



Computer System - Lecture notes 1,2

Introduction to computer systems (Jomo Kenyatta University of Agriculture and Technology)

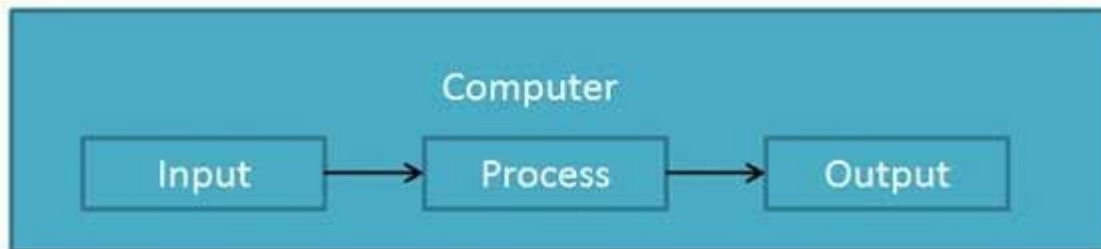
COMPUTER SYSTEM

Today's world is an information-rich world and it has become a necessity for everyone to know about computers.

Functionalities of a computer

Any digital computer carries out five functions in gross terms:

- Takes data as input.
- Stores the data/instructions in its memory and use them when required.
- Processes the data and converts it into useful information.
- Generates the output
- Controls all the above four steps.



Definition of a Computer System

Computer is an electronic data processing device which

- accepts and stores data input,
- processes the data input, and
- generates the output in a required format.

Advantages of Computer Systems

Following list demonstrates the advantages of computers in today's arena.

a) High Speed

- *Computer is a very fast device. The computer has units of speed in microsecond, nanosecond, and even the picosecond.*
- *It is capable of performing calculation of very large amount of data.*

b) Accuracy

- *Computers perform all jobs with 100% accuracy provided that correct input has been given.*

c) Storage Capability

- *It can store large amount of data.*
- *It can store any type of data such as images, videos, text, audio and many others.*

d) Diligence

- *Unlike human beings, a computer is free from monotony, tiredness and lack of concentration.*
- *It can work continuously without any error and boredom.*
- *It can do repeated work with same speed and accuracy.*

e) Versatility

- *A computer is very flexible in performing the jobs to be done.*
- *This machine can be used to solve the problems related to various fields.*

- *At one instance, it may be solving a complex scientific problem and the very next moment it may be playing a card game.*

f) Reliability

- *A computer is a reliable machine.*
- *Modern electronic components have long lives.*
- *Computers are designed in such a way that maintenance is easy.*

g) Automation

- *Automation means ability to perform the given task automatically.*
- *Once a program is given to a computer i.e. stored in computer memory, the program and instruction can control the program execution without human interaction.*

h) Reduction in Paper Work

- *The use of computers for data processing in an organization leads to reduction in paper work and results in speeding up a process.*
- *As data in electronic files can be retrieved as and when required, the problem of maintenance of large number of paper files gets reduced.*

i) Reduction in Cost

- *Though the initial investment for installing a computer is high but it substantially reduces the cost of each of its transaction.*

Disadvantages of Computer Systems

Following list demonstrates the disadvantages of computers in today's arena.

a) No I.Q

- *A computer is a machine that has no intelligence to perform any task.*
- *Each instruction has to be given to a computer therefore a computer cannot take any decision on its own.*

b) Dependency

- *It functions as per a user's instruction, so it is fully dependent on human being.*

c) Environment

- *The operating environment of a computer should be suitable. E.g. dust free, moisture free, etc*

d) No Feeling

- *Computers have no feelings or emotions. It cannot make judgment based on feeling, taste, experience, and knowledge unlike a human being.*

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Applications of Computer Systems

Following list demonstrates various applications of computers in today's arena.

a) Business

A computer has high speed of calculation, diligence, accuracy, reliability, or versatility which made it an integrated part in all business organisations.

