

IT 231

Foundation of Information
Technology

Central Processing Unit (CPU)

- Brain of the computer
- performs the basic arithmetical, logical, and input/output operations of a computer system
- Responsible for interpreting and executing most of the commands from the computer's hardware and software.
- Logic machine which executes computer program.
- Run program by fetching instruction from main memory.
- Instruction is combination of opcode, addressing mode and addressing field.
- Speed of CPU is measured in Hertz's.

Basic Parts of CPU

➤ ALU

- Does all of the mathematics in a computer
- Does all the logical comparisons
- Logic comparison symbols ($=, >, <, \geq, \leq, \ltgt$) etc.

➤ CU

- Fetching and executing Instruction.
- Generates the control signals.
- CU supervise the transfer of information among the register and instructs ALU as to which operation to perform.

➤ Register Set

- Store data & instruction inside processor.
- Register size affect performance & speed of processor.
- Hi-speed storing areas.
- Store data temporarily during processing.

Bus and It Types

- Collection of wire through which data are transmitted from one part of computer to another.
- Digital pathway to transmit data to several peripherals.
- Bus communicates different part of computer.
- Size of bus determine how much data can be transmitted at one time.
- In 32-bit bus, data are sent over 32 wires simultaneously.
- Buses transfer data analogous way.

Control Bus

- Carry control information between CPU and other devices.
- control bus is bidirectional and assists the CPU in synchronizing control signals to internal devices and external components.
- Control signal and other information are occurs through physical connection such as cable or circuits.
- This is a dedicated bus, because all timing signals are generated according to control signal.

Address Bus

- group of wires or lines that are used to transfer the addresses of Memory or I/O devices.
- Channel which transmits address of data from the CPU to memory
- Address bus are unidirectional in nature.
- No. of line in the address bus determines the amount of memory that can be directly addressed as each line carries one bit of the address.
- 3 bit address bus is used to locate 8 memory locations.

Data Bus

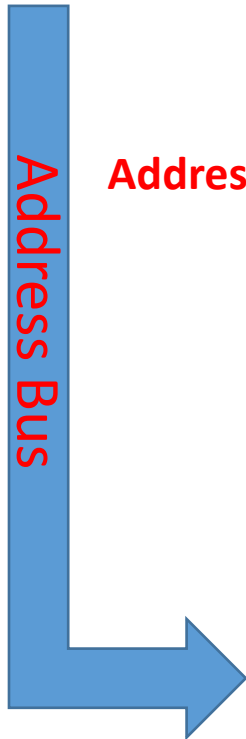
- Channel across which actual data are transmitted to and from the processor.
- no. of wires determine the amount of data can be transmitted at one time.
- Wider the data bus ,the more data it can carry at one time.
- Data bus are bidirectional, i.e data are transmitted to and from memory to other locations.

Address Register

1 0 1

Data Register

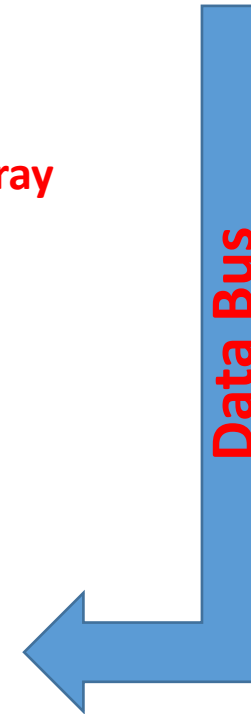
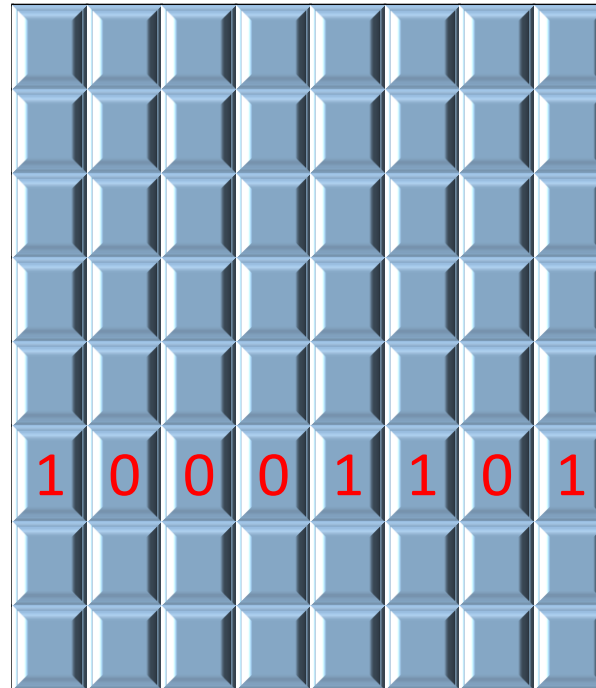
1 0 0 0 1 1 0 1



