

Course Title: 103 Introductions to Computers

UNIT-1: Introduction

1.1 Introduction of Computer

1.2 Applications of Computer

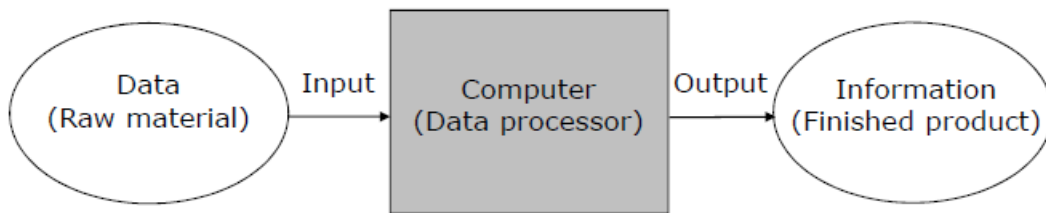
1.3 Types of Computers – Super Computers, Mainframes, Mini Computers, Micro computers (Desktop, Laptop, Notebook, Tablet, Smart Phones)

1.4 Block Diagram and functional units of computer

1.1 Introduction of Computer

❖ What is Computer?

- ✓ A word 'computer' comes from word 'compute' which means 'to calculate'.
- ✓ Computer is an electronic device, which can accept and store input data, process them and produce output according to the instructions given by the programmer or user.
- ✓ Activity of processing data using computer is known as data processing



characteristics of computer

Sr. No.	Characteristics	Description
1	Automatic	It carries out a job normally without any human intervention
2	Speed	It can perform several billion (10^9) simple arithmetic operations per second
3	Accuracy	It performs every calculation with the same accuracy
4	Diligence	It is free from monotony, tiredness, and lack of concentration
5	Versatility	It can perform a wide variety of tasks
6	Memory	It can store huge amount of information and can recall any piece of this information whenever required
7	No I. Q.	It cannot take its own decisions, and has to be instructed what to do and in what sequence
8	No Feelings	It cannot make judgments based on feelings and instincts

- **SPEED** : Computer is very fast calculating device. It can execute basic operations like subtraction, addition, multiplication and division at a few microseconds. It can move and copy data at a speed in the order of billion instruction per second.
- **ACCURACY** : Computer always gives accurate results. The accuracy of Computer does not go down when they are used continuously for hours together. It always gives accurate results.

- **STORAGE CAPACITY** : Computers have a very large storage capacity. A large volume of information can be stored in the memory of computer and information can be retrieved correctly when desired.
- **VERSATILITY** : The working of computer with different types of data is known as versatility. That means computer can perform different types of job efficiently. Computer can work with different type of data and information such as visuals, text, graphics & video etc. So, versatility is a most important characteristic of computer.
- **DILLIGENCE** : A Computer can work for long hours with the same accuracy and speed because it is free from problems of boredom or lack of concentration.
- **POWER OF REMEMBERING**: It can remember data for us.
- **NO IO** : Computer does not work without instruction.
- **NO THOUGHTS** : Computers have no thoughts because they are machine and they have no feelings. Since, computers have no thoughts and feelings so they can't make judgement based on thoughts and feelings.

Give limitations of computer.

Common Sense –

- It doesn't have common sense like human being has.
- It carries out instructions as given in program even if the instructions lack quality of common sense.

Intelligence –

- It doesn't have intelligence of its own.
- It operates on the instructions, which may lack this quality.

Decision Making –

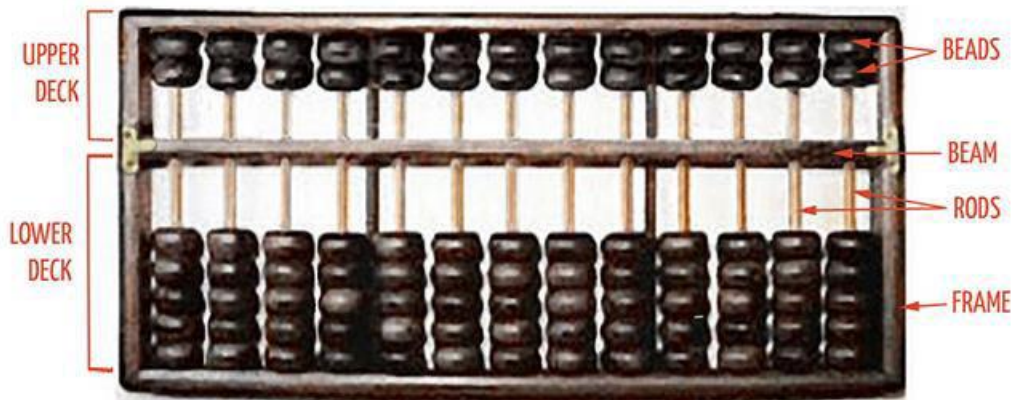
- It lacks the quality of decision making.
- It does only those tasks which are already instructed to it.

Write a note on History of Computers.

The word “**Computer**” is announced in **1613** and used to describe human who perform calculations and computations.

This definition remains same until the end of **19th century**, when the industrial revolution gave rise to machines whose primary purpose was calculating.

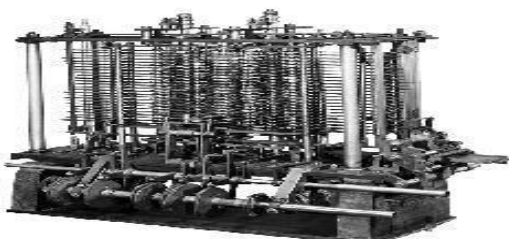
- **ABACUS** is the first counting machine invented by Cranmer **abacus**, which is also known as **SOROBAN**. In this, numbers are represented by position of beads on wire. Its upper part contains 2 beads and lower part contains 5 beads per wire.



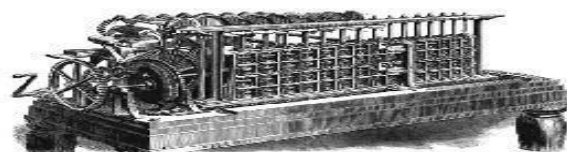
- Another manual calculating device was Jhon Napier's Bone (1614) or Cardboard Multiplication calculator (CMC).



- In 1822, **Charles Babbage**, professor at Cambridge University, began developing the first automatic computing machine, known as **difference engine**



Analytical Engine



Differential Engine

He is known as **father of the modern digital computers**.

In 1837, **Charles Babbage** proposed the **first general mechanical computer**, the **Analytical Engine**. It contained ALU, basic flow control and integrated memory.

- The **Turing machine** was first proposed by **Alan Turing** in **1936** which became foundation for theory about computing and computers.

Explain Generations of Computer in detail.

- The development of computers can be divided into five generations depending on the technologies used.

Generation (Period)	Key hardware technologies	Key software technologies	Key characteristics	Some representative systems
First (1942-1955)	▪ Vacuum tubes ▪ Electromagnetic relay memory ▪ Punched cards secondary storage	▪ Machine and assembly languages ▪ Stored program concept ▪ Mostly scientific applications	▪ Bulky in size ▪ Highly unreliable ▪ Limited commercial use and costly ▪ Difficult commercial production ▪ Difficult to use	▪ ENIAC ▪ EDVAC ▪ EDSAC ▪ UNIVAC I ▪ IBM 701
Second (1955-1964)	▪ Transistors ▪ Magnetic cores memory ▪ Magnetic tapes ▪ Disks for secondary storage	▪ Batch operating system ▪ High-level programming languages ▪ Scientific and commercial applications	▪ Faster, smaller, more reliable and easier to program than previous generation systems ▪ Commercial production was still difficult and costly	▪ Honeywell 400 ▪ IBM 7030 ▪ CDC 1604 ▪ UNIVAC LARC

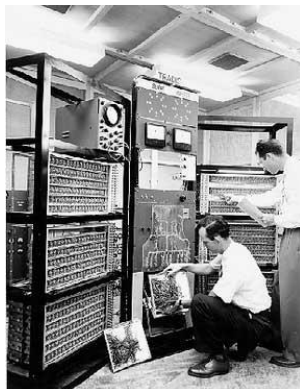
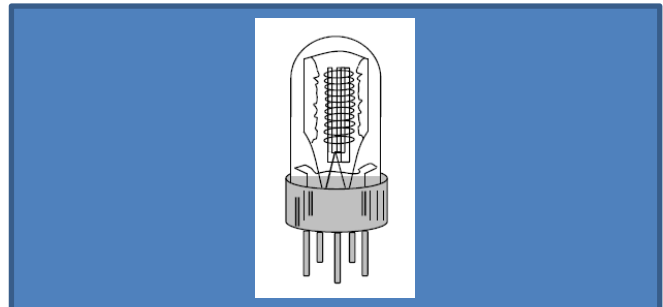
Generation (Period)	Key hardware technologies	Key software technologies	Key characteristics	Some rep. systems
Third (1964-1975)	▪ ICs with SSI and MSI technologies ▪ Larger magnetic cores memory ▪ Larger capacity disks and magnetic tapes secondary storage ▪ Minicomputers; upward compatible family of computers	▪ Timesharing operating system ▪ Standardization of high-level programming languages ▪ Unbundling of software from hardware	▪ Faster, smaller, more reliable, easier and cheaper to produce ▪ Commercially, easier to use, and easier to upgrade than previous generation systems ▪ Scientific, commercial and interactive on-line applications	▪ IBM 360/370 ▪ PDP-8 ▪ PDP-11 ▪ CDC 6600

Generation (Period)	Key hardware technologies	Key software technologies	Key characteristics	Some rep. systems
Fourth (1975-1989)	▪ ICs with VLSI technology ▪ Microprocessors; semiconductor memory ▪ Larger capacity hard disks as in-built secondary storage ▪ Magnetic tapes and floppy disks as portable storage media ▪ Personal computers ▪ Supercomputers based on parallel vector processing and symmetric multiprocessing technologies ▪ Spread of high-speed computer networks	▪ Operating systems for PCs with GUI and multiple windows on a single terminal screen ▪ Multiprocessing OS with concurrent programming languages ▪ UNIX operating system ▪ C and C++ programming language ▪ PC, Network-based, and supercomputing applications ▪ Object-oriented design and programming	▪ Small, affordable, reliable, and easy to use PCs ▪ More powerful and reliable mainframe systems and supercomputers ▪ Totally general purpose machines ▪ Easier to produce commercially ▪ Easier to upgrade ▪ Rapid software development possible	▪ IBM PC and its clones ▪ Apple II ▪ TRS-80 ▪ VAX 9000 ▪ CRAY-1 ▪ CRAY-2 ▪ CRAY-X/MP

Generation (Period)	Key hardware technologies	Key software technologies	Key characteristics	Some rep. systems
Fifth (1989-Present)	▪ ICs with ULSI technology ▪ Larger capacity main memory, hard disks with RAID support ▪ Optical disks as portable read-only storage media ▪ Notebooks, powerful desktop PCs and workstations ▪ Powerful servers, supercomputers ▪ Internet ▪ Cluster computing	▪ World Wide Web ▪ Multimedia, Internet applications ▪ Micro-kernel, multithreading, multicore OS ▪ JAVA ▪ MPI and PVM libraries for parallel programming	▪ Portable computers ▪ Powerful, cheaper, reliable, and easier to use desktop machines ▪ Very powerful mainframes ▪ High uptime due to hot-pluggable components ▪ General purpose machines ▪ Easier to produce commercially	▪ IBM notebooks ▪ Pentium PCs ▪ SUN Workstations ▪ IBM SP/2 ▪ SGI Origin 2000 ▪ PARAM Supercomputers

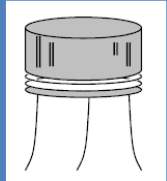
1. First Generation Computer (1942 – 1955) :—

- Use **Vacuum tube** technology
- Generated lot of heat
- Need of A.C.
- Consumed lots of electricity
- Very costly
- Huge in size
- Non portable
- Unreliable
- Punched cards, paper tape and magnetic tape used for input and output slow input and output devices Supported machine language only. Batch processing was use.
- Examples : ENIAC, EDVAC, EDSAC, UNIVAC, IBM 701, IBM 650



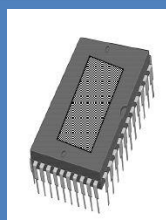
2. Second Generation Computer (1956 – 1964):–

- Use of **transistors**
 - Smaller size as compared to 1st generation computers
 - Faster than 1st generation computers
 - Generated less heat as compared to 1st generation computers
 - A.C. needed
 - Consumed less electricity as compared to 1st generation computers
 - Still very costly
 - Magnetic core as primary memory
- Magnetic tape and magnetic disks as secondary storage device
- Batch operating system
 - Reliable in comparison to 1st generation computers
 - Supported assembly languages and high level programming languages like FORTRAN, COBOL. Examples : IBM 1620, IBM 7094, CDC 1604, CDC 3600, UNIVAC 1108, LARC



3. Third Generation Computer (1965 – 1974):–

- **ICs (Integrated Circuits) with SSI**(Small Scale Integration means microchip containing tens of transistors) and **MSI** (Medium Scale Integration means microchip containing hundreds of transistors) used
- Smaller size
- Faster
- Less maintenance
- Generated less heat
- A.C. needed
- Consumed less electricity



- Still costly
- More reliable in comparison to previous two generations
- Larger capacity disk and magnetic tapes as secondary storage
- Time sharing OS
- Supported
- Supported high level language
- Examples : IBM 360 series, Honeywell 6000 series, PDP, IBM 370/168, TDC 316



4. Fourth Generation Computer (1975 – 1989): –

- **ICs with VLSI** (Very Large Scale Integration means microchip containing hundreds of thousands of transistors) technology used
- Very cheap
- Very small size
- Portable and reliable
- No A.C. needed
- Magnetic tapes and floppy disks as portable storage media
- Use of PC's OS and UNIX OS
- Pipeline processing
- Concept of internet was introduced
- Great development in the fields of networks
- Computers became easily available
- Examples : DEC 10, STAR 1000, PDP 11, CRAY 1 (super computer), CRAY-X-MP (Super Computer)



5. Fifth Generation Computer (1989 – Present) :-

- ICs with ULSI (Ultra LSI means microchip containing millions of transistors) technology used
- Larger capacity main memory and hard disk
- Optical disk as portable storage media
- 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
- Examples : Desktop, Laptop, NoteBook, UltraBook, ChromeBook



1.2 Application of Computer

Computers have become important tools in our day-to-day's operations. Some of the areas computers are used are in:

Home

Computers are used at homes for several purposes like online bill payment, watching movies or shows at home, home tutoring, social media access, playing games, internet access, etc. They provide communication through electronic mail. They help to avail work from home facility for corporate employees. Computers help the student community to avail online educational support.

• **Communication –**

Using your computer system for the purpose of communication gives you a lot of benefits. For example, if you will use email to send message or anything to your friends or any of your contacts, then you don't have to use pen and paper to write and take that paper to post office and then postman will deliver that later after some or few days that will not good if you want to send any urgent information to the same person.

Therefore, using email, you can also saves your time and cost to deliver any information very fast. You only need a computer and internet connectivity.

• **Entertainment-**

Most of the persons are using computer for entertainment purposes such as:

- Watching movies
- Watching videos
- Listening songs
- Photos
- Animations, games etc.

Computer can be used to create these things in an attractive manner so that user loves to enjoy the things.

• **Medical Field**

Computers are used in hospitals to maintain a database of patients' history, diagnosis, X-rays, live monitoring of patients, etc. Surgeons nowadays use robotic surgical devices to perform delicate operations, and conduct surgeries remotely. Virtual reality technologies are also used for training purposes. It also helps to monitor the fetus inside the mother's womb.

• **Industry**

Computers are used to perform several tasks in industries like managing inventory, designing purpose, creating virtual sample products, interior designing, video conferencing, etc. Online marketing has seen a great revolution in its ability to sell various products to inaccessible corners like interior or rural areas. Stock markets have seen phenomenal participation from different levels of people through the use of computers.

• **Education**

Computers are used in education sector through online classes, online examinations, referring e-books, online tutoring, etc. They help in increased use of audio-visual aids in the education field.

- **Government**

In government sectors, computers are used in data processing, maintaining a database of citizens and supporting a paperless environment. The country's defense organizations have greatly benefitted from computers in their use for missile development, satellites, rocket launches, etc.

- **Banking**

In the banking sector, computers are used to store details of customers and conduct transactions, such as withdrawal and deposit of money through ATMs. Banks have reduced manual errors and expenses to a great extent through extensive use of computers.

- **Business**

Nowadays, computers are totally integrated into business. The main objective of business is transaction processing, which involves transactions with suppliers, employees or customers. Computers can make these transactions easy and accurate. People can analyze investments, sales, expenses, markets and other aspects of business using computers.

- **Training**

Many organizations use computer-based training to train their employees, to save money and improve performance. Video conferencing through computers allows saving of time and travelling costs by being able to connect people in various locations.