Computer is used in business organisations for:

- Payroll calculations
- Budgeting
- Sales analysis
- Financial forecasting
- Managing employees database
- Maintenance of stocks etc.

b) Banking

Today banking is almost totally dependent on computer.

Banks provide following facilities:

- Banks provide online accounting facility, which includes current balances, deposits, overdrafts, interest charges, shares, and trustee records.
- ATM machines are making it even easier for customers to do transactions.

c) Insurance

Insurance companies are keeping all records up-to-date with the help of computers. The insurance companies, finance houses and stock broking firms are widely using computers for their concerns.

Insurance companies are maintaining a database of all clients with information showing insurance policy details such as procedure to continue with policies, starting date of the policies ,next due installment of a policy, maturity date , interests due ,survival benefits ,bonus

d) Education

The computer has provided a lot of facilities in the education system.

- The computer provides a tool in the education system known as CBE (Computer Based Education).
- CBE involves control, delivery, and evaluation of learning.
- There are number of methods in which educational institutions can use computer to educate the students.
- It is used to prepare a database about performance of a student and analysis is carried out on this basis, store students admission details, etc

e) Marketing

In marketing, uses of computer are following:

- **Advertising** - With computers, advertising professionals create art and graphics, write and revise copy, and print and disseminate ads with the goal of selling more products.

- **At Home Shopping** - Home shopping has been made possible through use of computerised catalogues that provide access to product information and permit direct entry of orders to be filled by the customers.

f) Health Care

Computers have become important part in hospitals, labs, and dispensaries. The computers are being used in hospitals to keep the record of patients and medicines. It is also used in scanning and diagnosing different diseases. Ultrasounds and CT Scans etc. are also done by computerised machines.

Some major fields of health care in which computers are used are:

- **Diagnostic System** - Computers are used to collect data and identify cause of illness.
- **Lab-diagnostic System** - All tests can be done and reports are prepared by computer.
- **Patient Monitoring System** - These are used to check patient's signs for abnormality such as in Cardiac Arrest, ECG etc.
- **Pharma Information System** - Computer checks Drug-Labels, Expiry dates, harmful drug's side effects etc.
- **Surgery:** Nowadays, computers are also used in performing surgery.

g) Engineering Design

Computers are widely used in Engineering purpose.

One of major areas is CAD (Computer aided design).that provides creation and modification of images. Some fields are:

- **Structural Engineering** - Requires stress and strain analysis for design of Ships, Buildings, Budgets, Airplanes etc.

- **Industrial Engineering** - Computers deal with design, implementation and improvement of integrated systems of people, materials and equipments.
- **Architectural Engineering** - Computers help in planning towns, designing buildings, determining a range of buildings on a site using both 2D and 3D drawings.

h) Military

Computers are largely used in defence. modern tanks, missiles, weapons etc. Military also employs computerised control systems. Some military areas where a computer has been used are:

- Missile Control
- Military Communication
- Military Operation and Planning
- Smart Weapons

i) Communication

Communication means to convey a message, an idea, a picture or speech that is received and understood clearly and correctly by the person for whom it is meant for. Some main areas in this category are:

- E-mail
- Chatting
- Usenet
- FTP (transfer of files)
- Telnet (remote connection to computers)

- Video-conferencing

j) Government

Computers play an important role in government. Some major fields in this category are:

- Budgets
- Income tax department
- Population analysis
- Computerization of voters lists, etc

Computer Generations

The view of computers into generations is based on the fundamental technology employed. Each new generation is characterized by greater speed, larger memory capacity and smaller overall size than the previous one.

There are totally five computer generations known till date.

Following are the main five *generations* of computers

S.N	Generation and Description
1	First Generation The period of first generation: 1946-1959. Vacuum tube based.
2	Second Generation The period of second generation: 1959-1965. Transistor based.
3	Third Generation The period of third generation: 1965-1971. Integrated Circuit based.
4	Fourth Generation The period of fourth generation: 1971-1980. VLSI microprocessor based.
5	Fifth Generation The period of fifth generation: 1980-onwards. ULSI microprocessor based

First Generation

The period of first generation was 1946-1959. The computers of first generation used vacuum tubes as the basic components for memory and circuitry for CPU (Central Processing Unit). These tubes, like electric bulbs, produced a lot of heat and were prone to frequent fusing of the installations, therefore, were very expensive and could be afforded only by very large

organisations. In this generation mainly batch processing operating system were used. Punched cards, paper tape, and magnetic tape were used as input and output devices. The computers in this generation used machine code as programming language.