Address Decoder

0
1
2
3
4
5
6
7

Byte Organized Memory Array



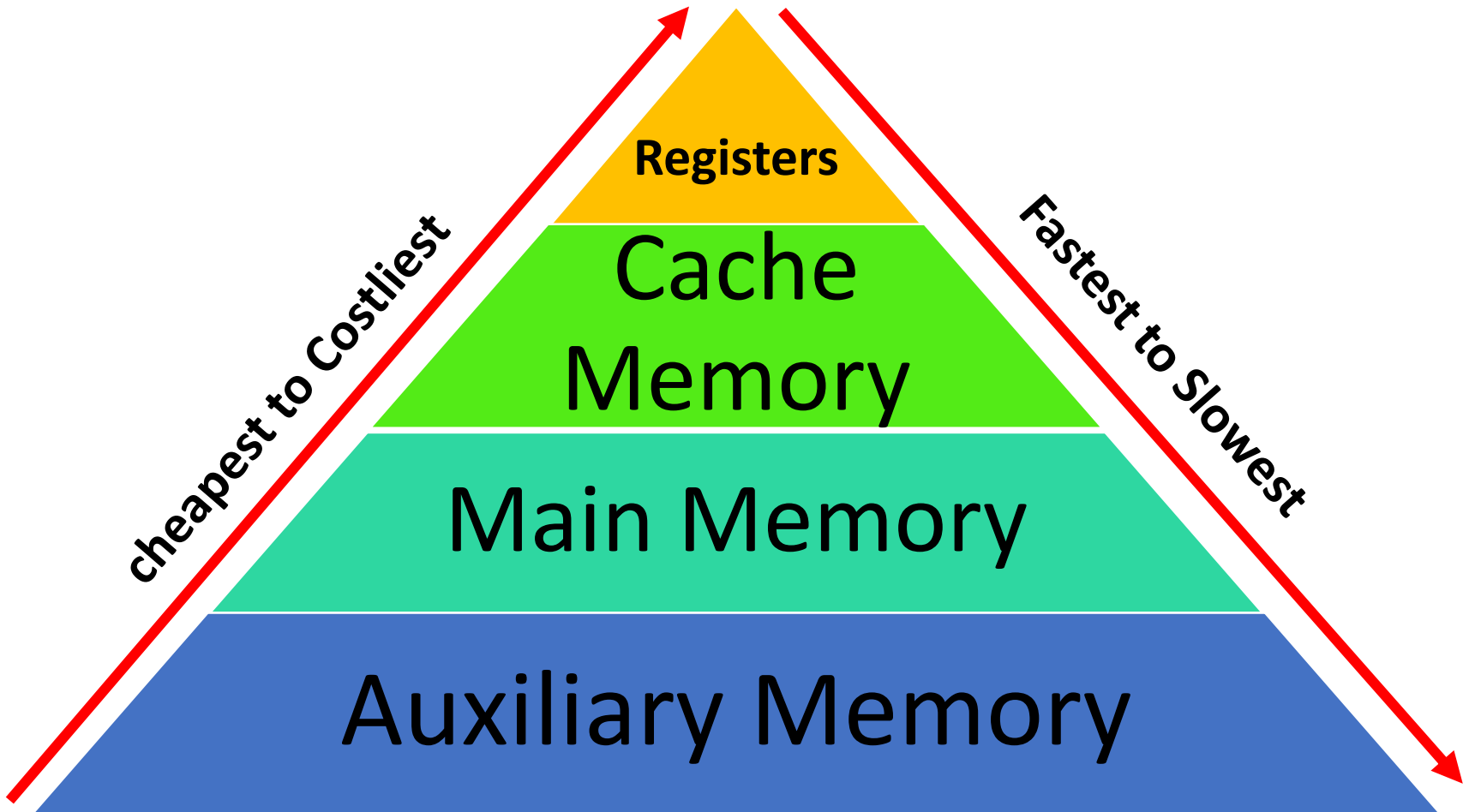
If size of address bus is (n) , it can locate 2^n memory location

Measuring Processing power of Computer

Following factors affect the speed of the computer

- Addressing Scheme
- Register Size
- Data Bus Capacity
- Clock Speed
- Instruction Set

Memory Hierarchy



Storage

- Storage devices are called storage or memory which contain digital data and information for current or future purpose.
- Storages are divided into two parts according to its nature.

1. Primary Memory

2. Secondary Memory

Primary Memory

- main area in a computer system where data is store for the quick access by the processor.
- CPU continuously read instructions stored and execute from main memory.
- Faster, expensive and small in size relative to secondary memory.
- CPU accessed memory in random fashion.

Cache Memory

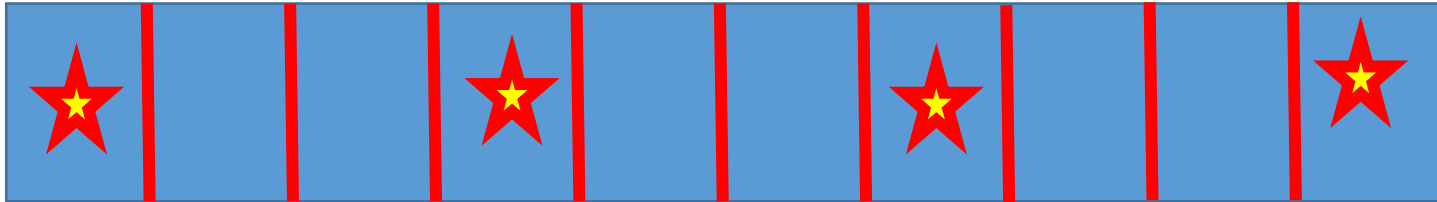
- supplementary memory systems that temporarily store frequently used instructions and data for quicker processing by the processor.
- Use in computer system to compensate the difference between main memory access time speed and processor speed.
- High speed memory, logically resides between CPU and main memory.
- Advantages of cache memory is that the CPU does not have to use motherboard's system bus for data transfer.

Cont...