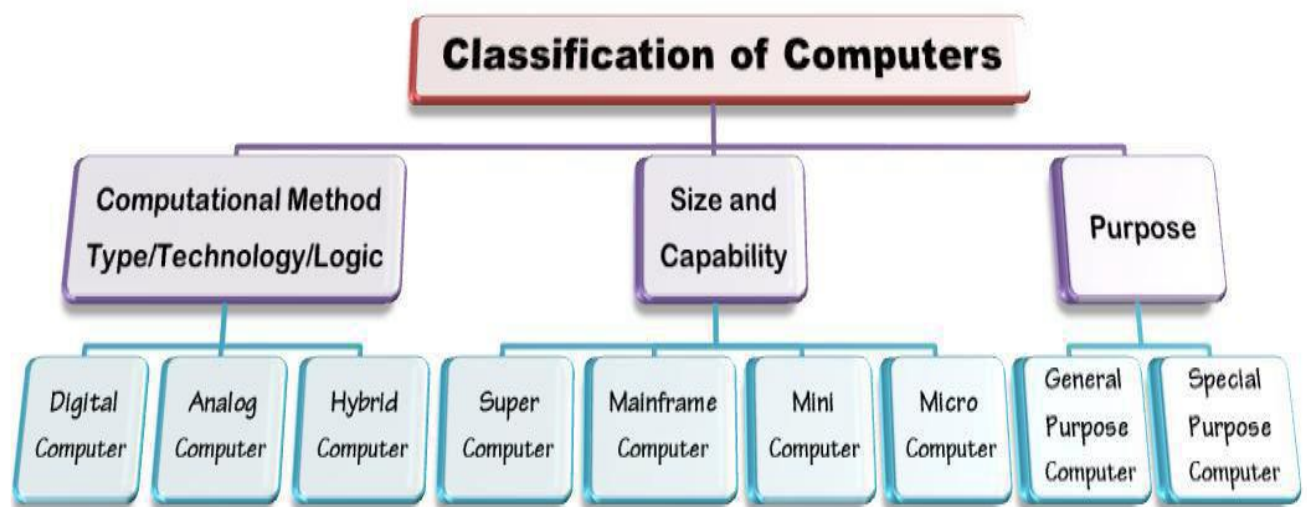
- **Arts**

Computers are extensively used in dance, photography, arts and culture. The fluid movement of dance can be shown live via animation. Photos can be digitized using computers.

- **Science and Engineering**

Computers with high performance are used to stimulate dynamic process in Science and Engineering. Supercomputers have numerous applications in area of Research and Development (R&D). Topographic images can be created through computers. Scientists use computers to plot and analyze data to have a better understanding of earthquakes.

1.3 Types of Computers – Super Computers, Mainframes, Mini Computers, Micro computers (Desktop, Laptop, Notebook, Tablet, Smart Phones)



According to computational method type/ functionality or Technology:

1. Analog Computers –

- Analog computer is a computer that operates on data in the form of continuously variable physical quantities such as electrical current.
- They are specially designed for storing physical quantities such as current, voltage or frequency.
- Used for measuring pressure, temperature, speed, etc.
- E.g. Thermometer, Speedometer

2. Digital Computers –

- Digital Computer is a computer that works with discrete quantities. It uses numbers to simulate real time processes.
- They are general purpose computers.
- In this type of computer, the data inputted by the user is in the form of character or number which is converted into binary form to store.
- E.g. Desktop, Laptop, etc.

3. Hybrid Computers (Analog + Digital) –

- The computers which combines the technology of Analog and Digital computers, is known as Hybrid Computers.
- Used in Oil Refineries, Robotics, Nuclear Power Plants, Mines, ICU of Hospitals, etc.

According to size & capability:

Since the advent of the first computer different types and sizes of computers are offering different services. Computers can be as big as occupying a large building and as small as a laptop or a microcontroller in mobile & embedded systems.

The four basic types of computers are.

1. Super computer
2. Mainframe Computer
3. Minicomputer
4. Microcomputer

1. Supercomputer

- ✓ The most powerful computers in terms of performance and data processing are the supercomputers.
- ✓ These are specialized and task specific computers used by large organizations.
- ✓ These computers are used for research and exploration purposes, like NASA uses supercomputers for launching space shuttles, controlling them and for space exploration purpose.
- ✓ The supercomputers are very expensive and very large in size.
- ✓ It can be accommodated in large air-conditioned rooms; some super computers can span an entire building.

Uses of Supercomputer

- ✓ Space Exploration
- ✓ Earthquake studies
- ✓ Weather Forecasting
- ✓ Nuclear weapons testing



2. Mainframe computer

- ✓ Although Mainframes are not as powerful as supercomputers, but certainly they are quite expensive nonetheless, and many large firms & government organizations use Mainframes to run their business operations.
- ✓ The Mainframe computers can be accommodated in large air-conditioned rooms because of its size.
- ✓ Super-computers are the fastest computers with large data storage capacity, Mainframes can also process & store large amount of data.
- ✓ Banks educational institutions & insurance companies use mainframe computers to store data about their customers, students & insurance policy holders.

3. Minicomputer

- ✓ Minicomputers are used by small businesses & firms.
- ✓ Minicomputers are also called as “Midrange Computers”.
- ✓ These are small machines and can be accommodated on a disk with not as processing and data storage capabilities as super-computers & Mainframes.
- ✓ These computers are not designed for a single user.
- ✓ Individual departments of a large company or organizations use Mini-computers for specific purposes.
- ✓ For example, a production department can use Mini-computers for monitoring certain production process.

4. Microcomputer

- ✓ Desktop computers, laptops, personal digital assistant (PDA), tablets & Smartphone's are all **types of microcomputers**.
- ✓ The micro-computers are widely used & the fastest growing computers.
- ✓ These computers are the cheapest among the other three types of computers.
- ✓ The Micro-computers are specially designed for general usage like entertainment, education and work purposes.
- ✓ Well known manufacturers of Micro-computer are Dell, Apple, Samsung, Sony & Toshiba.
- ✓ Desktop computers, Gaming consoles, Sound & Navigation system of a car, Netbooks, Notebooks, PDA's, Tablet PC's, Smartphones, Calculators are all type of Microcomputers.

4.1 Desktop -

- ✓ They are small enough to fit on a desk (rather than a server room) so they are called as desktop computers.
- ✓ Most of the equipment used by a desktop is tightly integrated within a single case, although some equipment may be connected at short distances outside the case, such as monitors, keyboards, mice, etc.

- ✓ In general, a desktop will not get much bigger than can be put onto most tables or desks.
- ✓ Its capacity (Processing Power, Memory) is limited for personal use only. So, that they are called personal computer (PC).
- ✓ They are cheap enough to be owned by an Individual (instead of shared within a corporation, or school).
- ✓ The configuration of PCs varies from one PC to another, depending on their usage.
- ✓ PCs generally costs from a few tens of thousands to about lakh of rupees, depending
- ✓ Several individual keep PC in there home to run business from home. PCs are used both by, children and adults, for education and entertainment. Hence PCs are very common everywhere, and can be found in offices, classrooms, homes, hospitals, shops, clinics etc.
- ✓ They are impractical for mobile computing.
- ✓ Popular operating systems for PCs are Ms-DOS, MS-Windows, Windows NT, UNIX, and LINUX.
- ✓ Ex Pentium III, Pentium IV etc.

4.2 Laptop / Notebook -

- ✓ A small, portable computer mainly for use by people who need computing power where ever they go is called laptop.
- ✓ These are light weight computers and can be carried in a briefcase.
- ✓ They are approximately of size of 8.5 x 11 inch notebook.
- ✓ A notebook computer uses a keyboard, Flat screen LCD and touchpad.
- ✓ They have a hard disk, a floppy disk drive, CD-ROM drive
- ✓ Notebook computers can be used while traveling in train or plain etc because they operate with chargeable battery. With a fully charged battery, a notebook computer can be used for a few hours.
- ✓ They are mostly used for word processing, spreadsheet computing, data entry, and preparing presentation materials, while a person Is traveling. They are also used for making presentation, by plugging them into LCD (Liquid Crystal Display) projection system.
- ✓ Processing capabilities of notebook computer is normally as good as an ordinary PC because they both use the same type of processor.
- ✓ Notebook computer generally has lesser hard disk storage then a PC, to keep its total
- ✓ weight around 2 kg.
- ✓ Notebook computers are typically more expensive than normal PC.



4.3 Tablet –

- ✓ A tablet is a wireless, portable personal computer with a touchscreen interface for both input and output.
- ✓ The tablet has Intermediate size between laptop and smart phone. It is smaller than a notebook computer, but larger than a smartphone. They are lighter than laptops.
- ✓ A key component among tablet computers is touch input on a touchscreen display. This allows the user to navigate easily and type with a virtual keyboard on the screen or press other icons on the screen to open apps or files.
- ✓ It has longer battery life than laptop.
- ✓ Since the tablet is flat, it can be laid on the table like a piece of paper or held in the lap and will be barely visible.
- ✓ Tablet uses Android, 105, Chrome OS, or iPadOS as operating system.
- ✓ The screen size of tablet is too small in comparison with a laptop.
- ✓ The cost of tablet is higher compared to laptops for the same processing power.
- ✓ It does not come with optical drives for use with CDs or DVDs.

4.4 Smartphone –

- ✓ Smartphone is a mobile device having capability of a telephone with
- ✓ some computational facility like web browsing, ability to run software
- ✓ applications,
- ✓ Smartphones are limited in the number or ways they can accept user
- ✓ input and provide output.
- ✓ Smart phones are pocket sized computer having facilities, such as calendar, calculator, notepad, etc.
- ✓ Alt smartphones come with some kind of personal information management (P1M) software that typically handles the following tasks to keep you organized:
- ✓ Store contact information (names, addresses, phone numbers, e-nail addresses)

Make to-do lists :

- ✓ Take notes
- ✓ Track appointments (date book, calendar)
- ✓ Remind you of appointments (clock, alarm functions)
- ✓ Perform calculations
- ✓ Can connect to the Internet
- ✓ global positioning system (GPS) devices
- ✓ Run multimedia software

4.4 PDA (Personal Digital Assistant) –

A PDA is small, highly integrated computer usually using flash memory for storage instead of hard drive.

- It uses touch screen technology for both output and input.
- It is light weight, portable, has good battery life and fits within the palm.
- It can access the Internet by Bluetooth or WI FI communication.
- It is normally used to keep track of appointment calendars, to-do lists, address books and talking notes.

4.5 Palmtops / Handheld PC

- A computer which is small enough to fit in pocket and operated by keeping it on palm, is called palmtop computer.
- It sacrifices power for small size and portability.
- It is just look like tiny laptop, with a flip-up screen and small keyboard.

4.6 Wearable computers –

- It is worn on the body like a watch and is used by military professionals or doctors to track human actions if their hands are engaged in other activities.
- It does not have to be turned on and off but remain in operation without user intervention.
- For examples, fabric PCs, smart watches

According to purpose:

1. General Purpose Computers –

- Computers used for general requirements like sales analysis, financial accounting, invoicing, inventory management, etc. are called General Purpose Computers.
- Used in commercial and educational applications.

2. Special Purpose Computers –

- Computers which are designed for special purpose like weather forecasting, space applications, medical diagnostics, etc. are called Special Purpose Computers.
- E.g. Chip in Washing Machine

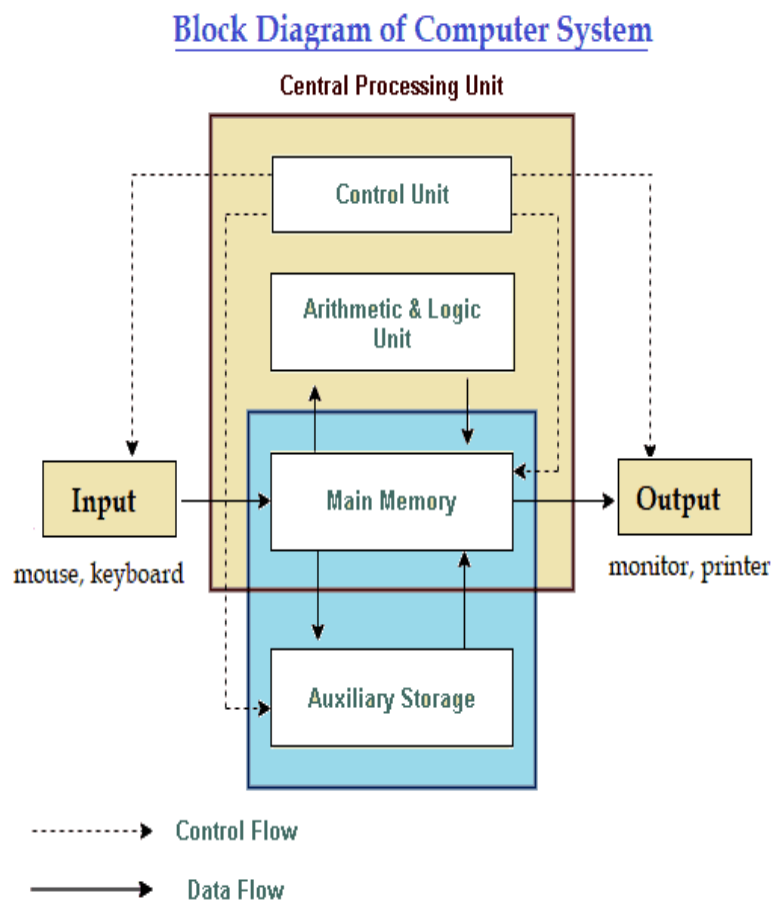
Difference between Desktop and Laptop

Desktop	Laptop
impractical for mobile computing	Designed for mobile computing
Lower cost	Higher cost
Easily expanded	Difficult to expand
Comfortable ergonomics	Uncomfortable ergonomics (small key board, often with inconvenient placement of function keys)
Easy-to-use mouse or other Pointing device	Awkward pointing devices (some allow traditional mouse to be connected)
High RAM and hard-drive capacity	Somewhat less RAM and hard drive capacity

1.4 Block Diagram and functional units of computer

Functional block diagram consists of four basic units:

1. Input Unit
2. Output Unit
3. Storage Unit
 - Primary storage
 - Secondary storage
4. Central Processing Unit (CPU)
 - Control unit
 - Arithmetic Logic unit



Input Unit:

- ✓ Computers need to receive data and instruction to solve any problem. Therefore we need to input the data and instructions into the computers.
- ✓ The input unit consists of input devices like keyboard, mouse, etc.

All input devices perform the following functions:

1. Accept the data and instructions from the outside world.
2. Convert it to a form that the computer can understand.
3. Supply the converted data to the computer system for processing.

Output Unit:

- ✓ The output unit of a computer provides the information and results of a computation to outside world.
- ✓ The output unit consists of output devices like printer, Visual display unit (VDU), Speaker, etc.

All output devices perform the following functions:

1. Accept the results produced by the computer, which are in the coded form.
2. Convert the coded results to human readable form.
3. Supply the converted results to outside world.

Storage Unit:

- ✓ The process of saving data and instructions permanently is known as storage.
- ✓ Data has to be stored into the system before the actual processing starts.

Storage unit divided into two types :**1. Primary Storage:**

- ✓ It consists of RAM, ROM and Cache memory. CPU can access the content of RAM directly.
- ✓ It is volatile storage that loses content if power off.

2. Secondary Storage:

- ✓ It consists of Hard disk, CD, DVD, etc. CPU cannot directly access the content on Secondary storage.
- ✓ It is non volatile storage that is it retains content if power off.

The storage unit performs the following functions :

1. Storing all data and instructions before and after processing.
2. Storing intermediate results of the processing.

Central Processing Unit:

- ✓ The CPU is the brain of the computer.
- ✓ The CPU performs the following functions :
 1. Performs all calculations.
 2. Takes all decisions.
 3. Controls all units of the computer.

It consists of following parts :**1. Control Unit (CU)**

- ✓ It is responsible for directing and coordinating most of the computer system activities.
- ✓ It does not execute instructions by itself. It tells other parts of the computer system what to do.
- ✓ It obtains instructions from the program stored in main memory, interpret the instructions and issues signals that cause other units of the system to execute them.

2. Arithmetic Logical Unit (ALU)

- ✓ ALU is the place where the actual execution of the instructions takes place.
- ✓ All calculations and comparisons are performed in ALU.
- ✓ ALU is designed to perform the four basic operations add, subtract, multiply, divide and logic operations or comparison such as less than or greater than.
- ✓ The ALU controls the speed of calculations.

3. Registers

- ✓ Registers are small temporary storage location within the CPU.
- ✓ Registers quickly accept, store and transfer data and instructions that are being used immediately to execute an instruction.
- ✓ The control unit of the CPU retrieves data from main memory and places it onto a register.

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UNIT-2: Basic Computer Architecture

2.1 Concepts of Address Bus and Data Bus

2.2 Concept of virtual memory and cache memory

2.3. Hardware Components

2.3.1. Motherboard

2.3.2. Types of Processor (CPU and GPU)

2.3.3. Understanding processor speed

2.3.4. Memory – RAM(SRAM, DRAM, SDRAM), ROM, EPROM, EEPROM

2.3.5. Storage Devices – Hard Disk, CD, DVD, USB flash memory

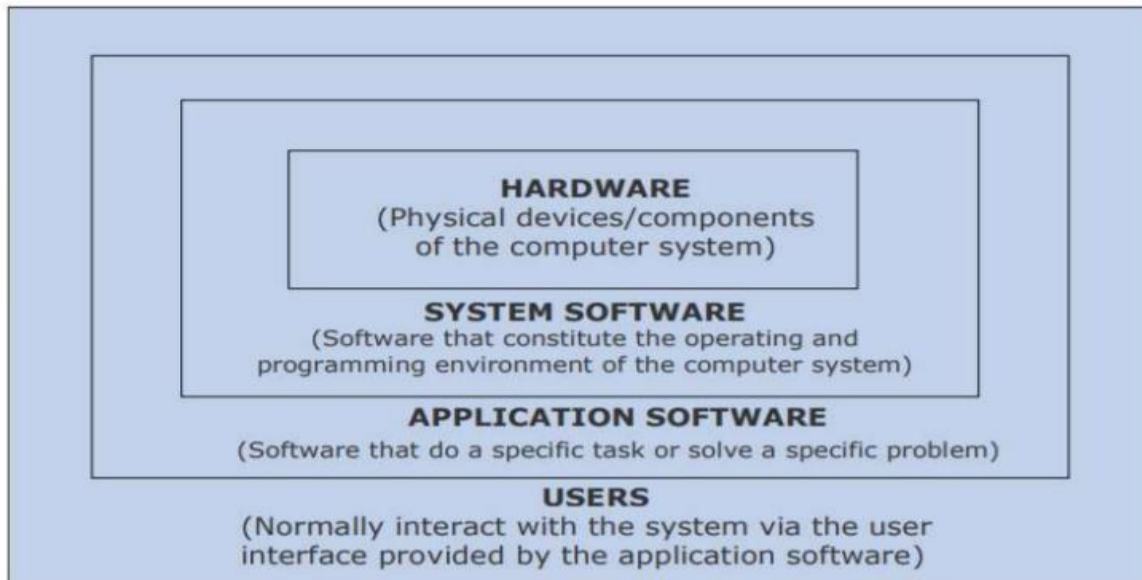
2.4. Introduction to Software

2.4.1. Purpose and significance of Operating System

2.4.2. Concept of System Software and Application Software

➤ Computer System Architecture

Computer system architecture is representation of relationship among the Hardware, Software (System & Application) and user. It can be depicted as follows:



Hardware: It is a physical device of computer system which can be touched, seen, moved, dragged. The hardware can be upgraded further as per the requirement of the user. Input output devices certain parts of CPU are hardware (monitor, keyboard, printer, ram, motherboard, speaker, network cards etc). Hardware is onetime expense thing which does not require to spend money until the hardware device stop working.

