, and subscribers.

   NB; Although the cookie resides on an individual's hard drive, it does not interact with other information store on the system.
                    Uses of cookies

- Web sites that allow for personalization often use cookies to track user preferences. On such sites, you may be asked to fill in a form requesting personal information, such as your name, postal code, or site preferences.
- A news Web site, for example, might allow users to customize their viewing preferences to display certain stock quotes. Your preferences are stored in cookies on your hard disk.
- Many Web sites use cookies to store users' passwords, so they do not need to enter it every time they log in to the Web site.
- Online shopping sites generally use session cookies to keep track of items in your shopping cart. This way, you can start an order during one Web session and finish it on another day in another session. Session cookies usually expire after a certain time, such as a week or a month.
- Some Web sites use cookies to track how regularly you visit a site and the Web pages you visit while at the site.
- Web sites may use cookie to target advertisements. Your interests and browsing habits are stored in the cookie.

b) Spyware and Adware

- *Spyware* is a program placed on a computer without the user's knowledge that secretly collects information about the user.
  Spyware can enter a computer as a virus or as a result of a user installing a new program.
- *Adware* is a program that displays an online advertisement in a banner or pop-up window on Web pages, email, or other Internet services.
- *Web bug*, is another type of spyware hidden on Web pages or in email messages in the form of graphical images.
  Web businesses use Web bugs to monitor online habits of Web site visitors.

c) Spam

Spam is an unsolicited (unrequested) email message or newsgroup posting sent to many recipients or newsgroups at once.

Spam is Internet junk (unwanted) mail.

The content of spam ranges from selling a product or service, to promoting a business opportunity, to advertising offensive material.

Types of spams

i)   Spim

This is a spam sent instant messaging

ii)   Spit

This is a spam sent via VoIP

How to get rid of spams

- ➢ Some email programs have built-in settings that allow users to delete spam automatically. Users also can sign up for email filtering form their Internet service provider.
- ➢ Email filtering is a service that blocks email messages from designated sources. These services typically collect the spam in a central location that users can view at any time.
- ➢ Using an anti-spam program that attempts to remove spam before it reaches your inbox.

NB: The disadvantage of email filters and anti-spam programs is that sometimes they remove valid email messages. Thus, users should review the contents of the spam messages periodically to ensure they do contain valid messages.

d) Phishing

Is a scam (a trick) in which a perpetrator sends an official looking email that attempts to obtain your personal and financial information.

A *phishing filter* is a program that warns or blocks you from potentially fraudulent or suspicious Web sites.

e) Pharming

Is a scam in which a perpetrator sends an official looking message that requests you to type a Web address in the Web browser, and then redirects you to a phony Web site that looks legitimate which requests you enter confidential information.

f) Employee Monitoring

Employee monitoring involves the use of computers to observe, record, and review an employee's use of a computer, including communications such as e-mail messages, keyboard activity, and Web sites visited.

g) Content Filtering

Content filtering is the process of restricting access to certain material on the Web.

Many businesses use content filtering to limit employees' Web access.

These businesses argue that employees are unproductive when visiting inappropriate or objectionable Web sites.

Some schools, libraries, and parents use content filtering to restrict access to minors.

Methods used to ensure privacy to data and information

i) Encryption

Encryption is the process of transforming plain text or data into cipher (unreadable) text that cannot be read by anyone other than the sender and the receiver.

Or

It is the process of covering readable data into unreadable characters to prevent unauthorized access.

The receiver needs an encryption key in order to regain the original data sent over a communications channel.

Methods of encrypting data

- **Transportation**; This involves switching the order of the characters.
- **Substitution;** this involves replacing characters with other characters.
- **Expansion insertion;** this involves inserting characters between other characters.
- **Compaction;** this involves removing characters and storing them elsewhere.

NB:

An encryption key is a formula used to decrypt encrypted data back into its original format.

Types of encryption keys;

- **Private key encryption**

  With this key, both the sender and the recipient use the same secret key to encrypt and decrypt the data.

- **Public key encryption**

  With this key, a public key encryption software generates both the private key and the public key.

The sender uses the receiver's public key to encrypt the message and the receiver uses his or her private key to decrypt the message.

d. Information accuracy

Millions and millions of information reside on websites of certain organizations. But in some instances, the website providing access to information may not be the one which created it. Some of the information on these websites may not be 100% accurate.