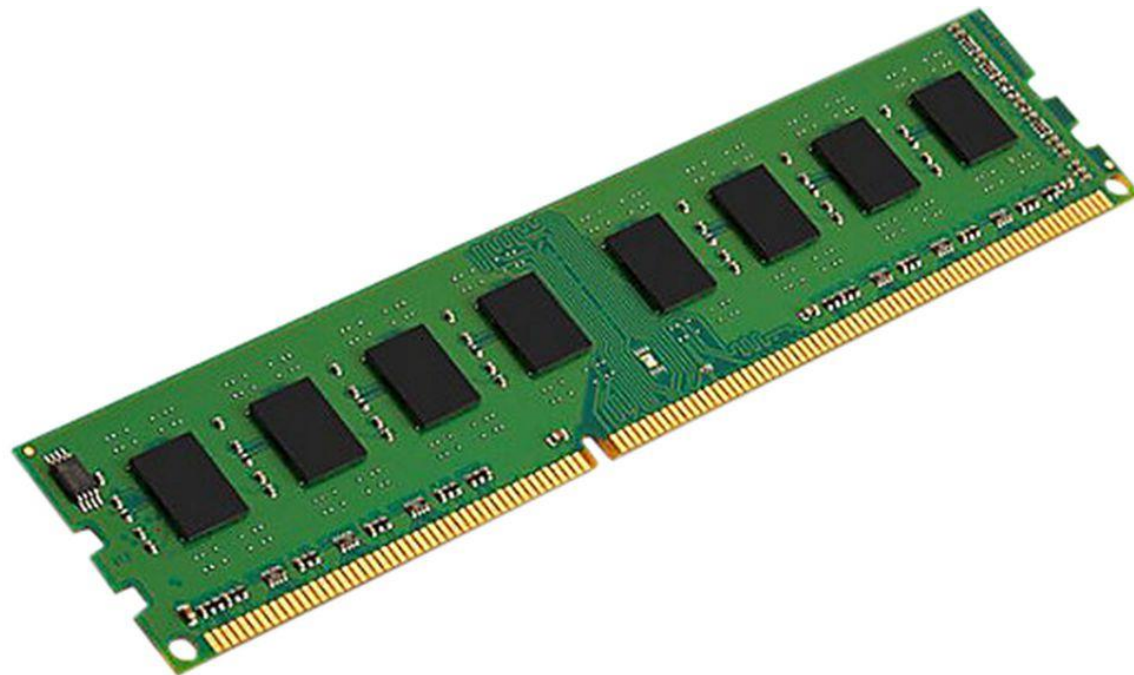
- CPU retrieves data more quickly from cache than that of RAM
- Cache built into the CPU itself is referred to as L1.
- Cache that resides on separate chip next to the CPU is referred as L2.
- Some CPUs have both L1 and L2 cache built-in and designate the separate cache chip referred as L3
- Successful retrieval of data is cache hit and failure to find the data from cache is cache miss.

RAM (Random Access Memory)

- known as working memory in computer which is also called main memory, primary memory or internal memory.
- Data access from RAM in random fashion i.e, any byte can be access without touching its preceding byte so it is called RAM.
- Called volatile memory because data stay in RAM as long as computer is running (power is supplied).
- CPU cannot use data and instruction directly from hard disk, it must be loaded into RAM before CPU uses it.



0 1 2 3 4 5 6 7 8 9



Types of RAM

- I. DRAM (Dynamic Ram)
- II. SRAM (Static RAM)
- III. NVRAM (Non-volatile RAM)
- IV. SDRAM (Synchronous Dynamic RAM)
- V. Video RAM

DRAM

- It uses transistors and capacitors. The transistors are arranged in a matrix of rows and columns.
- The capacitor holds the bit of information 0 and 1. The transistor and capacitor are paired to make a *memory cell*.
- DRAM gets its name from the refresh operation that it requires to store the information; otherwise it will lose what it is holding. The refresh operation occurs automatically thousands of times per second.
- DRAM needs to be refreshed thousand of times per second to retain data in memory. Access time of DRAM is 60 nanoseconds.

SRAM

- SRAM is made up of logic circuit (flip-flop) or semiconductors.
- Data contain in SRAM is not loss as long as power is supplied.
- External refreshed is not required in SRAM because once stored data in flip flop is available as much as power is available.
- It is used in small amount in computer where very fast RAM is required.
- Access time of SRAM is less than 10 nanoseconds.

NVRAM:

It is a type of memory which retains the information even when power is turned off. NVRAM obtain the power needed to keep it running from the CMOS battery installed in motherboard.

Store the information of various system parameter such as serial number, Ethernet MAC address, date of manufacture etc..

SDRAM:

It is variant of DRAM in which the memory speed is synchronized with the clock pulse of the CPU

Video RAM:

It is specialized RAM used on video card. Video RAM is dual ported, which means it can be accessed by two different devices simultaneously.

ROM

- “built-in” computer memory containing data that normally can only be read not written to.
- Contains the program that allows computer to be “booted-up” or regenerated each time you turn on.
- Non-volatile memory.
- also known as firmware, is an integrated circuit programmed with specific data during manufacture.
- design to perform specific function and cannot be changed.

Types of ROM

- Programmable Read only Memory (PROM)
- Erasable Programmable Read-only Memory (EPROM)
- Electrically Erasable Programmable Read-only Memory. (EEPROM)
- Flash Memory (Special types of EEPROM)

Auxiliary Memory (Secondary)

- Computer has to store a large amount of data or information for future as well as present purpose, such data and information need to be store permanently until and unless we delete or overwrite it.
- Auxiliary memory also called secondary storage used to store data permanently for long period of time.
- Secondary storages are comparatively slower access, large storage capacity and less expensive than primary storage.
- Various types of storage are: CD ROM, flash memory, magnetic disk, magnetic drive etc.

Magnetic Tape

- A recording medium consisting of a thin tape with a coating of a fine magnetic material.
- Magnetic tape is a one-half inch or one-quarter inch ribbon of plastic material on which data is recorded.
- Magnetic tapes are erasable, reusable, durable and in-expensive hence used to store large back up.
- Sequential data store so not suitable for data files that are revised or updated frequently. Slower access than disks.

Magnetic Tape

Different types of Magnetic Tape include:

- Half-inch tape with 60 MB to 400 MB data storage capacity.
- Quarter inch tape with 40 MB to 5 GB storage capacity.
- 8-mm Helical-scan with tape 1 GB to 5 GB data storage capacity.
- 4 mm DAT tape with 2 GB to 24 GB storage capacity.

Magnetic Tape



Magnetic Disk

- A magnetic disk is a storage device that uses a magnetization process to write, rewrite and access data.
- It is covered with a magnetic coating and stores data in the form of tracks, spots and sectors.
- magnetic disk primarily consists of a rotating magnetic surface and a mechanical arm that moves over it.
- mechanical arm is used to read from and write to the disk.

Magnetic Disk

- The data on a magnetic disk is read and written using a magnetization process.
- Data is organized on the disk in the form of tracks and sectors, where tracks are the circular divisions of the disk. Tracks are further divided into sectors that contain blocks of data.
- All read and write operations on the magnetic disk are performed on the sectors.
- Data access from magnetic disk in random manner, store large amount of data permanently.