Software: It is collection of programs where program is a sequence of instructions written in the language which computer can understand. Like hardware it is also important for computer system to work with hardware. Both hardware and software are complementary to each other. Rather comparing to hardware, software is continuing expense thing. It may be differing in terms of price as per the requirement of user as well as working of itself.

It can be categorized in System Software and Application Software.

- **System Software** It is designed for handling the operation and extending the processing capability of the computer system. It makes computer system operation more effective and efficient. System software helps for operating the hardware components together as well as supporting the development and execution of the application programs. Some example of system software: Operating Systems, utility programs, compilers/interpreters etc.
- **Application Software** It is a set of programs which are designed to some specific task or some special job. It can further classify in the two types: general purpose application software

and special purpose application software. General purpose application software can be used for very common need like word processing, spread sheets etc. Special purpose application software is specially designed for solving special problems or for performing specific task with use of some language of computers. E.g. Billing System, Hotel Management System.

User: We as a user can operate on the computer system through some software by the means of application software through system software on the computer hardware. So as per the architecture shown above it works in hierarchy. User cannot use computer hardware directly without the system software and application software.

2.1 Concepts of Address Bus and Data Bus

Buses: It is a set of lines used to move information from one part of computer to another. Different colored lines plotted on the motherboard.

Buses are divided to three functional groups:

Data Bus: Data transfers between peripherals, memory and CPU. It is very busy bus. The data bus Is a two-way pathway carrying the actual data (information) to and from the main memory.

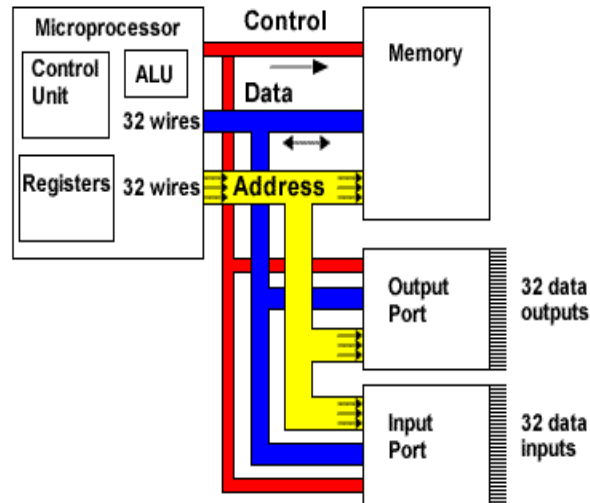
Address Bus: The components pass memory addresses to one another over the address bus. This determines the location in memory that the processor will read data from or write data to.

The address bus, a one-way pathway that allows information to pass in one direction only, carries information about where data is stored in memory, The data bus Is a two-way pathway carrying the actual data (information) to and from the main memory.

Control Bus: Used to send out signals to coordinate and manage the activities of the motherboard components The control bus holds the control and timing signals needed to coordinate all of the computer's activities.

✓ How Does Computer Bus Work?

- ➔ A bus transfers electrical signals from one place to another. An actual bus appears as an endless amount of etched copper circuits on the motherboard's surface.
- ➔ The bus is connected to the CPU through the Bus Interface Unit.
- ➔ Data travels between the CPU and memory along the data bus.
- ➔ The location(address) of that data is carried along the address bus. A clock signal which keeps everything in synch travels along the control bus.



2.2 Concept of virtual memory and cache memory

Virtual memory:

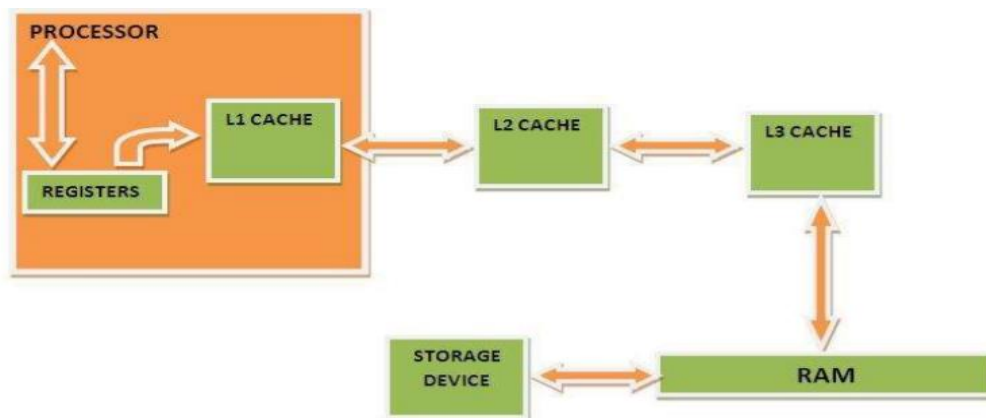
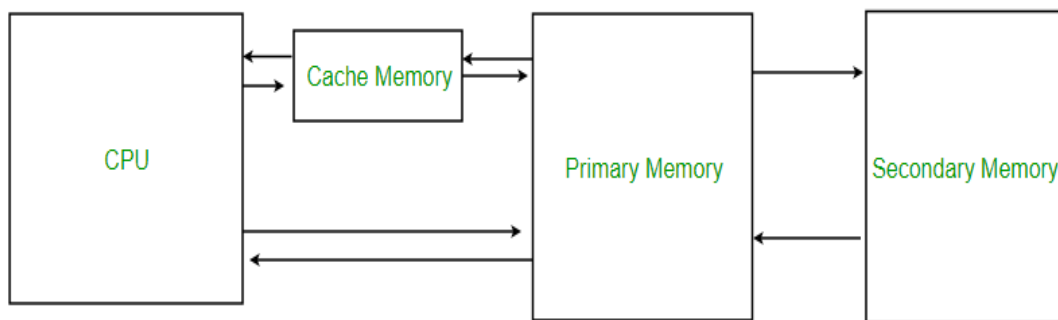
- Virtual Memory increases the capacity of main memory. Virtual memory is not storage unit, it's a technique. In virtual memory, even such programs which have a larger size than the main memory is allowed to be executed.
- Explain the concept of virtual memory and how it works.
- Pseudo RAM called virtual memory exists on your hard drive rather than as memory modules on your motherboard.
- Suppose that you PC has only 2 GB of RAM installed, but you ran photo shop and demanded that it load two 500MB high resolution digital images.
- If windows were limited to using only your computer's physical RAM, you would be trouble because windows 8 requires a minimum of around 500 MB of memory itself and photo shop also takes chunk of memory to run.
- You are also loading 1 GB of data. So, your 2 GB PC could not work because amount of RAM needed by memory hungry mega applications is so much.
- In this case, windows turn to your hard drive for help. It uses portion of the empty space on your hard drive to temporarily hold the data. That portion of hard drive is known as virtual memory.
- So, computer uses 2 GB of hard drive space, hence total memory available within windows is now 4 GB i.e. 2 GB of RAM (physical memory) and 2 GB of hard drive (virtual memory).
- Your programs don't know that they are using virtual memory.
- This virtual memory is always slower than true physical memory (RAM) because the data has to be written to and read from your hard drive. Demand paging
- Demand paging is the process where pages on hard drive are not loaded on RAM until the program calls the page.
- After data is paged, paging processes track memory usage and constantly call data back

and forth between RAM and hard drive.

- Page states (valid or invalid and available or unavailable to the CPU) are registered in the virtual page table.
- While executing a program, if the program references a page which is not available in the RAM because it was swapped out a little ago, the processor treats this invalid memory reference as page fault and transfers control from the program to the OS to demand the page back into the memory.

Cache memory:

- Cache memory is a chip-based computer component that makes retrieving data from the computer's memory more efficient.
- It acts as a temporary storage area that the computer's processor can retrieve data from easily.
- This temporary storage area, known as a cache, is more readily available to the processor than the computer's main memory source, typically some form of DRAM.



Levels of cache memory are:

1. Level 1(L1) cache –

It is also called primary or internal cache.

It is built directly into the processor chip.

It has small capacity from 8 kb to 128 kb.

2. Level 2 (L2) cache –

It is slower than L1 cache.

Its storage capacity is more i.e. from 64kb to 16 mb.

The current processors contain advanced transfer cache on processor chip that is a type of L2 cache.

The common size of this cache is from 512 kb to 8 mb.

3. Level 3 (L3) cache –

This cache is separate from processor chip on the motherboard.

It exists on the computer that uses L2 advanced transfer cache.

It is slower than L1 and L2 cache.

The personal computer often has up to 8 mb of L3 cache.

Difference between Virtual memory and Cache memory:

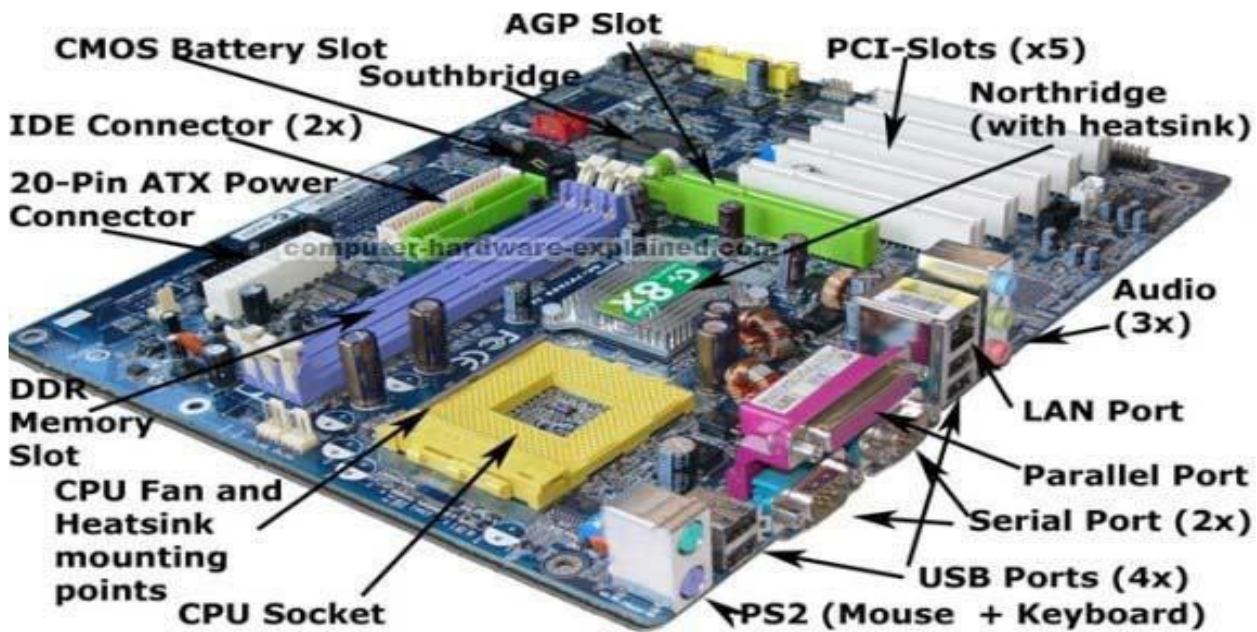
S.NO	VIRTUAL MEMORY	CACHE MEMORY
1.	Virtual memory increases the capacity of main memory.	While cache memory increase the accessing speed of CPU.
2.	Virtual memory is not a memory unit, its a technique.	Cache memory is exactly a memory unit.
3.	The size of virtual memory is greater than the cache memory.	While the size of cache memory is less than the virtual memory.
4.	Operating System manages the Virtual memory.	On the other hand hardware manages the cache memory.
5.	In virtual memory, The program with size larger than the main memory are executed.	While in cache memory, recently used data is copied into.

2.2 Explain mother board in detail.

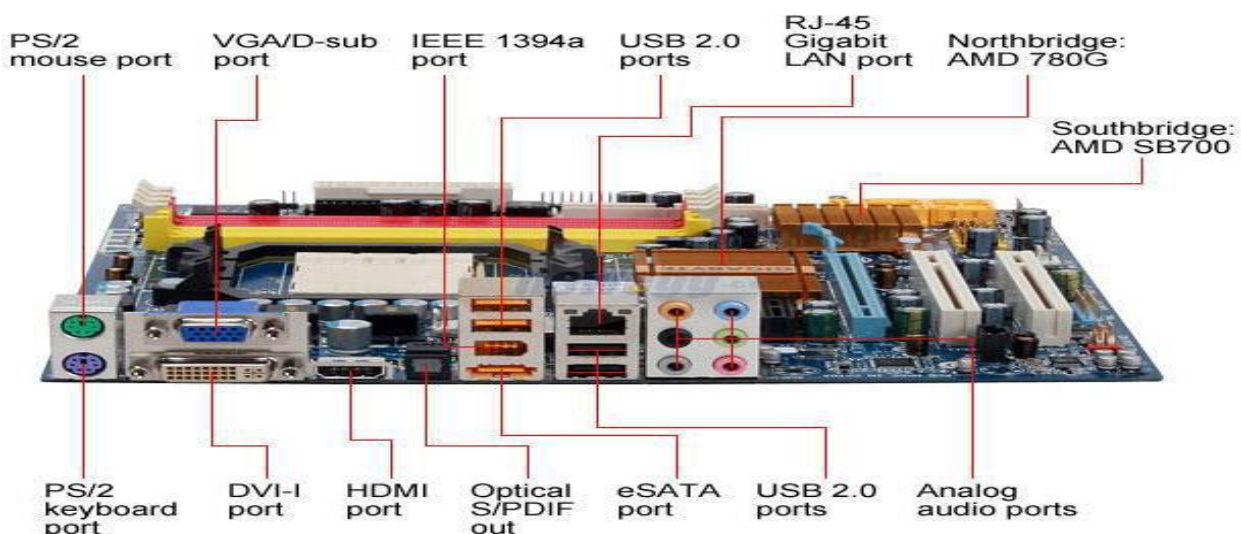
- A motherboard is the main circuit board inside the computer which is also known as mainboard or mobo.
- It holds the processor, memory and expansion slots and connects directly or indirectly to every part of the computer like power supply, CPU, hard drive, RAM, Graphics card, CD drive and other peripheral devices such as sound cards, network cards, etc.

- Motherboard is made up of a chipset (Glue Logic), some code in ROM and various interconnections or buses.
- In computer design, various types of buses are used to link different components of motherboard.
- Motherboard connected with all other boards of the computer. So, it is mother of all other board.

Front view:



Side view:



There are many different components on motherboard:**1. CPU Chip**

CPU or processor chip is main component of mother board.
The CPU chip may be different for one computer model to other.
It processes the data and controls the function of computer.

2. Co-processor Chip

The function of co-processor chip is to help CPU chip.
E.g., Math co-processor chip is used to support CPU chip, for doing mathematical operations.

3. Memory Chips

Memory chips are physically installed on motherboard by different packaging methods.
There are three different methods for packing RAM chips:

- (1) DIP : Dual Inline Package
- (2) SIMM : Single Inline Memory Module Packaging
- (3) SIPP : Single Inline Pin Package

4. Expansion Slots

Expansion Slots are connectors on motherboard where expansion cards like display card, hard disk controller card etc. can be connected.
Most common expansion slots are:

- (1) PCI Express – To communicate with motherboard. So, with microprocessor quickly and efficiently. Newest standard for expansion cards on personal computers.
- (2) PCI – Peripheral Component Interconnect is for internal expansion of computer using sound cards, network cards, USB expansion cards, etc.
- (3) AGP – Accelerated Graphics Port designed for graphics adapters.
- (4) ISA – Industry Standard Architecture, most ancient type of expansion slot, compatible with older expansion cards.

5. Buses

It is a set of lines used to move information from one part of computer to another.
Buses are divided to three functional groups:

- (1) Data Bus: Data transfers between peripherals, memory and CPU. It is very busy bus.

(2) Address Bus: The components pass memory addresses to one another over the address bus.

(3) Control Bus: Used to send out signals to coordinate and manage the activities of the motherboard components.

6. System Clock

It is used to synchronize the activities of various components.

7. BIOS

Basic input/output system (BIOS) is the set of software programs that test hardware at startup, start the operating system and support the transfer of data among hardware devices.