Therefore, it is always good to evaluate and analyze the information provided on a web page before using it.

e. Intellectual property rights

    i. ***Intellectual property rights***

    Intellectual property **(IP)** refers to unique and original works such as ideas, inventions, art, writings, processes, company and product names, and logos.

    Intellectual property rights are the rights to which creators are entitled for their work.

    ii. ***Copyright***

    Is the protection given to the author of an original piece, including "literary, dramatic, musical, artistic and certain other intellectual works," whether the work has been published or not

    A copyright gives authors and artists exclusive rights to duplicate, publish and sell their material. These material may be songs, movies or books.

    However, governments of some countries have come up with copyright laws which usually give the public a fair use to copyrighted material.

    iii. ***A trademark***

    A trademark protects a company's logos and brand names

7.6. Codes of conduct

A **code of conduct** is a written guideline that helps to determine whether a specific action is ethical or unethical.

Recognizing that individuals need specific standards for theethical use of computers, a number of computer-relatedorganizations have established IT codes of conduct, whichhelps determine whether a specific computer action is ethical or unethical;

Sample IT codes of Conduct

- Computers may not be used to harm other people
- Users may not interface with other's computer work
- Users may not intrude in other's computer files
- Computers may not be used to steal
- Computers may not be used to bear false witness
- Users may not copy or use software illegally
- Users may not use other's computer resources without authorization
- Users may not use other's output
- Users shall consider the social impact of programs and systems the design
- Users should always use computers in a way that demonstrates consideration and respect for other people.

GREEN COMPUTING

Green computing is the study and practice of environmentally sustainable use of computers and related IT resources.

Or

Green computing is the study and practice of designing, manufacturing, using, and disposing of computers, servers, and associated subsystems such as monitors, printers, storage devices, and networking and communications systems efficiently and effectively with minimal or no impact on the environment.

Goals of green computing

➢ Reduce the use of hazardous materials,

➢ Maximize energy efficiency during the product's lifetime,

➢ Promote the recyclability or biodegradability of malfunctioning products and factory waste.

The work habits of computer users and businesses can be modified to minimize adverse impact on the global environment. Here are some steps that can be taken:

- Create a power plan which allows the system to automatically turn off components such as monitors and hard drives after set periods of inactivity.
- Try to do computer-related tasks during contiguous, intensive blocks of time, leaving hardware off at other times. Avoid using the computers for long periods of time as this may lead to health and safety problems.
- Power-up and power-down energy-intensive peripherals such as laser printers, scanners, etc. according to need.
- Use liquid-crystal-display (LCD) monitors rather than cathode-ray-tube (CRT) monitors. This is because, CRT monitors emit a lot of electromagnetic radiations.
- Use notebook computers rather than desktop computers whenever possible. Notebooks computers consume less energy, emit very little heat and other electromagnetic radiations.
- Minimize the use of paper and properly recycle waste paper.
- Recycle computing equipment as this can keep harmful materials such as lead, mercury, and hexavalent chromium out of landfills.
- Dispose of e-waste according to federal, state and local regulations.
- Implement telecommuting (in which workers can accomplish much of their work away from their standard work places preferably from home). This reduces greenhouse gases emitted during travel, increases worker satisfaction and increases profit margins as a result of lower costs for office space, heat, lighting, etc.
- Terminal servers should be used instead of standalone computers. This cuts down power consumption to around 1/8 the amount of energy of a normal workstation, resulting in a decrease of energy costs and consumption.

Questions

1. *Explain what is meant by the following terms.*
   a. *Phishing*
   b. *Pharming*
   c. *Spam*   *[3]*

THE FUTURE OF COMPUTERS

The ever increasing need for faster and efficient computers is constantly creating technological advances that can be considered amazing.

The following is expected to happen to computers and to the lives of people in future;

- Computers are expected to increase in the processing speed, memory and storage capacity.
- Computers are being taught how to think like human beings. They are expected to think and reason like human beings in years to come.
- People are developing natural question and answering systems.
- Computers will become much easier to use by almost all people all over the whole world.
- There will be an increase in the use of expert systems, advanced robotics and autonomous systems.
- The internet will continue to expand and change in several ways.
- New multimedia is expected to be developed.
- There will be an increase in the use of virtual reality.
- More users are expected to connect to the internet. It will become universal.
- Learning will become possible at anytime, anywhere around the world.
- There will be reductions in physical movements. Workers will have to conduct much of their businesses from home.
- There will be less use of physical cash. There will be an increase in the use of electronic fund transfers (EFTs) and E – money.
- There will be less use of manual document systems to store information in most organizations.
- Most ordinary jobs like secretariat, store keeping etc, are likely to phase off. This will finally lead to a great increase in unemployment and loss of jobs.