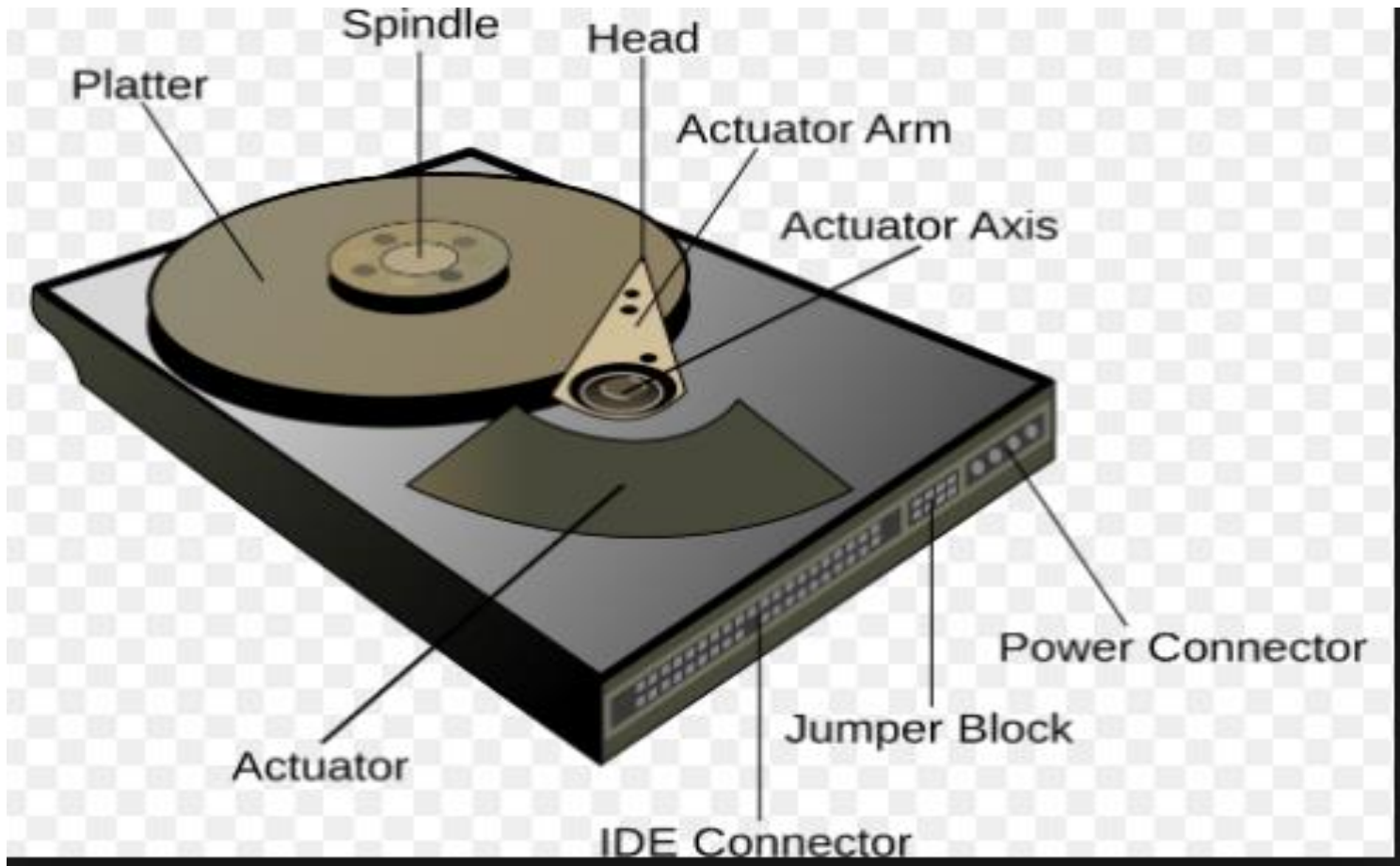
Magnetic Disk



Hard Disk

- Non volatile storage device which stores digitally encoded data on platters with magnetic surface.
- Hard disk comes with rotation speeds starting from 4500 rpm. Disk access time is measured in milliseconds.
- Hard disk consists of several platters , each platters requires two read/write heads one for each side.
- Each platters has same number of tracks and nth track of each platter taken together is called a cylinder.