BIOS is stored in read only memory (ROM) so that it can be executed when you turn on the computer.

BIOS setup gives the facility of :

1. Hard drives, diskette drives and peripherals
2. Video display type and display options
3. Password protection from unauthorized use
4. Power management feature

8. CMOS Battery

Complementary Metal Oxide Semiconductor (CMOS) that remembers date and time settings for every time you restart your computer.

It is used to power clock and BIOS. It is a little bit of memory that remembers all the BIOS settings, so that your computer won't have to be configured each time you turn your computer on.

9. Ports

It is used for connecting devices like keyboard, mouse, printer, etc.

Different ports are like,

- 1) PS2 Mouse Used to connect a PS/2 pointing device.
- 2) PS2 Keyboard Used to connect a PS/2 keyboard.
- 3) VGA Port Connect your monitor to the VGA port.
- 4) DVI-I Port Connect a monitor with DVI connection.
- 5) HDMI Connect a monitor or HDTV with HDMI connection.

- 6) Optical S/PDIF Used for sound connections to home audio receivers or powered PC speakers with optical connections.
- 7) LAN Port Used to connect an RJ-45 cable to a Network hub or router.
- 8) USB Ports Used to connect USB devices such as printers, scanners cameras etc...
- 9) Analog Audio Ports Used to connect audio devices.

10. NIC

A network card, network adapter, network interface card or NIC is a piece of computer hardware designed to allow computers to communicate over a computer network.

11. SMPS

A switched mode power supply, or SMPS, is an electronic power supply unit (PSU) that incorporates a switching regulator – an internal control circuit that switches the load current rapidly on and off in order to stabilize the output voltage.

2.3.2. Types of Processor (CPU and GPU)

CPU:

Central Processing Unit (CPU) consists of the following features –

- CPU is considered as the brain of the computer.
- CPU comprise of arithmetic logic unit (ALU) accustomed quickly to store the information and perform calculations and Control Unit (CU) for performing instruction sequencing as well as branching. CPU interacts with more computer components such as memory, input, and output for performing instruction.
- CPU performs all types of data processing operations.
- It stores data, intermediate results, and instructions (program).
- It controls the operation of all parts of the computer.
- A computer's CPU handles all instructions which it receives from hardware and software running on the computer.
- It is located on the motherboard. It referred to as brain of a computer.
- The processor speed is measured in terms of MHz or GHz.
- The CPU chip is in the shape of square or rectangle and on the bottom of chip have hundreds of connector pins that plug into each of the corresponding holes in the socket.

Intel Pentium processor



GPU (Graphics processing unit):

- A Graphics processing unit (GPU) is a specialized, electronic circuit.
- GPUs are used in embedded systems, mobile phones, personal computers, workstations, and game consoles.
- Modern GPUs are very efficient at manipulating computer graphics and image processing. GPU is used to provide the images in computer games.
- GPU is faster than CPU's speed and it emphasis on high throughput. It's generally incorporated with electronic equipment for sharing RAM with electronic equipment that is nice for the foremost computing task. It contains more ALU units than CPU.
- The basic difference between CPU and GPU is that CPU emphasis on low latency. Whereas, GPU emphasis on high throughput

S.NO	CPU	GPU
1	CPU stands for Central Processing Unit.	While GPU stands for Graphics Processing Unit
2	CPU consumes or needs more memory than GPU	While it consumes or requires less memory than CPU
3	The speed of CPU is less than GPU's speed	While GPU is faster than CPU's Speed
4	CPU contain minute powerful cores	While it contain more weak cores

5	CPU is suitable for serial instruction processing	While GPU is not suitable for serial instruction processing
6	CPU is not suitable for parallel instruction processing	While GPU is suitable for parallel instruction processing
7	CPU emphasis on low latency.	While GPU emphasis on high throughput.

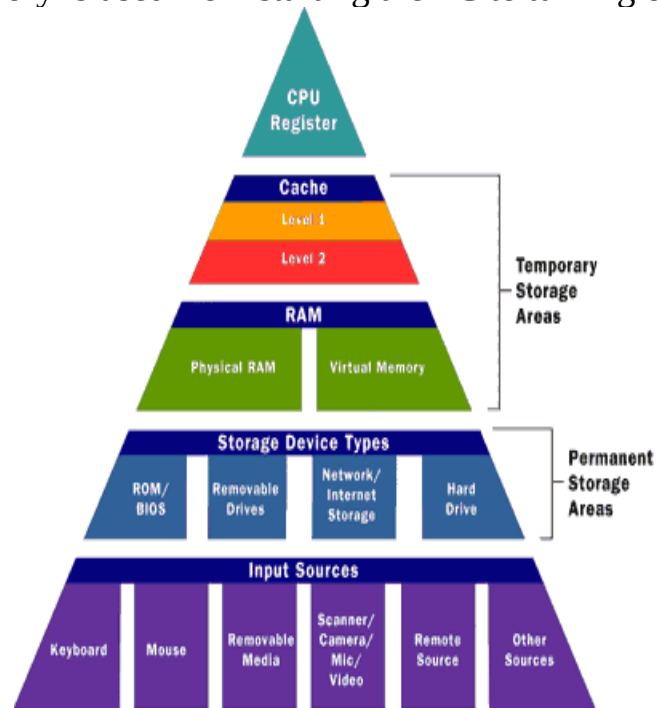
2.3.3. Understanding processor speed

- Normally when we go for purchasing any computer kind of electronic gadget, we are more concern for the processing speed of the device. CPU speed is basically **Clock speed**.
- The more cycles that a computer's central processing unit can complete per second, the faster data can be processed. The faster data can be processed, the faster the computer can complete a task. This means that a computer with a fast processor speed can complete more tasks in the same amount of time than a computer with a slow processor, and that more applications can be running at the same time.
- Some applications are processor-intensive, which means that they require a great deal of data to be processed in order to operate. Usually measured in Hz (Hertz as in number per second). These days CPUs tick at billions per second, with the prefix G (for giga) so you see CPUs in the range of between 1GHz and 4GHz.
- While often limited by other reasons, a 3.0 Ghz processor is roughly twice as fast as a 1.5Ghz processor. One gigahertz represents a processor's ability to perform a billion — 1,000,000,000 —operations per second, and a megahertz is 1000 times less, or one million operations per second. Thus, an older 500 Mhz processor would be considered one third the speed of a 1.5Ghz processor.
- Processor speed is impacted by several factors. These include circuit size, die size, cache size, efficiency of the instruction set and manufacturing variables. Smaller chips usually result in faster processor speeds because the data has less distance to travel, but smaller chips also result in greater heat generation, which needs to be managed.

2.3.4 Memory

- Memory is one of the core components of the computer hardware.
- In Memory, programs and data are stored. From the moment you turn on the computer until you shut it down, the memory is used.
- The basic unit of memory is the binary digit (bit). A bit may contain a 0 or 1.
- Memory is made up of large number of cells and each cell can store one bit.

- Computer's Memory is complicated System.
- The memory refers to the physical devices used to store programs (sequence of instructions) or data on a temporary or permanent basis for use in a computer or digital electronic devices.
- It is made up of large number of cells where each cell stores a bit (binary no 0 or 1).
- The computer memory is used from starting the PC to turning off the PC.



How memory works?

- When the computer is booting, the process begins.
- The operating system files are first loaded from the hard disk into the main memory and then the CPU starts executing the instructions from these files. Therefore, the user starts performing his actions.
- Whenever any file or folder is referenced, the same is made available in the
- main memory where the further processing is done on them.

Storage Evaluation Criteria

Capacity:

Total amount of data that can be stored / loaded on the storage unit.

Capacity of Primary storage device is less than the secondary storage device.

Access Time:

It is a time needed to locate and retrieve the stored data from the storage unit in response to any instruction.

Access time of Primary storage device is faster than the secondary storage device.

Cost per hit of storage:

It is the cost of the storage unit for a given storage capacity.

Cost per bit of Primary storage device is higher than the secondary storage device.

Volatile!

If a storage unit can hold the data even if the PC turns off or power interrupts, it is known as non-volatile memory.

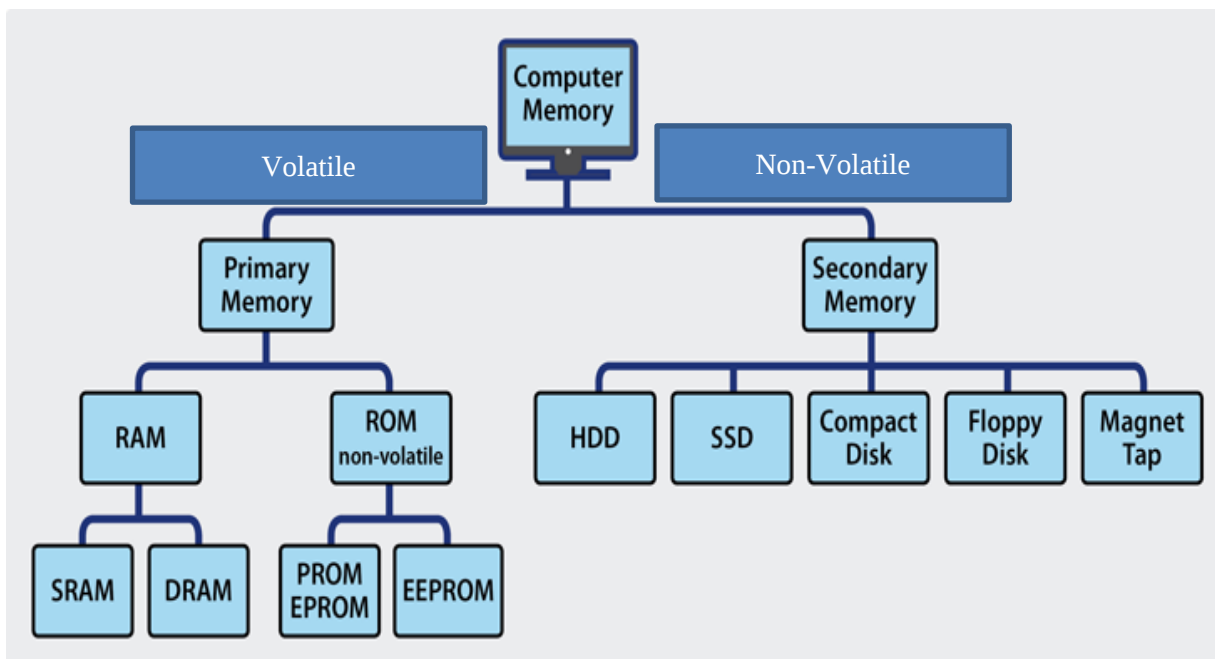
If a storage unit loses the data when the PC turns off or power interrupts, it is known as volatile memory.

Random Access:

If the time to access the data from the storage unit is independent of the location of the storage unit, it is called the Random Access or RAM.

Locations of the RAM are easy to access as well as it takes the same amount of time

Primary storage units are having the random access at most whereas the secondary storage unit uses the pseudo —random access.

Types of memory**Difference between Primary memory and Secondary memory.**

Primary Memory	Secondary Memory
1. It stores programs and data which are currently needed by the CPU.	1. The information which is not currently being processed resides in Secondary Memory.

2. Semiconductor memory is used as primary memory.	2. Magnetic or optical memory is used as secondary memory.
3. It is faster compared to secondary memory.	3. It is slower compared to primary memory.
4. It has higher cost per bit of storage.	4. It has lower cost per bit of storage.
5. It has low storage capacity.	5. It has much larger storage capacity than primary memory.
6. The CPU communicates directly with main memory.	6. The CPU does not communicate directly with secondary memory.
7. It is usually contained on the mother board.	7. The secondary memory is the external memory.
8. E.g. RAM, ROM, etc.	8. E.g. Hard disk, CDs, etc.

What do you mean by volatile and non-volatile storage?

Volatile Storage:

- Volatile memory is computer memory that requires an active power connection to function.
- When the power to a volatile memory source is shut off, volatile memory loses its contents and the information is deleted.
- RAM is the most common form of volatile memory.
- RAM is used to temporarily hold data that is required to run programs or applications on a computer or similar electronic device.

Advantages:

It functions fast.

It is well suited to protecting sensitive information.

When power is shut down, the information is quickly deleted.

Non-Volatile Storage:

- Non-Volatile memory is memory that does not require a connection to a power source to retain information.
- In other words, when the power source to which the memory is connected is shut off, the memory does not lose the information it has.
- Hard drives or flash drives are the most common examples of non-volatile memory.

Advantage:

Longer term retention of information

Volatile Memory Vs Non-Volatile Memory.

Volatile Memory	Non-Volatile Memory
1. Requires a <u>power source</u> to retain information.	1. <u>Does not require a power source</u> to retain information.
2. When power source is disconnected, information is <u>lost or deleted</u> .	2. When power source is disconnected, <u>information is not deleted</u> .
3. Often used for temporary retention of data, such as with RAM, or for retention of sensitive data.	3. Often used for long term retention of data, such as files and folders.
4. <u>E.g. RAM</u>	4. <u>E.g. Hard drive or CDs.</u>

What do you mean by random access?

Ability to access data at random. Direct access by a computer to any memory address of a data storage device, without starting from the first address, every time the data needs to be read.

➤ **What is RAM? Explain different types of RAM.**

- RAM stands for Random Access Memory. It is also called “Direct Access Memory”.
- It is made up of small IC on it
- It is the Read and Write (R/W) memory of a computer. The user can write information to it and read information from it.
- The RAM is a volatile memory, it means information written to it can be accessed if power is on. As soon as the power is off, it cannot be accessed.
- RAM holds data and processing instructions temporarily until the CPU needs it. So, program must be loaded into RAM before execution.
- RAM is considered as “Random Access” because you can access any memory cell directly if you know the row and column that intersect at that cell.
- RAM is made in electronic chips made of semiconductor material. In RAM, transistors make up the individual storage cells which can each “remember” an amount of data, for example, 1 or 4 bits – if the PC is switched on.
- This RAM are installed in the PC’s motherboard using sockets – there are typically, 2, 3 or 4 slots.
- RAM plays very important role in speed of a computer. The amount of data that can be stored in RAM is measured in bytes.
- Available in small sizes: 1gb. 2gb. 4gb etc.

There are two basic types of RAM:

1. Dynamic RAM (DRAM)

2. Static RAM (SRAM)

1. Dynamic RAM (DRAM) –

- DRAM is IC that made up of millions of transistors and capacitors.
- Dynamic memory cell represents a single bit of data in a small capacitor.
- The capacitor holds the bit of information – 0 or 1. The transistor acts as a switch that changes its state.
- A capacitor is like a small bucket that can store electrons.
To store a 1 in the memory cell, the bucket is filled with electrons.
To store a 0, it is emptied.
- The problem with the capacitor’s bucket is that it has a leak. So, in few milliseconds, a full bucket becomes empty.
- In other word, DRAM loses its stored data in very short time i.e. milliseconds even when

power supply is on.

- So, CPU or memory controller has to come along and recharge all of the capacitors holding it before they discharge.
- To do this, the memory controller reads the memory and then writes it back.
- This refresh operation happens automatically thousands of times per second. So, this RAM is known as Dynamic RAM. It has to be dynamically refreshed all the time or it forgets what it is holding.
- Because of this refreshing, it is too slow. So, it slows down the memory.
- It is cheaper and takes less space.

There are different types of DRAM :

- ☐ DDR-DRAM: Double Data Rate Dynamic RAM
- ☐ DDR-SDRAM Double Data Rate Synchronized Dynamic RAM
- ☐ FCRAM Fast Cycle RAM
- ☐ FPM-DRAM Fast Page Mode Dynamic RAM
- ☐ QDR-DRAM Quad Data Rate Dynamic RAM
- ☐ QDR-SRAM Quad Data Rate Static RAM
- ☐ SDRAM Synchronized Dynamic RAM
- ☐ SSRAM Synchronized Static RAM
- ☐ ZBT-SRAM Zero Bus Turnaround Static RAM
- ☐ RDRAM Rambus Dynamic RAM
- ☐ RDRAM Reduced Latency Dynamic RAM

2. Static RAM (SRAM) –

- Static RAM holds data in a static form, and does not need to be dynamically refreshed as in the case of DRAM.
- The reason is because SRAM chips are made of a flip-flop circuit which does not need constant refreshing.
- It is still volatile, means when the power is removed from the memory device, the data is not held and will disappear.
- SRAM has very fast access speed because of configuration of 6 transistors which keeps current flowing in one direction or the other (0 or 1 state). Each state can be written and read instantly, therefore the chip does not require a capacitor to fill up.
- It used as cache memory and has very fast access.
- It is more expensive and consumes more power.

Difference between SRAM and DRAM.

SRAM	DRAM
1. It is faster than DRAM.	1. It is slower than SRAM.
2. It is more expensive.	2. It is less expensive.
3. It does not need to be power refreshed.	3. It has to be refreshed after each operation.
4. It utilizes less power.	4. It utilizes more power.

3. SDRAM (Synchronous DRAM)

- The release of SDRAM changed the basic architecture of DRAM
- A large portion of MCC (memory control circuit) circuitry has been moved from the chipset to the SDRAM module itself.
- So, the CPU can directly access the RAM
- This provides a very good improvement in performance
- When we are using SDRAM 2 things need to be remembered:
- It will not co-exist with earlier types of memory
- It operates in synchronization with CPU's front side bus.

➤ What is ROM? Explain different types of ROM.