8. ICT INDUSTRY

8.1. Careers in computer and computing (People or Users)

The high rate of growth of computers has resulted in many new kinds of jobs and careers. These include;

i. *Computer operators*
   Responsibilities
   - Entering data into the computer for processing
   - Keeping up-to-date records (log files) of all information processing activities.

ii. *Computer technician*
   Is a person responsible for the maintenance, upgrading and repairing of computers and related devices
   Responsibilities
   - Troubleshooting computer hardware and software related problems
   - Assembling and upgrading computers and their components
   - Ensuring that all computer related accessories such as printers, modems, storage media and devices are in a good working condition.
   - In big computer companies, Technicians normally help hardware engineers in designing and creating some computer components such as storage devices, motherboards, etc.

iii. *Systems analyst*
   This is a person who is responsible for analyzing a company's needs or problems, then designs and develops a computer based information system to help prevent the problem.

Responsibilities

- Reviewing the current manual or redundant information system and making recommendations on how to replace it with a more efficient one.
- Working with programmers to construct and test the system.
- Coordinating training for users on how to use the new system.

iv. *Computer programmer*

Large organizations such as insurance companies, banks, manufacturing firms and government agencies hire programmers to work together with systems analyst in order to;

- Write in – house application programs or system programs.
- Customize commercial application package to suite the organization needs.
- Test, debug, install and maintain programs developed or customized for the organization.

v. *Software engineer*

Is a person who is skilled in software development and technical operation of computer hardware.

Responsibilities

- Developing system and application software
- Developing user and technical documentations for the new software.
- Maintaining and updating the software to meet day to day requirements while overcoming challenges.

vi. *Computer engineer*

Responsibilities

- Design and develop computer components such as storage devices, motherboards, and other electronic components.
- Determine the electrical power requirement of each computer component.
- Re – engineer computer components to enhance its functionality and efficiency.
- Design and develop engineering and manufacturing computer controlled devices such as robots.

vii. *Information systems manager*

Responsibilities

- He controls, plans, staffs, schedules and monitors all the activities of the ICT department in the organization.
- Using computerized management system (MIS). The manager can test the impact that an alternative course of action might have on the business.
- Ensures that all tasks in the IT department are done correctly and on time in order to support business planning, control and decision making process.
- Prepares budgets for the ICT department.
- Keeps the department's inventory records up-to-date.
- Manages the human resource within the ICT department.

viii. *Database administrators (DBA)*

Responsibilities

- Designing and developing database applications for the organization.
- Setting up security measures needed to control access to data and information.
- Keeping the database up-to-date by adding new records, modifying or deleting un necessary records.

ix. *Computer trainer/Instructor/Teacher*

Due to the dynamic nature of computers and information technology, there is a high demand for qualified ICT trainers.

Responsibilities

- Training people on how to use a computer and various application programs.
- Developing training reference materials
- Guide learners on how to acquire knowledge through carrying out research.
- Advising the learners on the best career opportunities in the broad field of ICT.
- Preparing learners for ICT examinations.

x. *Website administrator / Webmaster*

Responsibilities

- Developing and testing websites
- Maintaining, updating and modifying information on the websites to meet new demands by the users.
- Monitoring the access and use of internet connection by enforcing security measures.
- Downloading information needed by an organization or institution from the internet websites.

xi. *Computer graphics designer*

xii. *Network administrator*

- This manages and troubleshoots a computer network.

xiii. *Secretary;*

- Is a person who uses computers to keep all the necessary information instead of keeping paper files

8.2. Emerging technologies

8.2.1. Artificial intelligence

Artificial Intelligence is a group of related technologies that attempt to develop machines to emulate human like qualities such as learning, reasoning, communicating, seeing and hearing.

Applications of artificial intelligence

* Optical character recognition

It is the mechanical or electronic conversion of scanned images of handwritten, typewritten or printed text into machine – encoded text.

It is widely used as form of data entry from a hard copy data source.

* Handwriting recognition

It is the ability of a computer to receive and interpret intelligible handwritten input from sources such as paper documents, photographs, touch – screens and other devices.