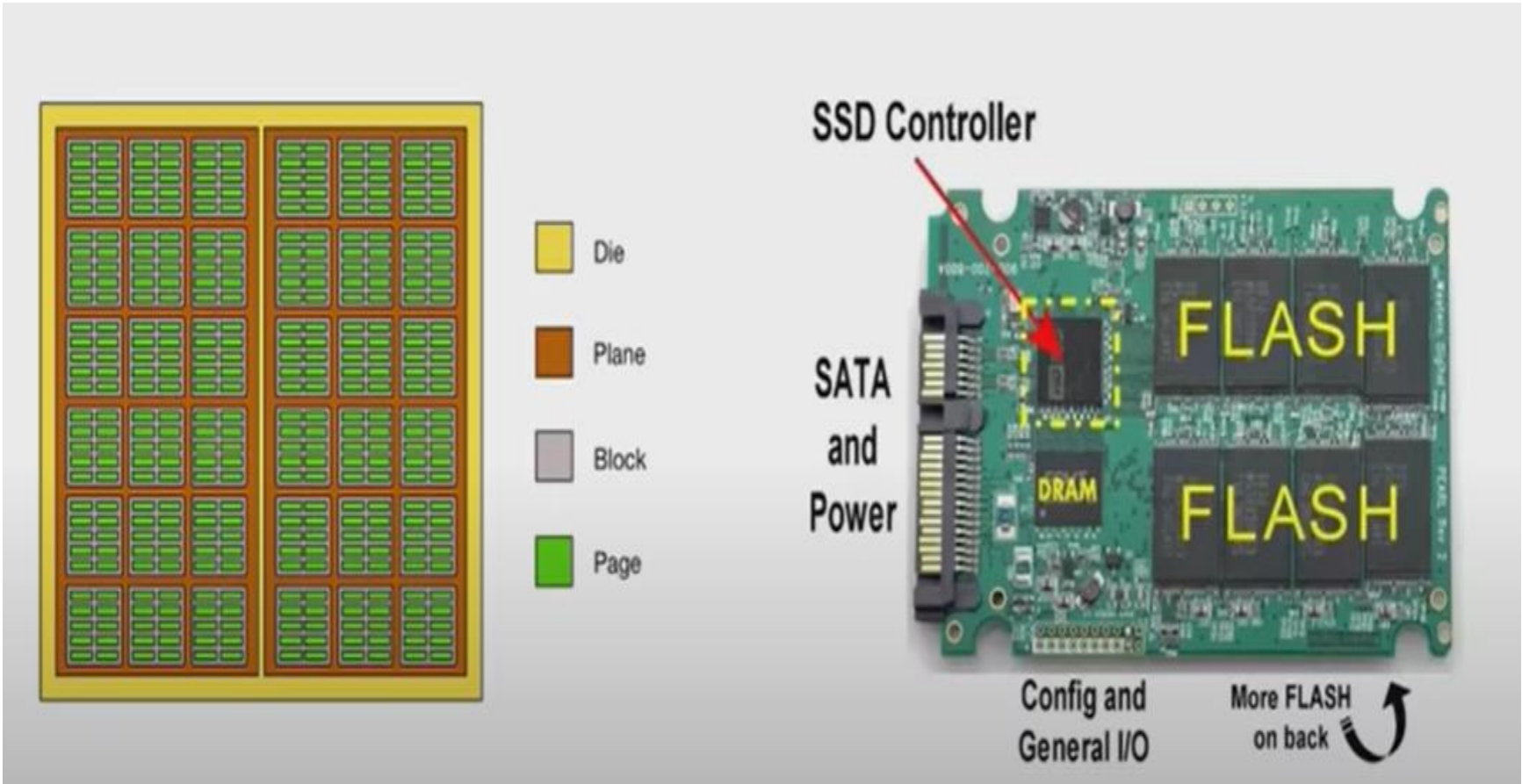
Hard Disk



Solid State Drive (SSD)

- type of nonvolatile storage media that stores persistent data on solid-state flash memory.
- Two key components make up an SSD: a flash controller and NAND flash memory chips.
- Unlike a hard disk drive, SSD has no moving parts to break or spin up or down.
- reads and writes the data to a substrate of interconnected flash memory chips, which are fabricated out of silicon. Manufacturers build SSDs by stacking chips in a grid to achieve varying densities.
- To prevent volatility, SSD manufacturers design the devices with floating gate transistors (FGRs) to hold the electrical charge.

Inside SSD



Solid State Drive



Memory Card/SD Card

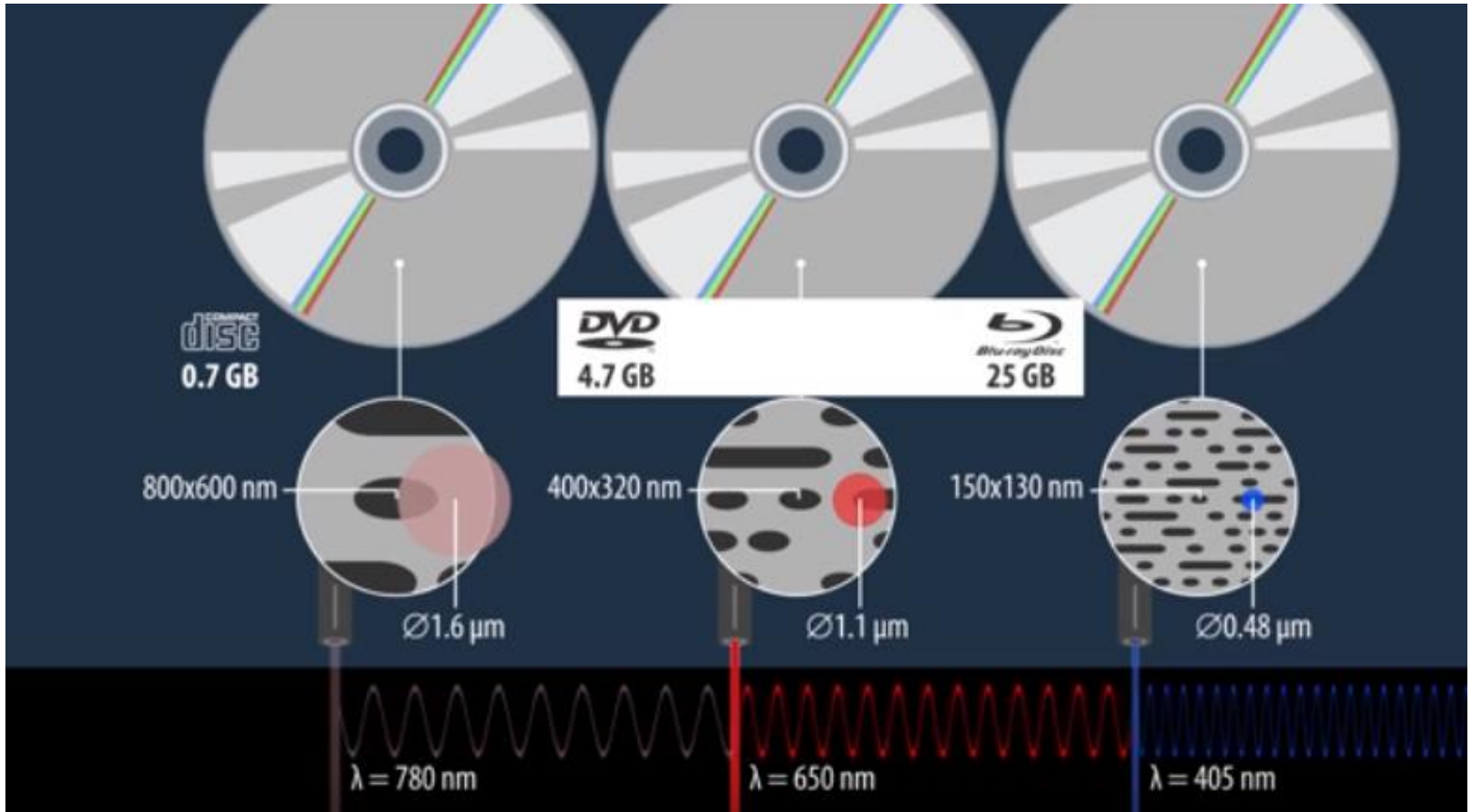
- Small storage medium (flash memory, storage card) used to store data such as text, image, audio, video for use on small, portable or remote computing devices.
- Used in digital camera, mobile phones, digital audio player, video game device and other electronic gadget.