- ROM stands for Read Only Memory.
- The data and instructions in ROM are stored by the manufacturer at the time of its manufacturing.
- This data and instructions cannot be changed or deleted afterwards.
- The data are stored by using fuse-links, which burnt the data permanently on the chip, since it is known as burnt-in-data
- That is, the data and instructions stored in ROM can only be read but new data or instructions cannot be written into it. So, it is known as Read Only Memory.
- ROM stores data and instructions permanently. When the power is turned off, the instructions stored in ROM are not lost. So, it is non-volatile memory.
- ROM is used to store frequently used data and instructions to control basic input/output operations of the computer. Frequently used small programs like operating system data are stored in ROM.
- When the computer is switched on, instructions in the ROM are automatically activated. These instructions help the booting process of computer.

- It is also known as field stores, permanent stores or dead stores

There are different types of ROM:

1. PROM

2. EPROM

3. EEPROM

1. PROM (Programmable Read Only Memory) –

- This type of ROM is initially blank.
- These types of ROMs are categorized in manufactured programmed ROM and user programmed ROM
- Main difference between ROM and PROM is that PROM is manufactured as blank whereas ROM is programmed during the manufacturing process.
- The user or manufacturer can write data or program on it by using special devices like PROM programmer or PROM burner.
- Once the data or program is written in PROM chip, it cannot be changed.
- If there is an error in writing data or program in PROM, the error cannot be erased. PROM chip becomes unusable.

2. EPROM (Erasable Programmable Read Only Memory) –

- This type of ROM is also initially blank.
- The user or manufacturer can write data or program on it by using special devices.
- But the data written on EPROM chip can be erased by using special devices and ultraviolet rays.
- So data or program written in EPROM chip can be changed and new data can also be added.
- When EPROM is in use, its content can only be read.

3. EEPROM (Electrically Erasable Programmable Read Only Memory) –

- This type of ROM can be written or changed with the help of high voltage electrical devices.
- So data stored in this type of ROM chip can be easily modified.

What is UV PROM?

- UV PROM stands for Ultra Violet Programmable Read Only Memory.
- An integrated circuit memory chip in which the stored information can be erased only by ultra violet light and the circuit can be reprogrammed with new information that can be stored indefinitely.

What is flash memory?

- Flash memory is the special type of EEPROM that can be erased and reprogrammed in blocks instead of one byte at a time.
- It retains information without requiring power. So, it is nonvolatile memory.
- It writes and reads at 512 bit at a time instead of usual one allowing for faster data transfer.
- It is also known as Flash ROM.
- It is used in smart phones, GPS, MP3 player, digital camera, PC, USB drive, etc.

Difference between RAM and ROM.

RAM	ROM
1. It is Temporary memory.	1. It is Permanent memory.
2. The data in RAM can be changed or deleted.	2. The instruction written in the ROM, cannot be changed or deleted.
3. Instructions in RAM change continuously as different programs are executed and new data is processed.	3. It is not possible to write new information or instruction in ROM.
4. It is volatile memory.	4. It is non-volatile memory.
5. The instruction is written into the RAM at the time of execution	5. The instruction written into ROM at manufacturing time.

2.3.5. Storage Devices – Hard Disk, CD, DVD, USB flash memory**➤ HARD DISK (HD, HDD)**

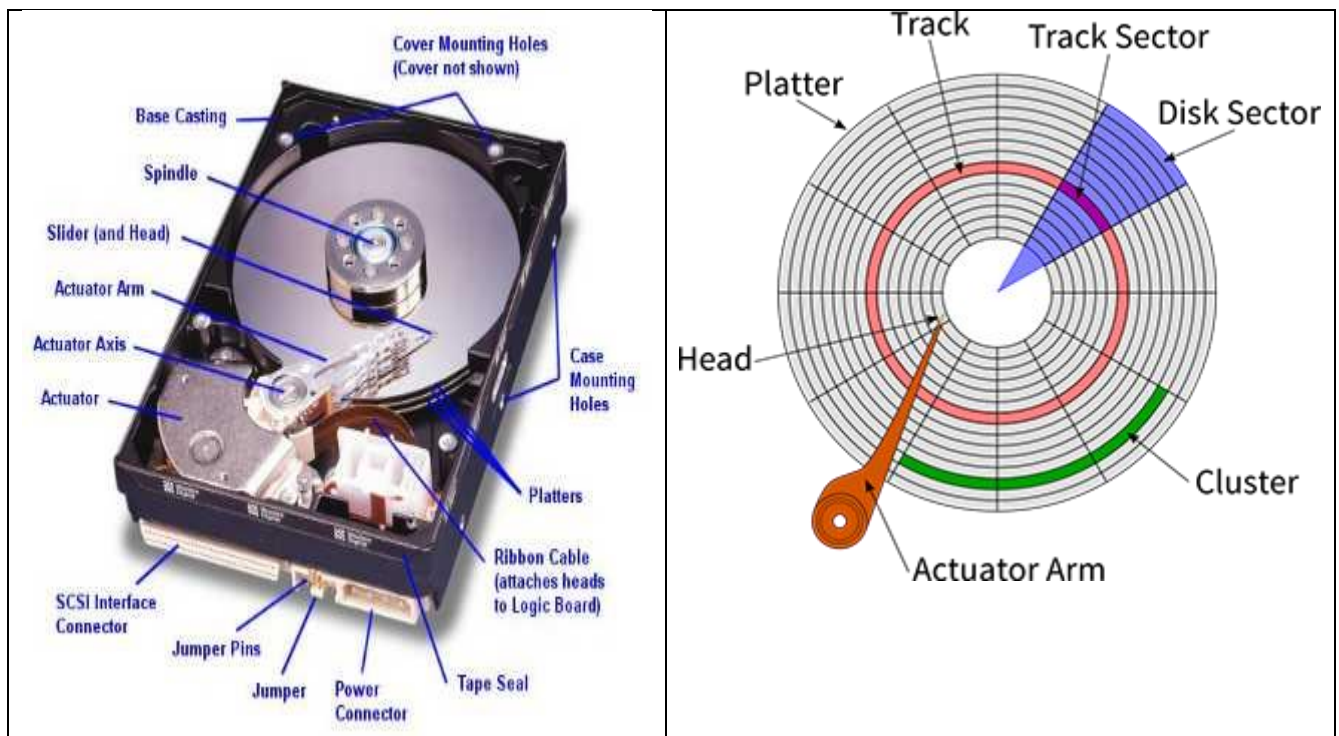
- A hard disk drive (sometimes abbreviated as a hard drive, HD, or HDD) is a non-volatile data storage device. It is usually installed internally in a computer, attached directly to the disk controller of the computer's motherboard.
- It contains one or more platters, housed inside of an air-sealed casing. Data is written to the platters using a magnetic head, which moves rapidly over them as they spin. Internal hard disks reside in a drive bay, connected to the
- motherboard using an ATA, SCSI, or SATA cable. They are powered by a connection to the computer's PSU (power supply unit).
- To install a computer operating system, a hard drive (or another storage device) is

required. The storage device provides the storage medium where the operating system is installed and stored.

- A hard drive is also required for the installation of any programs or other files you want to keep on your computer. When downloading files to your computer, they are permanently stored on your hard drive or another storage medium until they are moved or uninstalled.

ARCHITECTURE OF HARD DISK

- They are made up of rigid metal platters & comes in many sizes



Depending on how they are packed, they are of 3 types:

1. ZIP/BERNOULLI DISK

- It consist of single hard disk platter encased in a plastic cartridge.
- The disk is 3 1/2 inch and has a storage capacity of 100 MB.
- Its disk drive called Zip drive may be of portable or fixed type
- Fixed type is a part of computer system, permanently connected to it.
- The portable type can be brought and connected to the when needed. I
- It can be easily loaded or unloaded.

2. DISK PACK

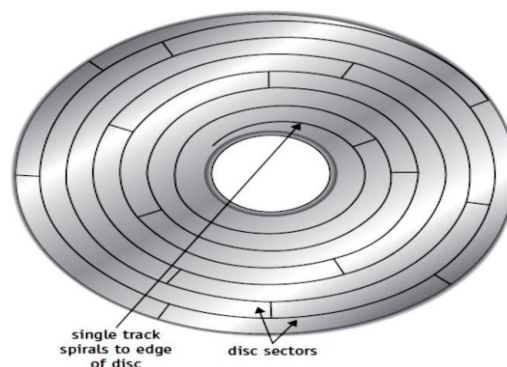
- It consists of multiple hard disk platters mounted on a single central shaft.
- All disks rotate together with the same speed.
- Its disk drive has a separate read/write head for each surface.
- Its disk drive is of interchangeable type.
- This gives unlimited capacity of data storage.

3. WINCHESTER DISK

- It consists of multiple hard disk platters, mounted on a central shaft.
- It is of fixed type.
- It has limited capacity storage but have larger than disk pack.

➤ OPTICAL DISKS

- All read and write activities are performed by light. All recording information stores at an optical disk. As per the opinions of data scientist that compact space is most useful for huge data storage.
- Their big advantages are not more costly, light weight, and easy to transport because it is removable device unlike hard drive.
- All data is saved like as patterns of dots which can be easily read with using of LIGHT.
- The data is read while bouncing laser beam on the surface of storage medium. Laser beam creates the all Dots while reading process, but it is used with high power mode to mark the surface of storage medium, and make a dot. This entire process is also called the "Burning" data onto Disc.



CD-ROM

CD-ROM stands for "Compact Disc Read Only Memory", and CD-ROM comes in the "Random Access" category's devices. These types of disc can capable to store almost 700-800 MB of digital data. These data can't discard by mistaken.

DVD-ROM

DVD-ROM stands for "Digital Versatile Disc — Read Only Memory", and it also comes in the "Random Access" category's devices. DVD-ROM discs can store data up to 4.7 GB, but Dual Layer DVD device's storage capacity is double. These types of disc are used to store ultra quality video.

BLUE RAY

Blue Ray discs are totally replaced by DVDs, because these discs are capable to hold data up to 25-50 GB, as well as double layer Blue Rays discs can store double data. Due to high storage capacity, Blue Ray discs are used to store HD (High Definition) videos.

HD DVD

HD DVD stands for "High Density DVD", and these devices are capable to store data up to 15 GB (Dual Layer HD DVDS have storage capacity double). High-Density DVD discs are also used to hold HD Videos.

DVD-RAM

DVD-RAM stands for "DVD-Random Access Memory", and it is able to Re-Write data. DVD-RAM is available in market like as floppy-disc style case. These types of discs have storage capacity of data similar to DVD (up to 4.7 GB).

Advantages of Optical Storage Devices

- It is capable to store vast amount of data.
- Affordable price
- It can be recycled (Re-used).
- It has ultra data stability.
- Countable/uncountable storage units
- Best Durability, Transport-ability, and archiving.

Disadvantages Optical Storage Devices

- Some traditional PCs are not able to read these disks.
- It is getting trouble while recycling.

➤ USB FLASH DRIVE (Universal Serial Bus)

- Also known as a thumb drive, pen drive, flash-drive, memory stick, jump drive, and USB stick, the USB flash drive is a flash memory data storage device that incorporates an integrated USB interfaces.

- Flash memory is generally more efficient and reliable than optical media, being smaller, faster, and possessing much greater storage capacity, as well as being more durable due to a lack of moving parts.

2.4. Introduction to Software

2.4.1. Purpose and significance of Operating System

- Operating system works like as bridge in between hardware and software, and primary purpose and goal of an operating system is to manage all resources of hardware and software that are connect with computer.
- Without operating system all computer system are helpless, because operating system create the interface between user and hardware.
- When user give any instruction to computer then operating system transform these instructions in to binary form such as 0 and 1, because computer systems are not able to understand directly our commands. Computer can understand only machine language.

2.4.2. Concept of System Software and Application Software

Software:

- It is collection of programs where program is a sequence of instructions written in the language which computer can understand.
- Like hardware it is also important for computer system to work with hardware. Both hardware and software are complementary to each other.
- Rather comparing to hardware, software is continuing expense thing. It may be differing in terms of price as per the requirement of user as well as working of itself. It can be categorized in System Software and Application Software.

□ System Software

- It is designed for handling the operation and extending the processing capability of the computer system. It makes computer system operation more effective and efficient.
- System software helps for operating the hardware components together as well as supporting the development and execution of the application programs.
- Some example of system software: Operating Systems, utility programs, compilers/interpreters etc.

□ Application Software

- It is a set of programs which are designed to some specific task or some special job. It can further classify in the two types: general purpose application software and special purpose application software.
- General purpose application software can be used for very common need like word processing, spread sheets etc.
- Special purpose application software is specially designed for solving special problems or for performing specific task with use of some particular language of computers.
- Eg. Billing System, Hotel Management System etc.

Register Vs. Cache

- ➔ Registers are both faster as well as nearest to CPU than cache
- ➔ Registers are crucial for CPU, without register CPU will not perform in feasible amount of time
- ➔ Cache can be seen as faster RAM, which can help only if the same data is needed again and again if we could predict which data will be needed next (or soon).

Course Title: 103 Introductions to Computers

UNIT-3: Number System

3.1. Introduction of Decimal, Binary, Octal and Hexadecimal number Systems.

3.2 Conversion of Decimal to Binary and Binary to Decimal

3.3 Binary addition & subtraction

3.4 ASCII and ANSI character code

What is a number system?

A Number system is a method of showing numbers by writing, which is a mathematical way of representing the numbers of a given set, by using the numbers or symbols in a mathematical manner. The writing system for denoting numbers using digits or symbols in a logical manner is defined as a Number system. The numeral system Represents a useful set of numbers, reflects the arithmetic and algebraic structure of a number, and provides standard representation. The digits from 0 to 9 can be used to form all the numbers. With these digits, anyone can create infinite numbers. For example, 156,3907, 3456, 1298, 784859 etc.

There are two types of Number System:**1. Non Positional Number System –**

- ➔ In this, each symbol represents the same value, regardless of its position in the number. Symbols are used to find out the value of a particular number.
- ➔ Use symbols such as I for 1, II for 2, III for 3, IIII for 4, IIIII for 5, etc
- ➔ Each symbol represents the same value regardless of its position in the number
- ➔ The symbols are simply added to find out the value of a particular number
- ➔ It is difficult to perform arithmetic with such a number system

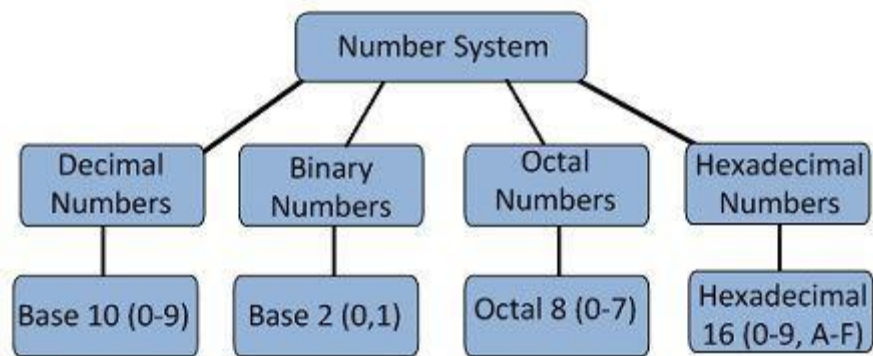
2. Positional Number System –

- ➔ The number system having a few symbols representing different values, depending on the position they occupy in the number is called positional number system.
- ➔ The radix or base of the number system is the total number of digits allowed by the number system.
- ➔ Use only a few symbols called digits
- ➔ These symbols represent different values depending on the position they occupy in the number
- ➔ The value of each digit is determined by:
 1. The digit itself
 2. The position of the digit in the number
 3. The base of the number system
(base = total number of digits in the number system)
- ➔ The maximum value of a single digit is always equal to one less than the value of the base

3.1. Introduction of Decimal, Binary, Octal and Hexadecimal number Systems.

✚ According to Radix/Base, there are four type of number systems :

1. Binary Number System
2. Octal Number System
3. Decimal Number System
4. Hexadecimal Number System



Circuit Globe

1. Binary Number System

- Base of binary number system is 2.
- 0 and 1 are the symbols used in binary number system.
- 1 is the largest single digit number.
- A single symbol of binary number system (0 or 1) is called bit.
- Aggregation of 8 bits is called byte.
- Aggregation of 4 bits is called nibble or half byte or half octet.
- Also called base 2 number system.
- Digital systems handle information using electronic components such as transistors etc. all of which can represent only two states or conditions on (1) or off (0).
- The highest decimal number that can be represented by n bits binary number is $2^n - 1$.
- Computer stores numbers, letters and other characters in binary form.
- E.g. $(10101)_2$

2. Octal Number System

- Base of octal number system is 8.
- 0 to 7 are the symbols used in octal number system.