The main features of first generation are:

- Vacuum tube technology
- Unreliable
- Supported machine language only
- Very costly
- Generated lot of heat
- Slow input and output devices
- Huge size
- Need of A.C.
- Non-portable
- Consumed lot of electricity

Second Generation

The period of second generation was 1959-1965. In this generation **transistors** were used that were cheaper, consumed less power, more compact in size, more reliable and faster than the first generation machines made of vacuum tubes. In this generation, magnetic cores were used as primary memory and magnetic tape and magnetic disks as secondary storage devices. In this generation assembly language and high-level

programming languages like FORTRAN, COBOL were used. The computers used batch processing and multiprogramming operating system.

The main features of second generation are:

- Use of transistors
- Reliable in comparison to first generation computers
- Smaller size as compared to first generation computers
- Generated less heat as compared to first generation computers
- Consumed less electricity as compared to first generation computers
- Faster than first generation computers
- Still very costly
- A.C. needed
- Supported machine and assembly languages

Third Generation

The period of third generation was 1965-1971. The computers of third generation used integrated circuits (IC's) in place of transistors. A single IC has many transistors, resistors and capacitors along with the associated circuitry. The IC was invented by Jack Kilby. This development made computers smaller in size, reliable and efficient. In this generation remote processing, time-sharing, multi-programming operating system were used. High-level languages (FORTRAN-II TO IV, COBOL, PASCAL BASIC, ALGOL-68 etc.) were used during this generation.

The main features of third generation are:

- Integrated Circuits (ICs) used
- More reliable in comparison to previous two generations
- Smaller size
- Generated less heat
- Faster
- Lesser maintenance
- Still costly
- A.C (Air Conditioners)needed
- Consumed lesser electricity
- Supported high-level language

Fourth Generation

The period of fourth generation was 1971-1980. The computers of fourth generation used Very Large Scale Integrated (VLSI) circuits. VLSI circuits having about 5000 transistors and other circuit elements and their associated circuits on a single chip made it possible to have microcomputers of fourth generation. Fourth generation computers became more powerful, compact, reliable, and affordable. As a result, it gave rise to personal computer (PC) revolution. In this generation time sharing, real time, networks, distributed operating system were used. All the high-level languages like C, C++, DBASE etc. were used in this generation.

The main features of fourth generation are:

- VLSI technology used
- Very cheap
- Portable and reliable
- Use of PC's
- Very small size
- Pipeline processing
- No A.C. needed
- Concept of internet was introduced
- Great developments in the fields of networks
- Computers became easily available

Fifth Generation

The period of fifth generation is 1980-till date. In the fifth generation, the VLSI technology became ULSI (Ultra Large Scale Integration) technology, resulting in the production of microprocessor chips having ten million electronic components. This generation is based on parallel processing hardware and AI (Artificial Intelligence) software. AI is an emerging branch in computer science, which interprets means and method of making computers think like human beings. All the high-level languages like C and C++, Java, .Net etc. are used in this generation.

AI includes:

- Robotics
- Neural networks
- Game Playing

- Development of expert systems to make decisions in real life situations.
- Natural language understanding and generation.