Optical Disk

- An electronic data storage medium that can be written to and read using a low-powered laser beam.
- Compact, lightweight, durable and digital. Capability of storing minimum of 650 MB data.
- Double-layered and double sided DVD optical disk holds up to 15.9 GB of data
- Blu-ray can store up to 50 GB.
- CD, DVD, Blue-ray are some example of optical disk.

Optical Disk



CD (Compact Disk)

- Standard CDs have a diameter of 120 mm and can hold up to 80 minutes of audio.
- Mini CD with diameters ranging from 60 to 80 mm.
- **CD-ROM:** CD-ROMs are stamped by vendor, and once stamped, they cannot be erase and filled with new data.
- **CD-R:** write once Read many.
- **CD-RW:** can be erased and reused.
- **VCD:** standard digital format for storing video on CD.

DVD (Digital Versatile Disk)

- Optical disk technology capability of storing 4.7 GB data on a single-sided, one-layered disk (133 min).
- Two layered disk can hold up to 17 GB data of video, audio or other information.
- DVD-ROM: only read not written.
- DVD-R, DVD+R can only record once.
- DVD-RW, DVD+RW can erase and reused.
- DVD drives are backward compatible .
- Access rate of DVDs ranging from 6000 KBps to 1.3 MBps.

Blue-ray

- Optical disc format designed to display high definition video and store large amounts of data.
- Standard was developed collaboratively by Hitachi, LG, Panasonic, Philips, Samsung, Sony and Thomson.
- Single sided blue ray store up to 27 GB and dual-layer can store up to 50 GB.

Other Storage

- Storage Area Network (SAN)
- Network Attached Storage (NAS)
- Cloud Storage

Input & Output Devices

→ data can be feed to the processing unit through input devices and again processed data are resulting through output devices.

→ every computer use input devices to take input from user and use output device to display result.

→ Keyboard ,mouse ,scanner are the example of input devices.

→ Printer, monitor are the example of output devices.

Input Devices

- Keyboard
- Mouse
- Microphone
- Scanner
- MICR, OBR, OCR
- Touch panel

Keyboard

- Alphanumeric keyboard primarily as a device for entering strings of characters.
- Used for entering non graphical data.
- Cursors control keys, function keys and numeric keypad are common features on general purpose keyboard.
- Function key allows user to enter frequently used operation on a single key stroke.

Mouse

- Hand held device which can be move on a smooth surface to simulate the movement of cursor on the screen.
- Generally mouse is used as pointing device, make selection of choices etc.
- Joystick, trackball, space balls are similar as mouse which perform the same function as mouse does.

Microphone

- Used to feed audio and voice command into a computer system.
- Most exciting area of research is in voice recognition so that this could form input to computer directly.

Scanner

- Used for capturing the information and storing them in graphical format for display.
- Consists of two components, the first one to illuminate the page so that the optical image can be captured and other to convert the optical image into digital format for storage.

Output Devices

- Any devices that display output from computer is called output device.
- An output device is also defined as any piece of computer hardware equipment used to communicate the results of a computer to the outside world.
- Output received from computer in the form of hard copy or soft copy.
- Examples include monitors, projectors, speakers, headphones and printers.

Output Devices

- Monitor (CRT,LCD,LED,PLASMA)
- Printer
 - Impact Printer
 - Dot Matrix Printer
 - Non Impact Printer
 - Ink-Jet Printer
 - Laser Printer
- Speakers