- 7 is the largest single digit number used in octal number system.
- Each octal digit can be represented using 3 binary digits.
- Uses eight digits 0,1,2,3,4,5,6 and 7.
- Also called base 8 number system.
- E.g. (12570)₈

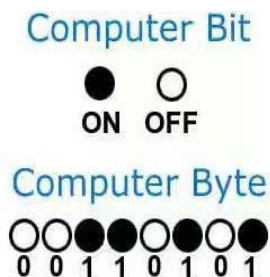
3. Decimal Number System

- Base of decimal number system is 10.
- 0 to 9 are the symbols used in decimal number system.
- 9 is the largest single digit number used in decimal number system,
- Use ten digits 0,1,2,3,4,5,6,7,8,9.
- Also called base 10 number system.
- Used in day-to-day life.
- E.g. (3925)₁₀

4. Hexadecimal Number System

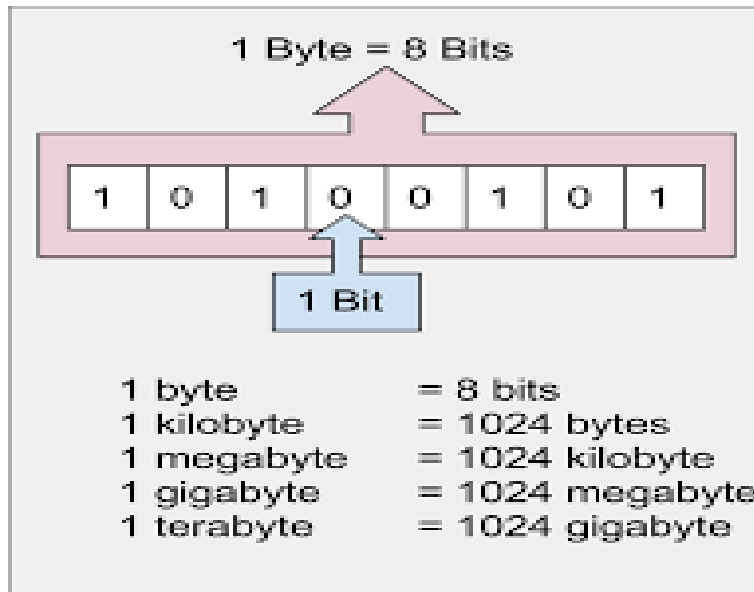
- Base of hexadecimal number system is 16.
- 0 to 9, A, B, C, D, E, and F are the symbols used in hexadecimal number system.
- F is the largest single digit number used in hexadecimal number system. IM
- Each hexadecimal digit can be represented using 4 binary digits.
- A nibble can be represented by a single hexadecimal digit also called hex digit.
- Use 16 digits 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F.
- Also called base 16 number system.
- E.g. (19FDE)₁₆

Bits and Bytes –



- The smallest unit of data in a computer is called Bit (Binary Digit).
- A bit has a single binary value i.e. 0 or 1.

- There are eight bits in a byte.
- A single character would use one byte of memory.
- An alphanumeric character is stored as 1 byte. For example, to store the letter 'R' uses 1 byte, which is stored by the computer as 8 bits '01010010'.
- Bit – A bit is a value of either a 1 or 0.
- Nibble – A nibble is 4 bits.



Need of Binary Number System

Digital computers use digital circuits. Digital circuits can handle only two states or conditions on /high (1) or off/low (0). Binary number system is ideally suited for representing two possible states and it greatly simplifies the internal circuit design of computers, resulting in less expensive and more reliable circuits.

Need of Decimal Number System

Human beings are more familiar with decimal number system. They can easily read, understand and manipulate decimal number system.

Need of Hexadecimal and Octal Number System

Octal and hexadecimal number systems are great ways to concisely represent a bit pattern. Each octal digit is exactly equivalent to 3 bits, and each hexadecimal digit is exactly equivalent to 4 bits. They are easily convertible to and from binary.

HEXADECIMAL	DECIMAL	OCTAL	BINARY
0	0	0	0000
1	1	1	0001
2	2	2	0010
3	3	3	0011
4	4	4	0100
5	5	5	0101
6	6	6	0110
7	7	7	0111
8	8	10	1000
9	9	11	1001
A	10	12	1010
B	11	13	1011
C	12	14	1100
D	13	15	1101
E	14	16	1110
F	15	17	1111

3.2 Conversion of Decimal to Binary and Binary to Decimal

❖ Decimal to binary –

- Divide the decimal number to be converted by 2.
- Get the remainder from step 1 as the rightmost digit (Least Significant Digit(LSD)) of new base number.
- Divide the quotient of the previous divide by 2.
- Record the remainder from step 3 as the next digit(to the left) of the new basenumber.
- Repeat step 3 and 4, getting remainders from right to left, until the quotientbecomes zero in step 3.
- The Last remainder obtained will be the Most Significant Digit (MSD) of the newbase number. At last remainders have to be arranged in reverse order.

Decimal to Binary Example:**EXAMPLE 1:**

$$(78)_{10} = (?)_2$$

		remainder
2	78	
2	39	0
2	19	1
2	9	1
2	4	1
2	2	0
	1	0

Solution:answer is (1 0 0 1 1 1 0)₂**Ex****Convert (68)₁₀ to Binary**

2	68	0
2	34	0
2	17	1
2	8	0
2	4	0
2	2	0
2	1	1
	0	

$$(68)_{10} = (1000100)_2$$

Convert 125₁₀ to Binary

2	125	1
2	62	0
2	31	1
2	15	1
2	7	1
2	3	1
2	1	1
	0	

$$(125)_{10} = (1111101)_2$$

❖ Decimal to binary with fraction part to binary –

- Begin with fractional part of decimal and multiply by 2. The whole number part of the result is the first binary digit to the right of the point.

Ex

.625 x 2 = 1.25, the first binary digit to the right of the point is a 1.

- Next disregard the whole number part of the previous result (the 1 in this case) and multiply by 2 for fractional part (0.25 in this case) again. The whole number part (0) of this new result (0.50) is the second binary digit to the right of the point.
- Continue this process until you get a zero as fractional part or until an infinite repeating pattern is recognized (if zero in fractional part does not come, minimum repeat process for six times).

EXAMPLE

$$(25.625)_{10} = (?)_2$$

		remainder
2	25	
2	12	1
2	6	0
2	3	0
	1	1

Solution:**integer part,****fractional part,**

$$0.625 * 2 = 1.25 \quad \text{integer 1}$$

$$0.25 * 2 = 0.5 \quad \text{integer 0}$$

$$0.5 * 2 = 1 \quad \text{integer 1}$$

So, $(0.101)_2$

Now, answer will be $(11001.101)_2$

Convert $(124.24)_{10}$ to Binary

2	124	0
2	62	0
2	31	1
2	15	1
2	7	1
2	3	1
2	1	1
	0	

$0.24 \times 2 = 0.48$	0
$0.48 \times 2 = 0.96$	0
$0.96 \times 2 = 1.92$	1
$0.92 \times 2 = 1.84$	1
$0.84 \times 2 = 1.68$	1
$0.68 \times 2 = 1.36$	1

 $(124.24)_{10} = (1111100.001111)_2$ **Convert $(120.25)_{10}$ to Binary**

2	120	0
2	60	0
2	30	0
2	15	1
2	7	1
2	3	1
2	1	1
	0	

$0.25 \times 2 = 0.50$	0
$0.50 \times 2 = 1.00$	1

 $120.25_{10} = (1111000.01)_2$ **❖ Binary to Decimal:**

Binary number system is like decimal number system, except that the base is 2, instead of 10. We can use only two symbols or digits (0 and 1) in this system. Note that the largest digit is 1 (One less the base).

1. Determine the positional value of each digit.

Ex: $(101)_2$ Positional value of underlined one is $2^2 = 1 \times 4 = 4$

2. Multiply the positional value (in step 1) by the digits in the corresponding columns.
3. Sum up the products calculated in step 2. Total is equivalent value in decimal.

EXAMPLE:

$$\begin{aligned}
 1. (101000)_2 &= (?)_{10} \\
 &= 1*(2)^5 + (0*2)^4 + (1*2)^3 + (0*2)^2 + (0*2)^1 + (0*2)^0 \\
 &= 32+0+8+0+0+0 \\
 &= 32+8 \\
 &= (40)_{10}
 \end{aligned}$$

$$\begin{aligned}
 2. (101111)_2 &= (?)_{10} \\
 &= 1*(2)^5 + 0*(2)^4 + 1*(2)^3 + 1*(2)^2 + 1*(2)^1 + 1*(2)^0 \\
 &= 32+0+8+4+2+1 \\
 &= 32+8+4+2+1 \\
 &= (47)_{10}
 \end{aligned}$$

$$\begin{aligned}
 3. (10011101)_2 &= (?)_{10} \\
 &= (1*2)^7 + (0*2)^6 + (0*2)^5 + (1*2)^4 + (1*2)^3 + (1*2)^2 + (0*2)^1 + (1*2)^0 \\
 &= 128+0+0+16+8+4+0+1 \\
 &= 128+16+8+4+1 \\
 &= (157)_{10}
 \end{aligned}$$

$$\begin{aligned}
 4. (10010110)_2 &= (?)_{10} \\
 &= (1*2)^7 + (0*2)^6 + (0*2)^5 + (1*2)^4 + (0*2)^3 + (1*2)^2 + (1*2)^1 + (0*2)^0 \\
 &= 128+0+0+16+0+4+2+0 \\
 &= 128+16+4+2 \\
 &= (150)_{10}
 \end{aligned}$$

Convert $(10101)_2$ to Decimal

$$\begin{aligned}
 (10101)_2 &= 1 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 \\
 &= 16 + 0 + 4 + 0 + 1 \\
 &= (21)_{10}
 \end{aligned}$$

Convert $(101101.001)_2$ to Decimal

$$\begin{aligned}
 (101101.001)_2 &= 1 \times 2^5 + 0 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 + 0 \times 2^{-1} + 0 \times 2^{-2} + 1 \times 2^{-3} \\
 &= 32 + 0 + 8 + 4 + 0 + 1 + 0 + 0 + 1 \times 0.125 \\
 &= (45.125)_{10}
 \end{aligned}$$

$$(101101.001)_2 = (45.125)_{10}$$

Convert $(110001.101)_2$ to Decimal

$$\begin{aligned}
 (110001.101)_2 &= 1 \times 2^5 + 1 \times 2^4 + 0 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 + 1 \times 2^{-1} + 0 \times 2^{-2} + 1 \times 2^{-3} \\
 &= 32 + 16 + 0 + 0 + 0 + 1 + 1 \times 0.5 + 0 + 1 \times 0.125 \\
 &= (49.625)_{10}
 \end{aligned}$$

3.3 Binary addition & subtraction**Binary Addition –**

- There are four rules for binary addition.

Input A	Input B	Sum (S) A+B	Carry (C)
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

Example:

$$0011010 + 001100 = 00100110$$

$$\begin{array}{r}
 11 \quad \text{carry} \\
 0011010 = 26_{10} \\
 + 0001100 = 12_{10} \\
 \hline
 0100110 = 38_{10}
 \end{array}$$

Add $(1100111)_2$ to $(110011)_2$

$$\begin{array}{r}
 \text{Carry } 1 \quad 1 \quad \quad 1 \quad 1 \quad 1 \\
 \quad 1 \quad 1 \quad 0 \quad 0 \quad 1 \quad 1 \quad 1 \\
 + \quad 1 \quad 1 \quad 0 \quad 0 \quad 1 \quad 1 \\
 \hline
 1 \quad 0 \quad 0 \quad 1 \quad 1 \quad 0 \quad 1 \quad 0
 \end{array}$$

Addition of 3 ones ($1+1+1$) can be performed by $1+1=10$, $10+1=11$. So, $1+1+1=11$ (1 carry 1)

Add $(11101.11)_2$ to $(11011.10)_2$

$$\begin{array}{r}
 \text{Carry } 1 \quad 1 \quad 1 \quad 1 \quad 1 \\
 \quad 1 \quad 1 \quad 1 \quad 0 \quad 1 \quad . \quad 1 \quad 1 \\
 + \quad 1 \quad 1 \quad 0 \quad 1 \quad 1 \quad . \quad 1 \quad 0 \\
 \hline
 1 \quad 1 \quad 1 \quad 0 \quad 0 \quad 1 \quad 0 \quad 1
 \end{array}$$

Binary Subtraction –

- There are four rules for binary subtraction.

Input A	Input B	Subtract (S) A-B	Borrow (B)
0	0	0	0
0	1	0	1
1	0	1	0
1	1	0	0

Examples:

$$0011010 - 001100 = 00001110$$

$$\begin{array}{r}
 11 \text{ borrow} \\
 00\cancel{1}1010 = 26_{10} \\
 -0001100 = 12_{10} \\
 \hline
 0001110 = 14_{10}
 \end{array}$$

Subtract $(1001)_2$ from $(10110)_2$

Borrow	0	10		0	10	←	Decimal value 2
	1	0	1	1	0		
-		1	0	0	1		
	0	1	1	0	1		

Subtract $(110.0011)_2$ from $(111.0100)_2$

						1		
Borrow						0	10	10
	1	1	1	.	0	1	0	0
-	1	1	0	.	0	0	1	1
	0	0	1	.	0	0	0	1

3.4 ASCII and ANSI character code

- ➔ ASCII (American Standard Code for Information Interchange) –is a 7-bit character set. It let's You represent up to 128 characters, number 0 to 127
- ➔ It is a standard data-transmission code that is used by personal computers to represent letters, numbers, punctuation marks, and control characters.
- ➔ ASCII code is popular in data communications, used to represent data in microcomputers and frequently found in larger computers.
- ➔ ANSI (American National Standards Institute) published ASCII in 1963.
- ➔ 0 to 31 & 127 is control character which can not display like enter key, backspace key, etc.

Character	ASCII value in Decimal
0 – 9	48 – 57
A – Z	65 – 90
a – z	97 – 122

ANSI character code:

- ➔ The generic term ANSI (American National Standards Institute) is the primary organization of US which is involved in the development of technology standards in the United States.
- ➔ Computer standards from ANSI include the American Standard Code for Information Interchange (ASCII) and the Small Computer System Interface (SCSI).
- ➔ ANSI Character Set, also known as Windows Code Page, is an 8-bit character set used by Microsoft Windows 95 and Windows 98 that lets you represent up to 256 characters (numbered 0 through 255).
- ➔ The ASCII (American Standard Code for Information Exchange) character set is a subset of the ANSI (American National Standards Institute) character set with characters numbered 32 through 126, each representing a displayable character. Some ANSI character codes cannot be displayed by Windows 95 or Windows 98 applications and are generally displayed as solid blocks on the output device.
- ➔ The 256-character limit of ANSI supports only a few international characters

Differences

- ➔ When ASCII was created, it only used 7 bits for a total maximum combination of 128 characters. It was created for the English language, and it proved good enough to hold all the letters, numbers, special characters and symbols, as well as non-printed characters.
- ➔ In ANSI, 8 bits are used; increasing the maximum number of characters to be represented up to 256. This is expanded even further because of how ANSI uses code pages with different character sets. There are a number of ANSI code pages that are meant for other languages like Japanese, Chinese, and many others. The application processing the file just needs to know which code page is in use in order to decipher the files properly.
- ➔ ANSI has more characters than ASCII
- ➔ ASCII uses 7 bits while ANSI uses 8
- ➔ ASCII characters are fixed to the code points while ANSI code points may represent different characters
- ➔ ASCII is more straightforward to use than ANSI
- ➔ ASCII works with Unicode while ANSI compatibility is very limited

Course Title: 103 Introductions to Computers

Unit – 4: Input & Output Devices

4.1. Introduction of Input Devices

4.1.1. Pointing Devices – Mouse, Trackball, Joystick, Touch Screen, Light Pen

4.1.2. Keyboard

4.1.3. RFID concepts and application in Fast Tag

4.2. Introduction and purpose of Scanning Devices

4.2.1. Optical Scanner

4.2.2. Bar Code Reader

4.2.3. Web Camera

4.3. Introduction and comparisons of Output Devices

4.3.1. Monitors – LED, LCD, TFT, OLED, Touchscreen Monitor

4.3.2. Printers – Dot Matrix Printer, Laser Printer, Inkjet Printer

4.1 Introduction of input devices

What is Input?

Input is any data or instructions entered to the computer. Input can be in the form of audio, video, graphics and animations and instructions

What Are Input Devices?

Any hardware component used to enter data, programs, commands, and user responses into a computer

Examples: Key Board, Mouse, Digital Camera, Webcam, Scanner, etc.

4.1.1 Pointing Devices

A pointing device is an input device which is used to control a pointer on a screen. Pointer is a small symbol on a screen.

A pointing device is an input interface (specifically a human interface device) that allows a user to input data to a computer. Graphical user interfaces (GUI) allow the user to control and provide data to the computer using physical gestures — point, click, and drag — for example, by moving a hand-held mouse across the surface of the physical desktop and activating switches on the mouse. Movements of the pointing device are echoed on the screen by movements of the pointer (or cursor) and other visual changes.

Mouse:

“Mouse is an input device that fits under palm of hand and Controls movement of pointer”.

The mouse is a palm-size device with a ball built into the bottom. The mouse is

usually connected to the computer by a cable (computer wires are frequently called cables) and may have from one to four buttons (but usually two). Mouse comes in many shapes and sizes.

When you move the mouse over a smooth surface, the ball rolls, and the pointer on the display screen moves in the same direction.

With the mouse, you can draw, select options from a menu, and modify or move text. You issue commands by pointing with the pointer and clicking a mouse button.

TYPES OF MOUSE

There are three types of mouse

1. Mechanical mouse
2. Optical mouse
3. Laser mouse
4. Wireless mouse

MECHANICAL MOUSE:

- It is also known as **ball mouse** because it uses a moving ball to work.
- A mechanical mouse is comprised of a metal or rubber ball in its underside.
- When you move the mouse across a surface, the ball also moves.
- Inside the mouse, there are two rollers that roll against two sides of the moving ball.
- One roller tracks the horizontal motion of the mouse and the other roller tracks the vertical motion.

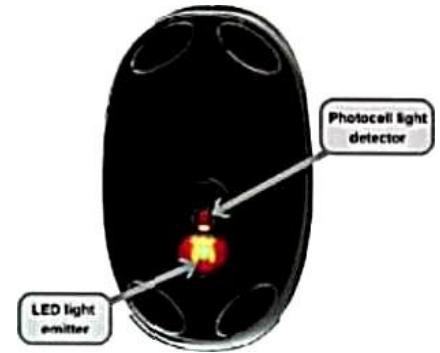
- The motion of the two rollers is converted into electrical signals which is then sent to the computer through a cord.
- The software on the computer then converts these electrical signals into meaningful X and Y movement of the mouse cursor that you see on screen.
- Moving the mouse causes the ball to foil, and sensors Inside the mouse detect the movement of the ball and consequently send signals to the cursor on the screen.
- The mechanical mouse has largely been replaced by the optical mouse.