The main features of fifth generation are:

- ULSI(Ultra Large Scale Integration) technology
- Development of true artificial intelligence
- Development of Natural language processing
- Advancement in Parallel Processing
- Advancement in Superconductor technology
- More user friendly interfaces with multimedia features
- Availability of very powerful and compact computers at cheaper rates

Some computer types of this generation are:

- Desktop
- Laptop
- NoteBook
- UltraBook

CLASSIFICATION OF COMPUTER SYSTEMS

Computers can be classified in different ways as shown below:

i) Classification by processing

This is by how the computer represents and processes the data.

a) **Digital computers** are computers which process data that is represented in the form of discrete values by operating on it in steps. *Digital computers* process data represented in the form of discrete values like 0, 1, 2. They are used for both business data processing and scientific purposes since digital computation results in greater accuracy.

b) **Analog computers** are used for scientific, engineering, and process-controlled purposes. Outputs are represented in the form of graphs. *Analogue computers* process data represented by continuous physical variables and output physical magnitudes in the form of smooth graphs.

c) **Hybrid computers** are computers that have the combined features of digital and analog computers. They offer an efficient and economical method of working out special problems in science and various areas of engineering.

ii) Classification by purpose

This is a classification by the use to which the computer is put.

a) *Special purpose* computers are used for a certain specific function e.g. in medicine, engineering, manufacturing.

b) *General-purpose* computers can be used for a wide variety of tasks e.g. accounting, word processing

iii) Classification by power and size/ configuration/computing power

Computers can be broadly classified by their speed and computing power.

Sr No	Type	Specifications
1	PC (Personal Computer)	It is a single user computer system having moderately powerful microprocessor
2	WorkStation	It is also a single user computer system which is similar to personal computer but have more powerful microprocessor.
3	Mini Computer	It is a multi-user computer system which is capable of supporting hundreds of users simultaneously.
4	Main Frame	It is a multi-user computer system which is capable of supporting hundreds of users simultaneously. Software technology is different from minicomputer.
5	Supercomputer	It is an extremely fast computer which can execute hundreds of millions of instructions per second.

PC (Personal Computer)

A PC can be defined as a small, relatively inexpensive computer designed for an individual user. PCs are based on the microprocessor technology that enables manufacturers to put an entire CPU on one chip. Businesses use personal computers for word processing, accounting, desktop publishing, and for running spreadsheet and database management applications. At home, the most popular use for personal computers is playing games and surfing Internet.

Although personal computers are designed as single-user systems, these systems are normally linked together to form a network. In terms of power, now-a-days High-end models of the Macintosh and PC offer the same computing power and graphics capability as low-end workstations by Sun Microsystems, Hewlett-Packard, and Dell.



Workstation

Workstation is a computer used for engineering applications (CAD/CAM), desktop publishing, software development, and other

such types of applications which require a moderate amount of computing power and relatively high quality graphics capabilities.

Workstations generally come with a large, high-resolution graphics screen, large amount of RAM, inbuilt network support, and a graphical user interface. Most workstations also have a mass storage device such as a disk drive, but a special type of workstation, called a diskless workstation, comes without a disk drive.

Common operating systems for workstations are UNIX and Windows NT. Like PC, Workstations are also singleuser computers like PC but are typically linked together to form a local-area network, although they can also be used as stand-alone systems.



Minicomputer

It is a midsize multi-processing system capable of supporting up to 250 users simultaneously.



Mainframe

Mainframe is very large in size and is an expensive computer capable of supporting hundreds or even thousands of users simultaneously. Mainframe executes many programs concurrently and supports many simultaneous execution of programs.



Supercomputer

Supercomputers are one of the fastest computers currently available. Supercomputers are very expensive and are employed for specialized applications that require immense amount of

mathematical calculations (number crunching). For example, weather forecasting, scientific simulations, (animated) graphics, fluid dynamic calculations, nuclear energy research, electronic design, and analysis of geological data (e.g. in petrochemical prospecting).