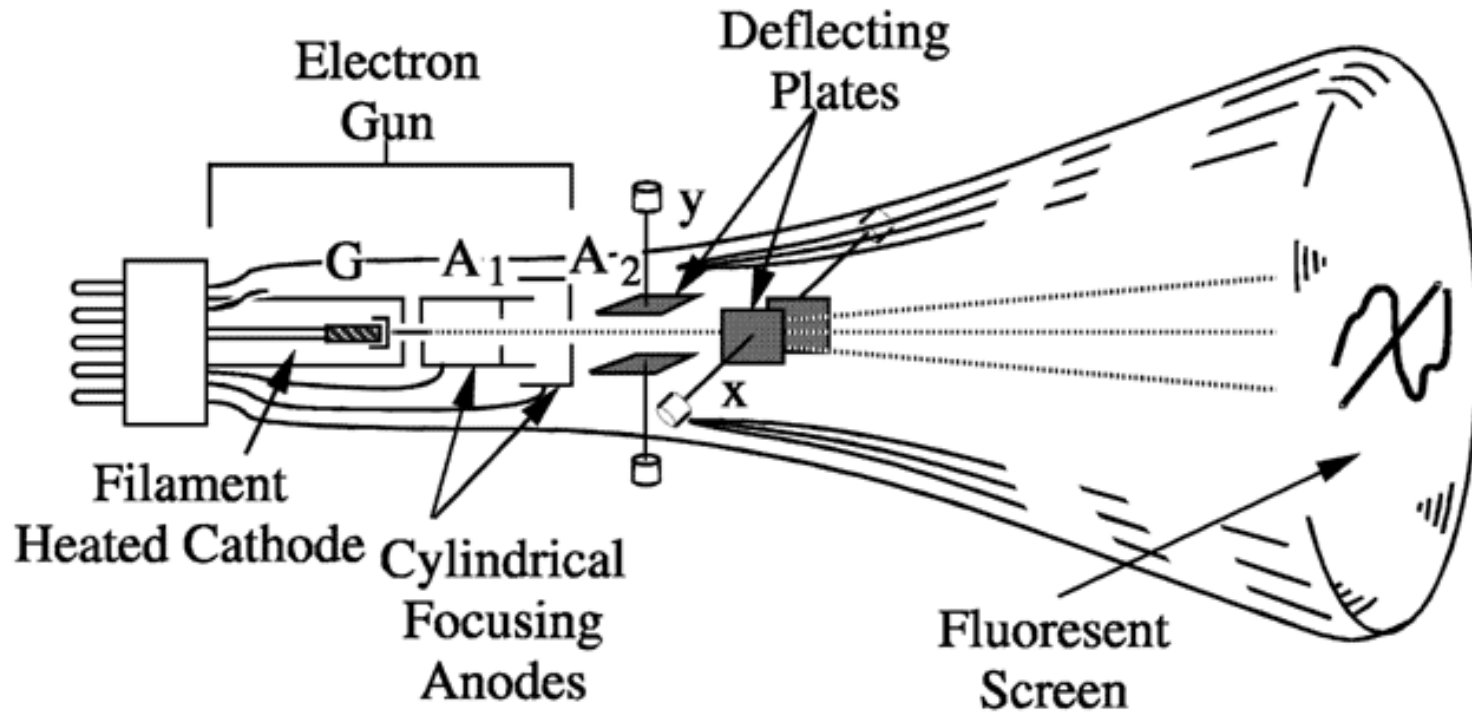
Monitor (Display Devices)

- Computer monitor or screen is a device used to display information to the users.
- It is also called a video display unit or video display screen. It is used to display information, programs and applications in a computer.
- The operation of video monitor is based on Cathode ray tube (CRT), Liquid Crystal Display (LCD), Light Emitting Diode (LED) or Plasma Display.
- Quality of Monitor depends on resolution, dot pitch, and color depth.

Cathode Ray Tube (CRT)

- A cathode ray tube (CRT) is a specialized vacuum tube in which images are produced when an electron beam strikes phosphorus surface.
- It consists of a vacuum tube, focusing system, gun and a fluorescent screen.
- Different internal and external systems are used to accelerate and deflect the electron beam on the fluorescent screen to form image in the form of light .
- To produce an image on the screen, complex signals are applied to the deflecting coils, and also to the system that controls the intensity of the electron beam.
- This causes the spot to move across the screen from right to left, and from top to bottom in a sequence of horizontal lines called raster to produce the picture.

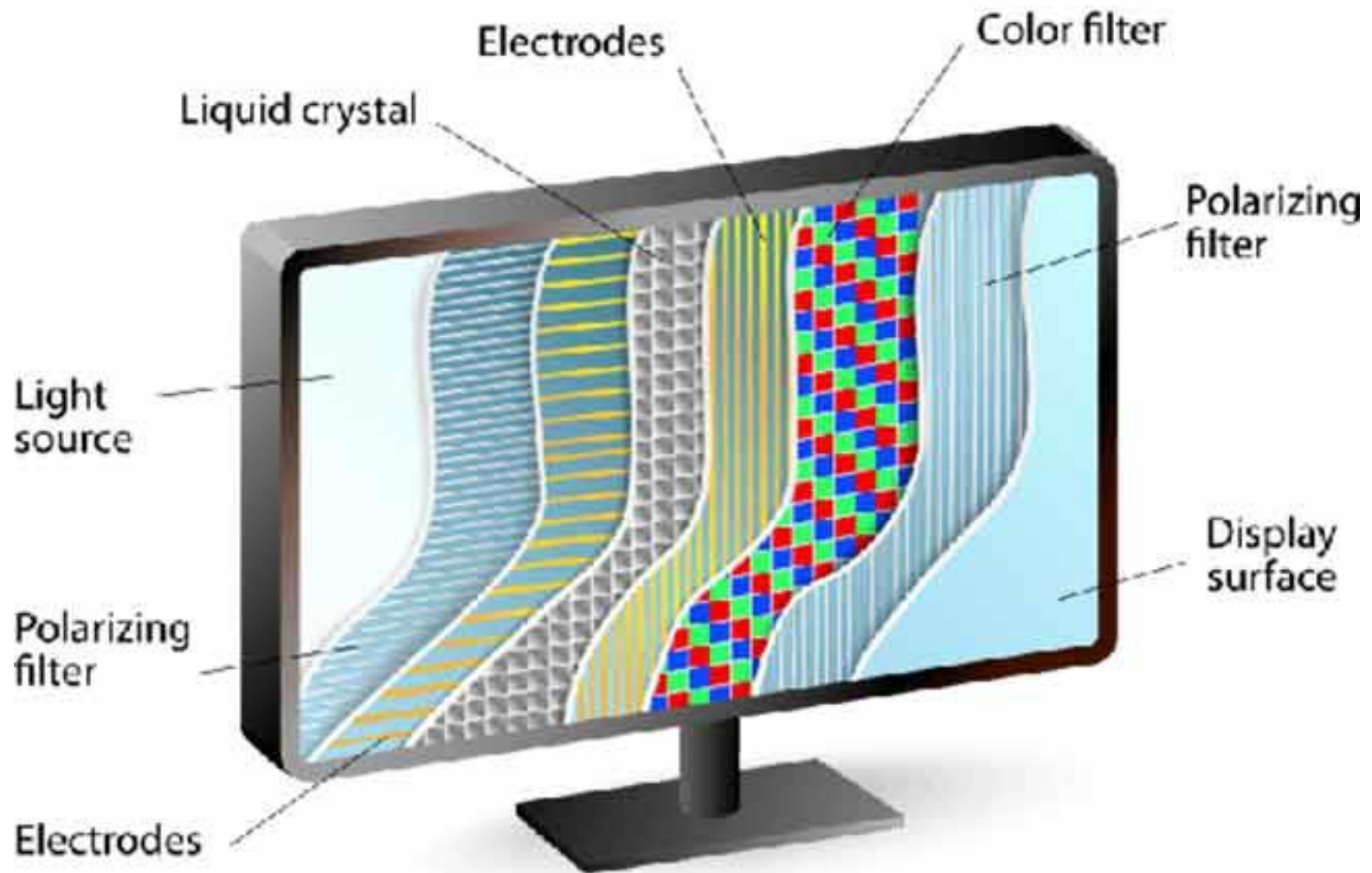
CRT Image



Liquid Crystal Display (LCD)