2. Optical Mouse

- An Optical mouse works using optical technology. So, it doesn't require any moving parts.
- When you move the mouse over a surface, a small red LED (Light Emitting Diode) emits light onto a surface and reads the pattern or grid on that surface.
- The mouse converts this surface information into meaningful motion data which is sent to the computer.
- As you push the mouse around your desk, the pattern of

reflected light changes, and the chip inside the mouse uses this to figure out how you're moving your hand.



- **Optical mouse has advantages over mechanical mouse:**

1. Less wear and lower change of failure because there are no moving parts.
2. Dirt or dust cannot get into the mouse and interfere with the sensors.
3. Smoother response due to increased tracking resolution.
4. Mouse pad is not required, because it works on any flat surface like desk.

3. Laser Mouse

- It is the newest technology.
- It works same way as optical mouse but give better results.
- The laser inside the laser mouse can deliver up 20 times the performance of an optical mouse which gives more accurate tracking of motion and smoother movement.
- It also works flawlessly on any type of surface, where optical mouse may not work.

4. Wireless Mouse

- Wireless mice usually work via radio frequencies commonly referred to as RF.
- RF wireless mouse require two components to work properly a radio transmitter and a radio receiver.

Trackball-

- A trackball is like an upside-down mouse. Used similarly to the mouse, the trackball is frequently attached to or built into the keyboard.
- The main advantage of a trackball is that it requires less desk space than a mouse.
- The user spins the ball in different directions to move the cursor on the screen. The
- The associated electronic circuits detect the direction and speed of the spin. The information is sent to processor.
- It is used on a laptop computer where there is no space for a conventional mouse.
- Early alternatives, such as trackballs clipped to the side of the keyboard, have not proved satisfactory. The IBM ThinkPad replaces the trackball with a red plastic button, called a track point, located in the middle of the keyboard. You move the button with your thumbs.
- It serves the same purpose as a mouse, but is designed with a moveable ball on the top, which can be rolled in any direction. Instead of moving the whole device, you simply roll the moveable ball on top of the trackball unit with your hand to generate motion input.



Joystick –

- A joystick is an input device that allows the user to control a character or machine in a computer program, like in flight simulator.
- It has a lever that moves in all directions and controls the movement of a pointer or some other display symbol.
- It consists of a small, vertical lever i.e. stick, on a base.
- Most joysticks select screen position with actual stick movement, others respond to pressure on the stick.
- Some joysticks are put on the keyboard, others function as stand-alone unit.
- The distance that stick is moved in any direction from its center position corresponds to screen cursor movement in that direction.
- Springs returns the stick to center position when it is released.
- On most joystick buttons are provided to select the option, which is currently pointed to by cursor.
- Typical uses of joystick include video games, flight simulators, training simulators and controlling industrial robots.



How Joystick works?

- A joystick is connected to two potentiometers.
- Each potentiometer is used to record for left and right and forward and

backward movements.

- When a joystick is moved these two potentiometers send the details of the x and y coordinates to the **CPU** and the required movement is achieved.

Touch screen-

- A touch screen is a computer display screen that is also an input device. The screens are sensitive to pressure; a user interacts with the computer by touching pictures or words on the screen.
- Touch screen technology is the direct manipulation type of gesture-based technology. Direct manipulation is the ability to manipulate the digital world inside a screen. A Touch screen is an electronic visual display capable of detecting and locating a touch over its display area.
- This technology is most widely used in computers, user interactive machines, smartphones, tablets, etc. to replace most functions of the mouse and keyboard.

Components and working of touch screen:

- A basic touch screen has a touch sensor, a controller, and a software driver as three main components. The touch screen is needed to be combined with display and a PC to make a touch screen system.

Touch sensor:

-  The sensor generally has an electrical current or signal going through it and touching causes a change in the signal. This change is used to determine the location of the touch on the screen.

Controller:

- A controller will be connected between the touch sensor and PC. It takes information from the sensor and translates it for the understanding of PC. The controller determines what type of connection is needed.

Software driver:

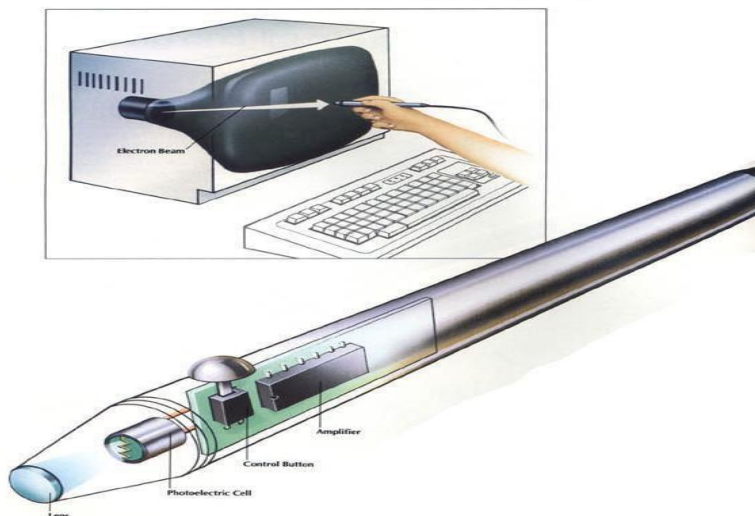
- It allows computers and touch screens to work together. It tells OS how to interact with the touch event information that is sent from the controller.

Light Pen –

- Light pen is an input device that utilizes a light sensitive detector to select objects on a display screen.
- In this pen, you hold the pen in your hand and directly point with it on the screen to select menu items or icons or directly draw graphics on screen or write with it on a special pad for direct input of the written information to the system.
- It is used with CRT base display, but not with LCD screens.

How light pen works?

- Light enters the lens of a light pen, where it encounters a photoelectric cell, which converts the energy to a signal that is sent to the computer.
- The light is obtained from the refresh of the CRT, and at the instant the light is generated, the computer knows what location on the screen is being refreshed.
- This information is coordinated with the signal from the light pen and is subsequently used by the graphics software.



Touch Pad / Track pads –

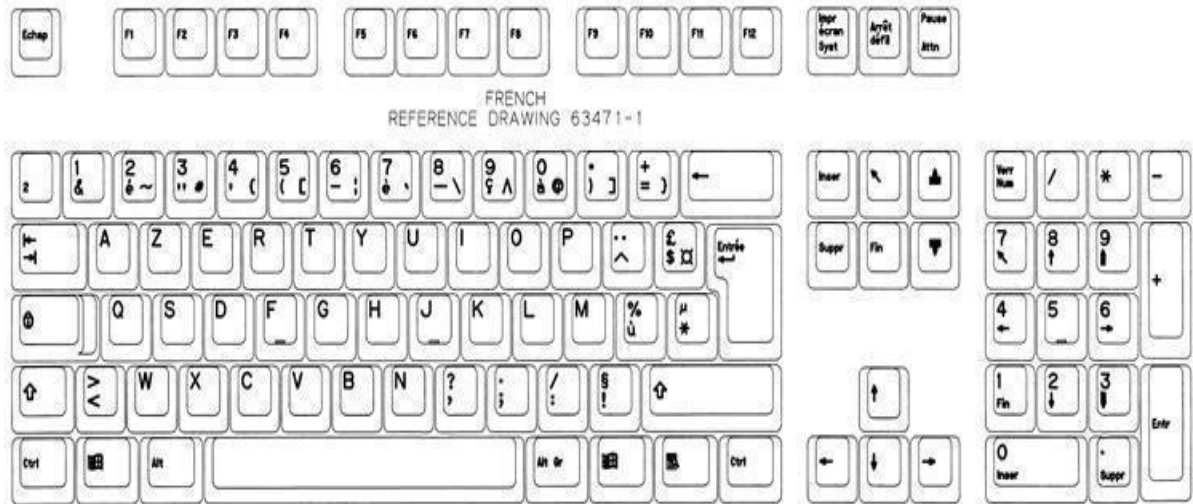
- A touch pad is a device for pointing on a computer display screen.
- It is an alternative for the mouse and designed mainly for laptop computers.
- It works by sensing the user's finger movement and downward pressure.
- **How touchpad works?**
 - A touch pad contains several layers of material.
 - The top layer is the pad that you touch.
 - After that, there are layers containing horizontal and vertical rows of electrodes that form a grid.
 - After this layer, there is a circuit board to which the electrode layers are connected.
 - The layers with electrodes are charged with a constant alternating current (AC).
 - As the finger approaches the electrode grid, the current is interrupted and the interruption is detected by the circuit board.
 - The initial location where the finger touches the pad is registered so that subsequent finger movement will be related to that initial point.
 - Touchpad also has two buttons below the touch panel that allows you to left click or right click.
 - Some touch pad sense single or double taps of the finger at any point on it.

4.1.2 Keyboard –

- Keyboard is the most common input device which helps in inputting data to the computer.
- Its layout is like traditional typewriter, but it performs additional functions.
- Using keyboard, a person can type a document, make key shortcuts, play games

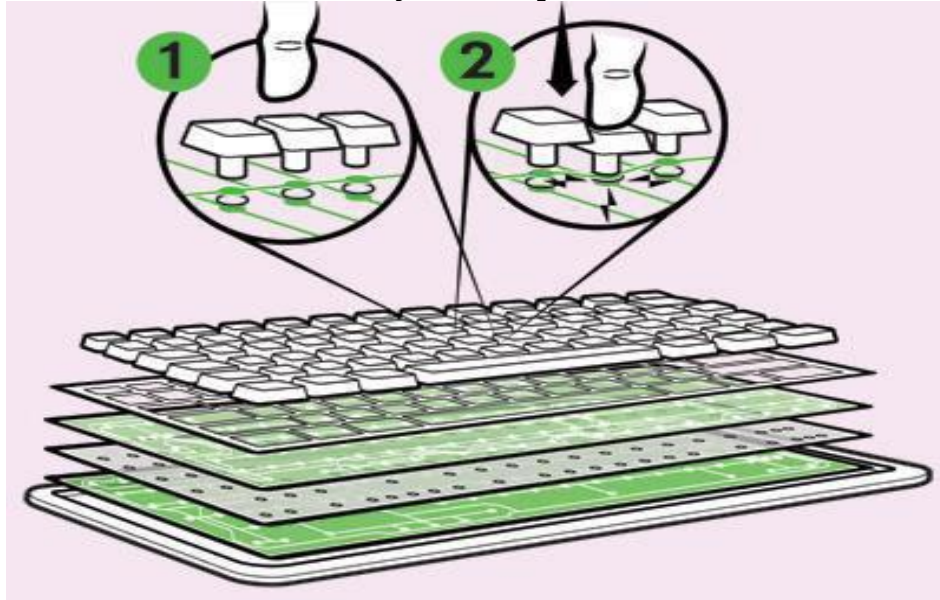
and perform other tasks.

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



- The keys on the keyboard are as follows:
 1. Alphanumeric keys (A-Z, 0-9)
 2. A numeric keypad
 3. Function keys (F1 – F12)
 4. Control keys (Home, End, Insert, Delete, Page Up, Page Down, Ctrl, Alt, Esc, Arrow keys)
 5. Special Purpose keys (Enter, Shift, Caps Lock, Space bar, Tab, Print screen)
- **How keyboard works?**
 - In each key of keyboard, there is a little electrical switch under it.
 - When you press a key(1), its switch completes an electrical circuit(2).
 - A processor inside the keyboard records which circuits were completed and in what order.

- This keyboard processor records information into part of its memory, known as keyboard buffer.
- Then it sends that information to your computer.



- Your computer is programmed for “what to do” with the information sent by keyboard processor.
- For example, when the computer gets the signal that the backspace key was pressed, it knows to erase a keystroke.

4.1.3 RFID (Radio frequency identification) Concepts and Application in Fast Tag

RFID (Radio frequency identification) Concepts

FAST Tag – A smarter way of Toll Collection.

In India, the concept was decided to implement in the month of April 2013 and the Scheme of ‘One Nation One FAST Tag’ came into force on 15 December 2019. To prevent the overcrowding of traffic, air pollution and to ensure a smooth transportation on National highway’s Toll plazas, the NPCL (National Payments

Corporation of India) has introduced FAST Tag as a nationwide Electronic Toll Collection solution which has become compulsory on Fast tag-only lanes and presently it is operational at 240 plus toll plazas across national & state highways.

FAS Tag is a vehicle-specific and RFID Technology-based device which enables digital cash transaction for paying toll-fare while being a vehicle in motion. It is an RFID tag fixed on the windscreen of a vehicle which enables electronic toll collection immediately from the registered bank account of the car owners without stopping them for payment.



RFID:

- RFID is a technology behind Fast tag.
- RFID belongs to a group of technologies referred to as Automatic Identification and Data Capture (**AIDC**).
- AIDC methods automatically identify objects, collect data about them, and enter those data directly into computer systems with little or no human intervention. RFID methods utilize radio waves to accomplish this.
- **At a simple level, RAID systems consist of three components: an RFID tag or smart label, an RFID reader, and an antenna.**
- RFID tags contain an integrated circuit and an antenna, which are used to transmit data to the RFID reader (also called an interrogator).
- The reader then converts the radio waves to a more usable form of data. Information collected from the tags is then transferred through a communications interface to a host computer system, where the data can be stored in a database and analyzed at a later time.
- When the vehicle reaches the toll plaza, the RFID antenna at the top of the toll gates scans the tag identification number and the QR code and then lifts the barriers to allow a vehicle to pass through.

Types of RFID tags:

Passive RFID tags (used in FAST Tag): Passive RFID tags are those tags which operate **without a battery** and get power supply from the electromagnetic energy transmitted by the RFID reader.

Active RFID tags (battery-powered): Active RFID tags operate through a **small battery** that powers the relay of information. These have a short time span and need to be replaced when the battery dies.

RFID Applications:

- Inventory management
- Asset tracking
- Personnel tracking
- Controlling access to restricted areas
- Supply chain management

FAST Tag Benefits:

- It is a reloadable tag which is simple to use.
- Reduces the overcrowding and waiting time at toll plazas.
- Prevents air pollution which occurs due to congestion around toll plaza.
- Facilitate ease of transaction through digital payment of toll-fare.
- Saves the travel time and fuel consumption.
- Provide secure interoperable framework applicable across the country.
- Eco-friendly initiative as it reduces pollution and use of paper.
- Better highway management and reduced efforts in managing toll plaza.
- A web portal for all the customers to access their statements of transaction by logging on the FAST Tag customer portal.
- SMS alerts for the transactions on the registered mobile number of the customer.
- Online recharge facility by using any of the authorized method of payments and bank linked to the FAST Tag.

4.2 Explain about different scanner available.

- A scanner is an input device that converts paper document into a digital file format that can be stored in a computer.
- The input documents may be typed text, pictures, graphics or hand written material.
- This input device is very useful for preserving paper documents in electronic form.
- This stored image can also alter and manipulated using image processing software.
- These scanners are of various shapes and sizes. Commonly used types are:

4.2.1 Optical Scanner

- An optical scanner is an input device using light beams to scan and digitally convert images, codes, text or objects as two-dimensional (2D) digital files and sends them to computers and fax machines.
- Flatbed scanner are optical scanner which makes use of a flat surface for scanning documents. The scanner is capable of capturing all elements on the document and does not require movement of the document
- A flatbed scanner is like a copier machine consisting of a box having a glassplate on its top and lid that covers the glass plate.



- A document to be scanned is placed upside down on the glass plate, moves horizontally from one end to another when activated.
- After scanning one line, the light beam moves up a little and scans the next line. The process is repeated for all the lines.
- Its name derives from the fact that, the glass plate, where the document to be scanned is placed, is flat.
- Flatbed scanner comes in different sizes like A4, A3, etc.
- Flatbed scanner can scan single sheet of paper and page from book.
- Most scanners can scan documents of 8 ½ by 11 inches. Some can scan larger documents.

- These scanners are larger than hand held or sheet fed scanner. It produces good quality image.

Hand Held Scanner –

- A handheld scanner is a small manual scanning device which is moved over the object that needs to be scanned.
- It is generally cheap and for home user market.
- It has a set of light emitting diodes encased in small case, which can be conveniently held in hand during scanning operation.



- Most common example of hand-held scanner is **barcode scanner**, which is used in shopping store.

4.2.2 Bar Code Readers

- Bar Code Reader is a device used for reading bar coded data (data in the form of light and dark lines).
- Bar coded data is generally used in labeling goods, numbering the books, etc.
- It may be a handheld scanner or may be embedded in a stationary scanner.
- Bar Code Reader scans a bar code image, converts it into an alpha numeric value, which is then fed to the computer that the bar code reader is connected to.
- This method uses a number of bars (lines) of varying thickness and spacing between them to indicate the desired information.
- An optical-bar reader can read such bars and convert them into electrical pulses to be processed by a computer.
- The most commonly used bar-code is Universal Product Code (UPC).

- The UPC code uses a series of vertical bars of varying width. These bars are detected as ten digits. The first five digits identify the supplier or manufacturer of the item. The second five digits identify individual product.
- The code also contains a check digit to ensure that the information read is correct or not.