Components of a Computer System

A computer system has three major components:-

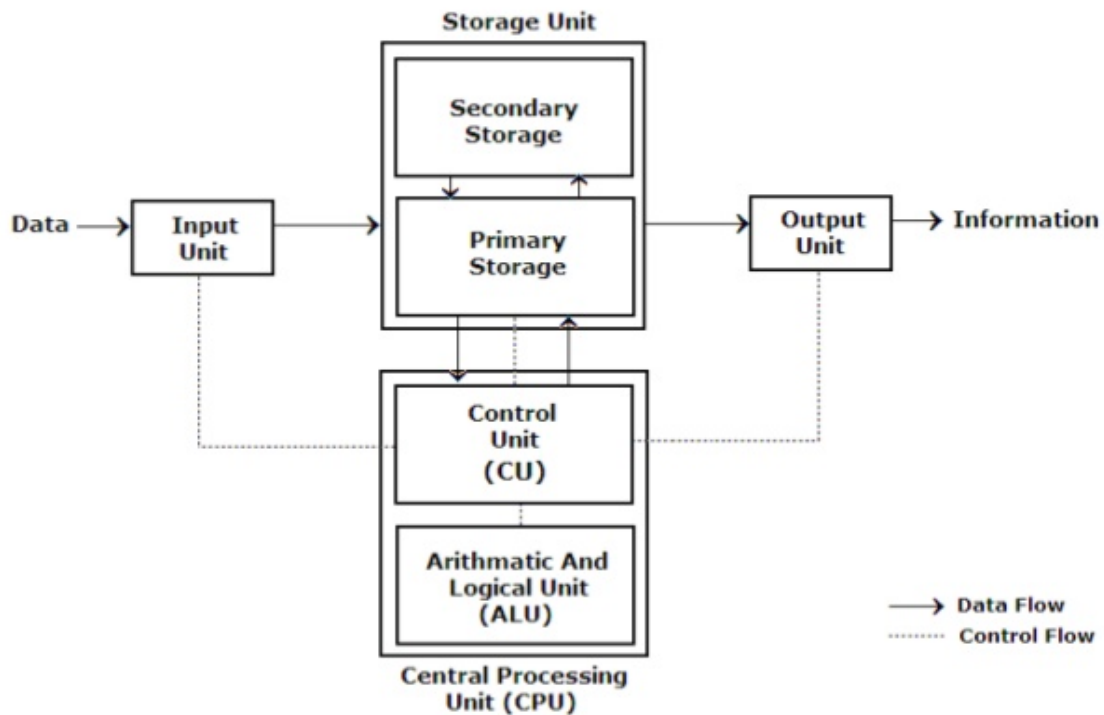
1. Hardware- This is the physical / tangible part of the computer
2. Software- the programs and data on the computer system
3. Live ware- the personnel working on computers

Operations/Functions of a Computer System

All types of computers follow a same basic logical structure and perform the following five basic operations for converting raw input data into information useful to their users

S.No	Operation	Description
1	Take Input	The process of entering data and instructions into the computer system.
2	Store Data	Saving data and instructions so that they are available for processing as and when required.
3	Processing Data	Performing arithmetic, and logical operations on data in order to convert them into useful information.
4	Output Information	The process of producing useful information or results for the user, such as a printed report or visual display.
5	Control the workflow	Directs the manner and sequence in which all of the above operations are performed.

Block diagram of computer



COMPUTER HARDWARE

INPUT UNIT

The unit contains devices used to enter data into a computer system. The unit makes link between the user and computer. The input devices translate the data into the form that is understandable by the ,computer system.

Input Devices

Following are few of the important input devices which are used in a computer:

- Keyboard
- Mouse
- Joy Stick
- Light pen
- Track Ball
- Scanner
- Graphic Tablet
- Microphone
- Magnetic Ink Card Reader(MICR)
- Optical Character Reader(OCR)
- Bar Code Reader
- Optical Mark Reader(OMR)

Keyboard

Keyboard is the most common and very popular input device which helps in inputting data to the computer. The layout of the keyboard is like that of traditional typewriter, although there are

some additional keys provided for performing additional functions.

Keyboards are of two sizes 84 keys or 101/102 keys, but now keyboards with 104 keys or 108 keys are also available for Windows and Internet.