- LCD produces picture by passing polarized light from an internal source through a liquid crystal material.
- An LCD is made with either a passive matrix or an active matrix display grid.
- The passive matrix LCD has a grid of conductors with pixels located at each intersection in the grid.
- A current is sent across two conductors on the grid to control the light for any pixel.

LIQUID CRYSTAL DISPLAY



Cont...

- An active matrix has a transistor located at each pixel intersection, requiring less current to control the luminance of a pixel.
- LCDs are commonly used in PDA's, laptop, desktop and other more device.
- LCDs consume much less power than LED and gas-display displays because they work on the principle of blocking light rather than emitting it.

WHAT IS LCD?

- ◉ LCD stands for liquid crystal display. It is a flat panel display which uses the light modulating properties of liquid crystal in order to display the picture.
- ◉ A liquid like material is sandwiched between the horizontal and vertical grids of electrodes and because of this it is called a liquid crystal display.
- ◉ Liquid crystals do not emit light directly, but uses backlight to produce images.
- ◉ The device is more economic, light in weight and consumes less power.
- ◉ Here, the electrical signals are used to turn pixels on and off in order to produce the patterns of the image.
- ◉ LCD is widely used in laptops, digital clocks ,watches, micro oven ,CD players.

Light Emitting Diode (LED)

LED

- ◉ LED stands for light emitting diode .
- ◉ It is a type of display device in which the matrix of diode is arranged to form a pixel position in the display.
- ◉ To display the image on screen, stored information is read from the frame buffer and converted to voltage levels that are applied to the diode to produce the light patterns in the display.
- ◉ It is used in electronic test equipments such as TV, radio, calculator, watches.
- ◉ It is used in many electrical and electronics devices for testing equipments, calculators watches and so on.
- ◉ It consumes less power and has better image quality as compared to the LCD.

PLASMA

- ⦿ A plasma display is a type of flat panel display that uses plasma, an electrically charged ionized gas, to illuminate each pixel in order to produce a display output.
- ⦿ In this type of display, each pixel on the screen is illuminated by a tiny bit of plasma or charged gas, like a tiny neon light.
- ⦿ It is commonly used in large TV displays of 30 inches and higher.
- ⦿ Plasma displays are often brighter than LCD displays and also have a wider color gamut.
- ⦿ Plasma displays are sometimes marketed as "thin-panel" displays and can be used to display either analog video signals or display modes digital computer input.

PRINTERS

- ◉ Printer is an external hardware device that prints computer data on paper and in many cases on transparencies and other media.
- ◉ It generates hard copy of the computer data. Printers are one of the most used peripherals on computers and are commonly used to print text, images etc.
- ◉ Printers have two major qualities: resolution and print speed.
- ◉ Print resolution is measured as the number of dots per inch (dpi).
- ◉ Print speed is typically measured in pages per minute (ppm).
- ◉ Printers are used for producing output on paper which is a hard copy output.



⦿ There are printing devices which can be classified according to the print quality and printing speed.

- Impact printers

- Non impact printers

Impact Printers

- ⦿ It is the type of printer that prints the texts by hammering on the inked ribbon which results in printing data on the paper placed behind the ribbon.
- ⦿ They are slow in nature and makes lot of noises.
- ⦿ They can be used to generate multiple copies of same document at a time using carbon paper.

- ⦿ Impact printer- It refers to a class of printers that work by banging a head or needle against an ink ribbon to make a mark on the paper. This includes dot-matrix printers, daisy-wheel printers, and line printers.

Characteristics of Impact Printers are the following –

- 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(DMP)

- ⦿ Dot Matrix printer uses impact technology and has a print head containing wires moving at high speed against in Ribbon and paper.
- ⦿ Characters are produced in matrix format.
- ⦿ The speed of Dot Matrix printer ranges from 40 characters per second to 1000 characters per second.
- ⦿ It has the ability to produce multiple copies of a document in a single print.

Advantages

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

Disadvantages

- Slow Speed
- Poor Quality

NON IMPACT PRINTERS

- ⦿ They are the type of printers that uses chemical, heat or electrical signal to etch or induced symbols on a paper.
- ⦿ Many of these printers required special treated paper.
- ⦿ These printers print a complete page at a time, thus they are also called as Page Printers.

- ⦿ Non-impact printer - A printer that prints without banging a ribbon onto paper. Laser, LED, inkjet, solid thermal wax transfer and dye sublimation printers are examples of non-impact 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
- Supports many fonts and different character size

Impact printer / Dot-matrix Printer	Non impact Printer / Laser Printer
1. It prints characters or images by striking print hammer or wheel against an inked ribbon.	1. It prints characters and images without striking the papers.
2. Its speed is slower.	2. Its speed is faster.
3. Its printing quality is lower.	3. Its printing quality is higher.
4. It normally uses continuous paper sheet.	4. Its normally uses individual paper sheet.
5. It generates noise during printing.	5. It does not generate noise during printing.
6. It uses inked ribbon for printing.	6. It uses toner or cartridge for painting.
7. It is less expensive.	7. It is more expensive.
8. Dot matrix is an impact printer.	8. Laser printer is a non-impact printer.