The image of the written text may be sensed off line from a piece of paper by optical scanning or intelligent word recognition.

* Speech recognition

It is the translation of spoken words into text. It is also known as *automatic speech recognition*.

It can translate spoken words into text .

These systems analyze the person's specific voice and use it to fine tune the recognition of that person's speech, resulting in more accurate transcription.

* Facial recognition system

It is a computer application for automatically identifying or verifying a person from a digital image or a video frame from a video source.

One of the ways to do this is by comparing selected facial features from the image and a facial database.

It is typically used in security systems and can supplement other biometric devices such as fingerprint or eye iris recognition systems.

* **Computer vision**

It is a field that includes methods for acquiring, processing, analyzing and understanding images and in general high – dimensional data from the real world in order to produce numerical or symbolic information, e.g. in the forms of decisions.

* **Virtual reality (VR)**

It is a term that applies to computer – simulated environments that can simulate physical presence in places in the real world as well as imaginary words.

Most current virtual environments are primarily visual experiences, displayed either on a computer screen or through special stereoscopic displays, but some simulations include additional sensory information such as sound through speakers or headphones.

* **Image processing**

It is any form of signal processing for which the input is an image, such as a photograph or video frame.

The output of image processing may either be an image or a set of characteristics or parameters related to the image.

8.2.2. Digital forensics

These involve the recovery and investigation of material found in digital devices, often in relation to computer crime.

Investigations involving digital forensics help to support or refute a hypothesis before criminal or civil courts.

Stages involved in digital forensic

  i. *Acquisition*

   This involves creating forensic duplicate of the media, often using a write blocking device to prevent modification of the original

  ii. *Analysis*

   An investigator recovers evidence material using a number of different methodologies and tools.

   The actual process of analysis can vary between investigations.

   Common methodologies used include;

   - Conducting keyword searches across the digital media recovering deleted files and extraction of registry information for example to list user accounts or attached USB devices. The evidence recovery is analyzed is analyzed to reconstruct events or actions and reach conclusions

  iii. *Reporting*

   When an investigation is complete, the data is presented usually in the form of a written report.

Branches of digital forensics

a. **Computer forensics**

   The goal of computer forensics is to explain the current state of a digital artifact (object), such as a computer system, storage medium or electronic document.

Computer forensics can deal with a broad range of information from logs (such as internet history) through to the actual files on the drives.

Applications of computer forensics

- Investigate and uncover evidence of illegal activities conducted via computer. This includes credit – card fraud, intellectual – property theft and computer system intrusion (hacking)
- Investigate and uncover evidence of crimes that weren't directly committed via computer, but for which the accused might have stored evidence on computer data storage devices.
- Detect and close computer system security holes through legal hacking.
- Computer forensics experts are often called "Cyber Cops", "Cyber Investigators" or "Digital Detectives".

Disadvantages of computer forensics

- ➢ The privacy of the client may be compromised in some cases. This normally happens if the information is necessary to prove the crime and should be produced as the evidence in the court of law to prove the crime.
- ➢ It is also possible that some sensitive data or information to the client may be lost in order to find the evidence.
- ➢ There are also chances of introduction of some malicious programs such as viruses or worms in the computer system that may corrupt the data at a later stage of time.
- ➢ It is also possible that the hardware of the computer system is damaged physically.
- ➢ Physically extracted and relevant evidence may be destroyed or lost.
- ➢ It is possible in some cases the operations cost may exceed. Steps should be taken to minimize the costs.
- ➢ Data may be corrupted / modified in the process as they try to retrieve for lost or hidden data.
- ➢ The cost to maintain a laboratory containing appropriate computers, computer analysis tools, software and security implements to safeguard information can be enormous.
- ➢

b. *Mobile device forensics*
   It is a branch of digital forensics relating to recovery of digital evidence or data from a mobile device.
   Unlike the computer forensics, digital forensics has an inbuilt communication system (e.g. GSM) and usually a storage mechanism.
   Mobile devices are also useful for providing location information either from inbuilt GPS/location tracking which track the devices within their range.

c. *Network forensics*
   It is concerned with the monitoring and analysis of computer network traffic, both LAN and WAN/internet, for the purposes of information gathering, evidence collection or intrusion detection.

d. *Data forensics*
   It is a branch of digital forensics relating to the forensic study of databases and their metadata. Investigations use database contents, log files and in-RAM data to recover relevant information.