The keys on the keyboard are as follows:

Sr. No.	Keys	Description
1	Alphanumeric Keys	These keys include the letter keys (A-Z) and digit keys (0-9) which generally give same layout as that of typewriters.
2	Numeric Keypad	It is used to enter numeric data or cursor movement. Generally, it consists of a set of 17 keys that are laid out in the same configuration used by most adding machines and calculators.
3	Function Keys	The twelve function keys are present on the keyboard which are arranged in a row at the top of the keyboard. Each function key has unique meaning and is used for some specific purpose.
4	Control keys	These keys provide cursor and screen control. It includes four directional arrow keys. Control keys also include Home, End, Insert, Delete, Page Up, Page Down, Control(Ctrl), Alternate(Alt), Escape(Esc).
5	Special Purpose Keys	Keyboard also contains some special purpose keys such as Enter, Shift, Caps Lock, Num Lock, Space bar, Tab, and Print Screen.



Mouse

Mouse is most popular pointing device. It is a very famous cursor-control device having a small palm size box with a round ball at its base which senses the movement of mouse and sends corresponding signals to CPU when the mouse buttons are pressed.

Generally it has two buttons called left and right button and a wheel is present between the buttons. Mouse can be used to control the position of cursor on screen, but it cannot be used to enter text into the computer.

Advantages

- Easy to use
- Not very expensive
- Moves the cursor faster than the arrow keys of keyboard.

A mouse can be mechanical, optical(uses LED) or cordless (uses infrared).

Joystick

Joystick is also a pointing device which is used to move cursor position on a monitor screen. It is a stick having a spherical ball

at its both lower and upper ends. The lower spherical ball moves in a socket. The joystick can be moved in all four directions.

The function of joystick is similar to that of a mouse. It is mainly used in Computer Aided Designing(CAD) and playing computer games.



Light Pen

Light pen is a pointing device which is similar to a pen. It is used to select a displayed menu item or draw pictures on the monitor screen.



Track Ball

Track ball is an input device that is mostly used in notebook or laptop computer, instead of a mouse. This is a ball which is half inserted and by moving fingers on ball, pointer can be moved. Since the whole device is not moved, a track ball requires less

space than a mouse. A track ball comes in various shapes like a ball, a button and a square.



Scanner

Scanner is an input device which works more like a photocopy machine. It is used when some information is available on a paper and it is to be transferred to the hard disc of the computer for further manipulation. Scanner captures images from the source which are then converted into the digital form that can be stored on the disc. These images can be edited before they are printed.



Digitizer

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



Microphone

Microphone is an input device to input sound that is then stored in digital form. The microphone is used for various applications like adding sound to a multimedia presentation or for mixing music.

Magnetic Ink Card Reader(MICR)

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



Optical Character Reader(OCR)

OCR is an input device used to read a printed text. OCR scans text optically character by character, converts them into a machine readable code and stores the text on the system memory.



Bar Code Readers

Bar Code Reader is a device used for reading bar coded data (data in form of light and dark lines). Bar coded data is generally used in labelling goods, numbering the books etc. It may be a hand held scanner or may be embedded in a stationary scanner. Bar Code Reader scans a bar code image, converts it into an

alphanumeric value which is then fed to the computer to which bar code reader is connected.



Optical Mark Reader(OMR)

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



CPU - Central Processing Unit

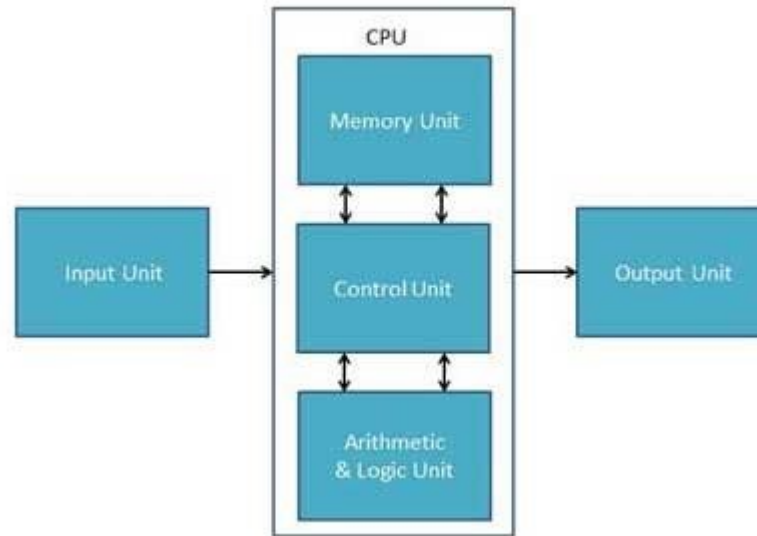
CPU consists of the following features:

- CPU is considered as the brain of the computer.
- CPU performs all types of data processing operations.
- It stores data, intermediate results and instructions (program).
- It controls the operation of all parts of computer.



CPU itself has following three components.

- Memory or Storage Unit:
- Control Unit
- ALU(Arithmetic Logic Unit)



Registers/ Memory Unit

These are high speed storage locations that temporarily store data and instructions during processing. They may store a program instruction while it is being decoded, store data while it is being processed by the ALU, or store the results of a calculation

Control Unit

This unit controls the operations of all parts of computer but does not carry out any actual data processing operations.

This is the device in charge of the operations of the computer and its peripherals. Provides timing and harmonization for communication process between the CPU and the peripherals and any other circuits connected to the CPU. The control unit deciphers/ decodes each instruction stored in it and then carries out the instruction. It directs the movement of electronic signals between main memory and the ALU. It also directs these electronic signals between the main memory and the input and output devices

ALU(Arithmetic Logic Unit)

This unit consists of two parts namely

- Arithmetic section
- Logic Section

Arithmetic Section

Function of arithmetic section is to perform arithmetic operations like addition, subtraction, multiplication and division. All complex operations are done by making repetitive use of above operations.

Logic Section

Function of logic section is to perform logic operations such as comparing, selecting, matching and merging of data.

The results from the ALU is stored in the registers temporarily.

Output Unit

This unit is used to give out (display) information (result of processed data).

Following are few of the important output devices which are used in a computer system:

- Monitors
- Graphic Plotter
- Printer
- 3D headset
- Audio output
- Data projector
- Output devices for physically challenged users

Monitors

Monitors, commonly called as Visual Display Unit (VDU), are the main output device of a computer. It forms images from tiny dots, called pixels that are arranged in a rectangular form. The sharpness of the image depends upon the number of pixels.

There are two kinds of viewing screen used for monitors.

- Cathode-Ray Tube (CRT)
- Flat- Panel Display

Cathode-Ray Tube (CRT) Monitor

A CRT monitor, or monitor, is a display device that consists of a screen in a plastic or metal case. The core of a CRT monitor is a large glass tube called a cathode ray tube (CRT). The screen, which is the front of the tube, is coated with tiny dots (pixels) of

phosphor material that glow producing an image on the screen when electrically charged by an electron beam. The CRT display is made up of small picture elements called pixels. The smaller the pixels, the better the image clarity, or resolution. It takes more than one illuminated pixel to form whole character, such as the letter 'e' in the word help.

There are some disadvantages of CRT

- Large in Size
- High power consumption



Flat-Panel Display Monitor

The flat-panel display refers to a class of video devices that have reduced volume, weight and power requirement in comparison to the CRT. You can hang them on walls or wear them on your wrists. Current uses of flat-panel displays include calculators, videogames, monitors, laptop computer, graphics display.

The flat-panel display is divided into two categories

- **Emissive Displays** - The emissive displays are devices that *convert electrical energy into light*. Example are plasma panel and LED(Light-Emitting Diodes) and plasma panels.
- **Non-Emissive Displays** - The Non-emissive displays use *optical effects to convert sunlight or light from some other source into graphics patterns*. Example is LCD(Liquid-Crystal Device)



Printers

A Printer is an output device, which is used to print information on paper.

There are two types of printers

- Impact Printers
- Non-Impact printers

Impact Printers

The impact printers print the characters by striking them on the ink ribbon which is then pressed on the paper.

Characteristics of Impact Printers are the following

- Very low consumable costs
- Very noisy
- Useful for bulk printing due to low cost
- There is physical contact with the paper to produce an image

These printers are of two types

- Character printers
- Line printers

Character Printers

Character printers are the printers which print one character at a time.

These are further divided into two types

- Dot Matrix Printer(DMP)
- Daisy Wheel

Dot Matrix Printer

In the market one of the most popular printers is Dot Matrix Printer. These printers are popular because of their ease of printing and economical price. Each character printed is in form of pattern of dots and head consists of a Matrix of Pins which come out to form a character that is why it is called Dot Matrix Printer.

Advantages

- Inexpensive
- Widely Used
- Other language characters can be printed

Disadvantages

- Slow Speed
- Poor Quality



Daisy Wheel

Head is lying on a wheel and pins corresponding to characters are like petals of Daisy (flower name) that is why it is called Daisy Wheel Printer. These printers are generally used for word-processing in offices which require a few letters to be sent here and there with very nice quality.

Advantages

- More reliable than DMP
- Better quality
- The fonts of character can be easily changed

Disadvantages

- Slower than DMP
- Noisy
- More expensive than DMP



Line Printers

Line printers are the printers which print one line at a time.



These are of further two types

- Drum Printer
- Chain Printer

This printer is like a drum in shape so it is called drum printer. The surface of drum is divided into number of tracks. Total tracks are equal to size of paper i.e. for a paper width of 132 characters, drum will have 132 tracks. A character set is embossed on track. The different character sets available in the market are 48 character set, 64 and 96 characters set. One rotation of drum prints one line. Drum printers are fast in speed and can print 300 to 2000 lines per minute.

Advantages

- Very high speed

Disadvantages

- Very expensive
- Characters' fonts cannot be changed

Chain Printer

In this printer, chain of character sets are used so it is called Chain Printer. A standard character set may have 48, 64, or 96 characters.

Advantages

- Character fonts can easily be changed.
- Different languages can be used with the same printer.

Disadvantages

- Noisy

Non-impact Printers

Non-impact printers print the characters without using ribbon, they use other technologies such as thermal and laser technologies. These printers print a complete page at a time so they are also called as **Page Printers**.

These printers are of two types

- Laser Printers
- Inkjet Printers

Characteristics of Non-impact Printers

- Faster than impact printers.

- They are not noisy.
- High quality.
- Support many fonts and different character size.

Laser Printers

These are non-impact page printers. They use laser lights to produce the dots needed to form the characters to be printed on a page.

Advantages

- Very high speed
- Very high quality output
- Give good graphics quality
- Support many fonts and different character size

Disadvantages

- Expensive.
- Cannot be used to produce multiple copies of a document in a single printing.



Inkjet Printers

Inkjet printers are non-impact character printers based on a relatively new technology. They print characters *by spraying small drops of ink onto paper*. Inkjet printers produce high quality output with presentable features.

They make less noise because no hammering is done. Colour printing is also possible. Some models of Inkjet printers can produce multiple copies of printing also.

Advantages

- High quality printing
- More reliable

Disadvantages

- Expensive as cost per page is high
- Slow as compared to laser printer



Thermal Printers

A thermal printer generates images by pushing electrically heated pins against heat-sensitive paper. Standard thermal printers are inexpensive, but the print quality is low and the images tend to fade over time.

3D Headsets

These are used in virtual reality e.g. gaming, simulation in an aircraft, etc



Audio Output

Audio is music, speech, or any other sound. Audio output devices are the components of a computer that produce music, speech, or other sounds, such as beeps. Two commonly used audio output devices are speakers and headsets.

Data Projectors

A data projector 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.

Output Devices For Physically Challenged Users

The growing presence of computers in everyone's lives has generated an awareness of the need to address computing requirements for those with physical limitations. For users with mobility, hearing, or vision disabilities, many different types of output devices are available. Hearing-impaired users, for example, can instruct programs to display words instead of sounds. Another example is a Braille printer, which outputs information in Braille onto paper.