4.2.3 Web camera

- The webcam is a compact digital camera that works the same as a conventional digital camera but is designed to interact with the web pages and other Internet pages. It is also known as a web camera that can capture pictures or motion video.
- Webcam, the small bug-eyed camera mounted on the computer captures light through the front small lens using a grid of microscopic light-detector. These light detectors are built into the image-sensing microchip.
- This chip is the core of webcam that captures the images and videos and converts them to the digital format (such as the string of zero and one).
- Also, the webcam does not include any memory chip as it does not store the captured images and videos rather immediately transfer them to the computer.
- Take a close look at the back of the webcam and you will notice a USB cable. This is the cable through which computer or laptop supplies power to the webcam and then the captured images are sent back to the computer again.

Features of Web camera

The webcams can differ in terms of size, shape, specification, and price. There are several features of webcam that help you choose the best webcam for your individual needs:

Megapixels

The megapixels are very small dots of colour that make a visual image when they are combined. Accordingly, a webcam produces a clearer bright image with more megapixels. Although a webcam with 320X240 or 640X480 pixels provides a better image. Also, the 1280X720 pixels are considered a better specification for your webcam to produce high definition (HD) quality.

Frame Rate

As the megapixels control the image and color brightness, the frame rate deals with the video quality, which decides how many images per second are displayed. At least the frame rate in a reasonable webcam will have 30 frames

per second. If the frame rate is less than 30fps, this is out of date, and images may shake and vibrate. A webcam that supports 60 fps recording can provide a higher quality moving image or smoothest video.

Lens Quality

In the video process, the lens is the first stage. Therefore, it is most important that your camera has the correct lens for full filling your requirements.

Autofocus

There can be a lot of activity happening during a webcam session in many scenarios; autofocus is a feature that works by automatically focusing the subject, while it moves around.

Low Light Quality

Sometimes, if you need to use your webcam in the evening or in low light conditions, the image quality can be very poor.

Resolution

A resolution is an important aspect in pictures or videos, although many webcams support 720p and 1080p high-definition quality. Also, some webcams come to have 4k capability, but they come with a premium price tag. A webcam with a resolution between 1.3MP and 2.0MP can provide you clear pictures.

Applications of Web camera:

Buildings, Banking sector, Video calling, home security system, Roads and parking areas

Explain optical scanner in detail. OR Write detail note on OCR and OMR.

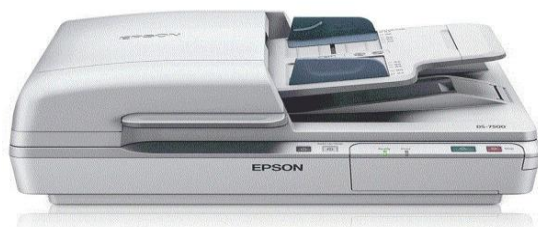
Optical Character Reader / Optical Character Recognition (OCR) –



- OCR is the recognition of printed or written text characters by a computer.
- It scans the text character by character, analyzes scanned image and translates character image into character codes like ASCII.
- With normal image scanner scanned documents are stored as an image. So, word processing is not possible. Image data required more storage than text data. These limitations are overcome using OCR.
- It is used by libraries to digitize and preserve their documents. It is also used to process checks; credit card slips and sort mails.
- In this, the data is passed to the computer by either scanner or other hardware device like digital camera.
- OCR still has difficulty with handwritten text.

Optical Mark Reader / Optical Mark Recognition (OMR) –

- OMR are capable of recognizing a pre-specified type of mark made by pencil or pen.
- It is very useful for grading tests with objective type



- questions, or for any input data that is of a choice or selection nature.
- This technique involves focusing a light on the page being scanned and detecting the reflected light pattern from the marks.
- Reflection of light from marks made by pencil and plain paper are different, which enable the reader to determine



which response is marked.

- It allows the processing of hundreds or thousands of physical documents per hour.
- It allows the processing of hundreds or thousands of physical documents per hour.

4.3 Introductions and comparisons of Output devices

4.3.1 Monitors

A monitor is an electronic output device that is also known as a video display terminal (VDT) or a video display unit (VDU). It is used to display images, text, video, and graphics information generated by a connected computer via a computer's video card.

Types of monitors:

1. CRT monitors (Cathode Ray Tube)

It is a technology used in early monitors. It uses a beam of electrons to create an image on the screen. It comprises the guns that fire a beam of electrons inside the screen.

The electron beams repeatedly hit the surface of the screen. These guns are responsible for generating RGB (Red, Green, Blue) colours, and more other colours can be generated with the help of combining these three colors. Today's Flat Panel Monitors replace the CRT monitors.

When CRT monitors can still be found in some organization, many offices have stopped using them largely because they are bulky, heavy, costly and require more space.



2. LED monitors (light-emitting diode)

LED monitor is a flat screen computer monitor, which stands for light-emitting diode display. It is lightweight in terms of weight and has a short depth.

As the source of light, it uses a panel of LEDs. Nowadays, a wide number of electronic devices, both large and small devices such as laptop screens, mobile phones, TVs, computer monitors, tablets, and more, use LED displays.

A LED display is a flat panel display that uses an array of light-emitting diodes as pixels for a videodisplay.

An LED is an electronic device that emits light when an electrical current is passed through it.

Light Emitting Diode (LED) monitors also feature a liquid crystal display, but the backlighting is produced by LEDs, not fluorescent lamps.



3. LCD monitors (liquid-crystal display)

The LCD monitors bring lots of advantages when compared to the CRT ones. The first advantage which is also the most obvious one is the fact that the LCD monitors are smaller and have a smaller weight than the CRT monitors.

The LCD monitors can be placed on the table and they use far less space than the CRT monitors. This is a great advantage. The picture quality of the LCD monitors will be increased as well which means that the movies will be displayed in a better quality and the games will have better colours, and so on.



LCD displays utilize two sheets of polarizing material with a liquid crystal solution between them.

The LCD **monitor does not produce its own light**. Instead, additional lighting behind the screen shines through the glass and illuminates the crystals. LCD monitors are usually backlit **fluorescent lamps**.

4. TFT monitors (thin-film transistor)

It is a type of LCD flat panel display, which stands for a thin-film transistor. In TFT monitors, all pixels are controlled with the help of one to four transistors.

The high-quality flat-panel LCDs use these transistors. Although the TFT-based monitors provide better resolution of all the flat-panel techniques, these are highly expensive.

The LCDs, which use thin-film transistor (TFT) technology, are known as active-matrix displays. The active-matrix displays offer higher quality as compared to older passive-matrix displays.



5. OLED monitors (organic light-emitting diode)

It is a new flat light-emitting display technology, which is more efficient, brighter, thinner, and better refresh rates feature and contrast as compared to the LCD display.

These displays do not need a backlight as they are emissive displays. Furthermore, it provides better image quality ever and used in tablets and high-end smartphones.

Nowadays, it is widely used in laptops, TVs, mobile phones, digital cameras, tablets, VR headsets.



6. Touch Screen Monitor

These monitors are also known as an input device. It enables users to interact with the computer by using a finger instead of using a mouse or keyboard.

When users touch the screen by their finger, it occurs an event and forward it to the controller for processing.

These types of screens include pictures or words that help users to interact with the computer. It takes input from the users by touching menus or icons presented on the screen.



A touch screen is a computer display screen that serves as an input device. When a touch screen is touched by a finger or stylus, it registers the event and sends it to a controller for processing.

A touch screen may contain pictures or words that the user can touch to interact with the device.

How a touch screen event is registered depends on the touch screen's inherent technology? The three main touch screen technologies are:

Resistive: This screen has a thin metallic layer that is conductive and resistive, so that touching results in a change in the electrical current sent to the controller.

Surface Acoustic Wave (SAW): Ultrasonic waves pass over this screen. Touching it results in absorption of part of the wave, registering the position of the touch, which is sent to the controller.

Capacitive: This screen is coated with an electrically-charged material. Touching it causes a change in capacitance, which allows the location to be determined and sent to the controller.

4.3.2 Printers

A printer Is a hardware output device that is used to generate hard copy and print any document.

A document can be of any type such as a text file, image, or the combination of both.

It accepts input command by users on a computer or on other devices to print the documents. For example, if you have to submit a project report at your college, you need to create a soft copy of your report and print it with the help of the printer

Printer can be classified into two types according to technology used in their manufacturing:

Impact Printers

Impact printers print the characters by striking them on the ribbon, which is then pressed on the paper. These printers are of two types – Character printers, Line printers. **(Dot Matrix printer)**

Non-impact printers

Non-impact printers print the characters without using the ribbon. These printers print a complete page at a time, thus they are also called as Page Printers. **(Laserprinter, Inkjet printer)**

BASIS FOR COMPARISON	IMPACT PRINTERS	NON-IMPACT PRINTERS
Contain	Electromechanical print head	No electromechanical device
Mechanism	Printing Is done by hammering a set of metal pin or character set	Printing is done using laser beam or ink
Multiple copies	Can be created	Hard to produce multiple copies.
Noise	Operation produces noise	Works silently
Speed	Slow	Faster
Quality	Low	High
Cost	Low	High
Example	Dot matrix, chain printer, drum printer	Inkjet and laser printers.

According to hinting style, printers are divided in three types!

- 1) Character printer
 - o Prints one character at a time
 - o Examples: dot matrix printer, Inject printer
- 2) Line printer
 - o Prints one line at a time
 - o Examples: drum printer, chain printer
- 3) Page printer
 - o Prints one page at a time
 - o Examples: laser printer

1. 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.

Dot matrix printers are character printer, which print one character at a time.

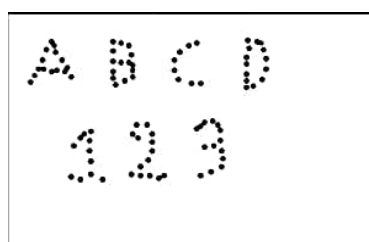
They form characters and all kind of Images as a pattern of dots.

it has a print head which can move horizontally left to right / right to left across the paper.

A print head contains an array of pins, which can be activated independent of each other to extend and strike against an inked ribbon to form a pattern of dots on the paper.

The printer activates the appropriate set of pins as the print head moves horizontally,

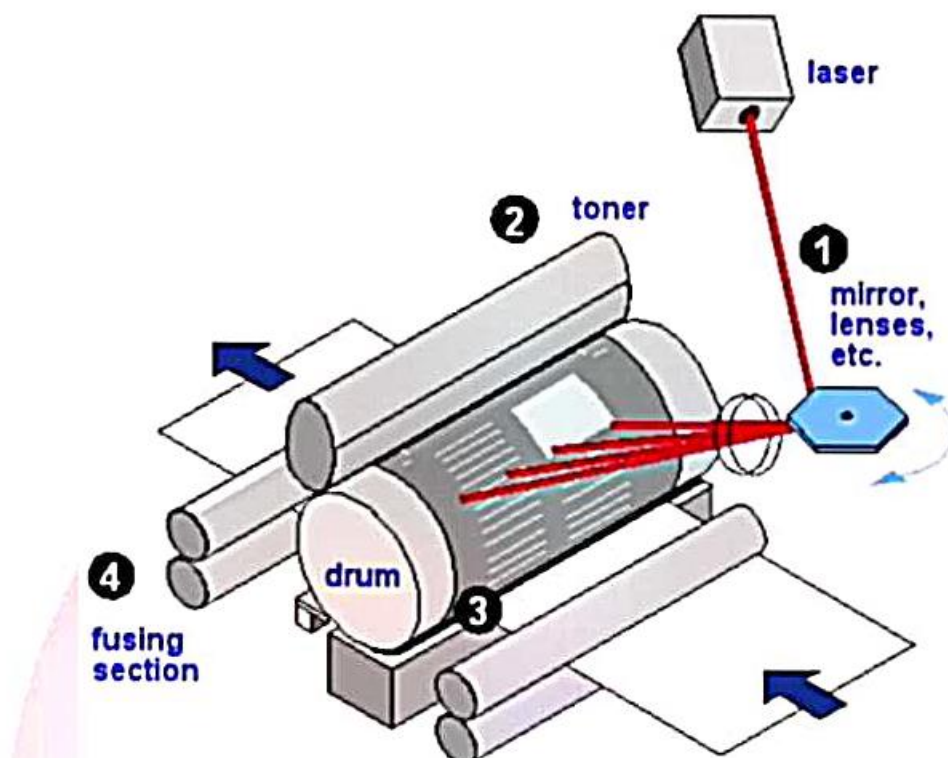
For faster printing, Dot-matrix printers are designed to print both while move from left to right and while it moves return from right to left.



Advantages Inexpensive Widely Used Other language characters can be printed	Disadvantages Slow Speed, Poor Quality
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2. 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.



Structure: The main component of a laser printer are

1. Laser beam source
2. A multi sided mirror
3. Photoconductive drum
4. Toner

Working

Laser beam Is focused on electro statically charged drum which spinning by multisided mirror.

The mirror focuses laser beam on the surface of the drum in a manner to create the pattern of character to be print on page.

Drum is photoconductive

Different electric charge is created on those part of drum surface which exposed to laserbeam.

Toner which is opposed to charged ink particles, stick to the drum in the places where laser

beam has charged the drum surface.

Toner is finally fused on paper with heat and pressure to generate the printed output.

After print one-page drum is rotated and cleaned with rubber blade to remove toner sticking to its surface.

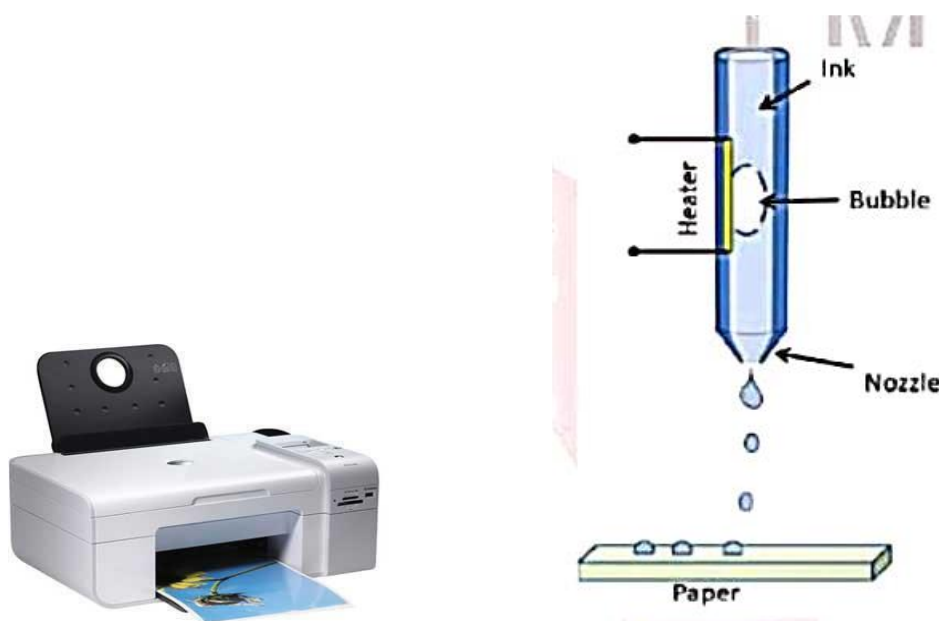
Advantages	Disadvantages
Very high speed Very high quality output Good graphics quality Supports many fonts and different character size	Expensive Cannot be used to produce multiple copies of a document in a single printing.

3. 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 and these have many styles of printing modes available.

Color printing is also possible. Some models of Inkjet printers can produce multiple copies of printing also.



An ink jet printer uses dot-matrix approach to print text and graphics. Most ink jet printers use multiple jets vertically aligned on a cartridge, which move horizontally across a page.

The ink cartridges contain a column of tiny heaters. When a heater is activated a drop of ink is exploded onto the paper.

The print head contains an ink cartridge which is made up of a number of Ink-filled firing chambers each attached to a nozzle thinner than a human hair.

When an electric current is passed through a resistor, the resistor heats a thin layer of ink at the bottom of the chamber.

This causes the ink to boil and form a vapour bubble. The vapour bubble expands and pushes Ink through the nozzle to form a droplet at the tip of the nozzle.

The pressure of vapour bubble forces the droplet to move to the paper.

When the resistor cools down, the bubble collapses. This results in a pressure which pulls fresh ink from the cartridge into the firing chamber.

Advantages	Disadvantages
High quality printing More reliable	Expensive as the cost per page is high Slow as compared to laser printer

COMPARISION OF PRINTERS

Technology Type	LASER PRINTER Non-Impact printer	INK JET PRINTER Non-Impact printer	Dot Matrix Printers Impact printer
How it works	Laser printers use fineink powder and heat the powder on the paper.	Inkjet printers spray liquidink on paper through microscopic nozzles.	Dot Matrix works having pins pushed against an ink-soaked ribbon to paper.
Printing style	One page at a time	One Character at a time	One Character at a time
Printing speed	20 pages a minute	6 pages a minute	30-550 characters per second.
Quality	Printing quality is adequate. Best for black and white.	Printing quality is good, especially for smalls. fonts.	Printing quality is badif printing images. In terms of text. printing is fine
Maintenance	Expensive	Cheaper	Expensive, difficult to get parts.
Noisy	No	No	Yes

Print multiple copies at a time.	No	NO	Yes
Main Component	Photo conductive drum, toner, laser beam	ink, tiny nozzle	Pin array
Advantages	Prints faster High quality High speed No noise	Low printer cost Compact size No noise No warm up time compare to laser printer	Cheap Produce multiple Copy
Disadvantages	Expensive	Expensive ink Short life time of printed page Easily get "blur" If get water drop	Low resolution Low speed Noisy

Course Title: 103 Introductions to Computers

Unit – 5: Concepts of Internet

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5.1 Concepts of Internet and WWW

Internet is a massive global network of interconnected computers and devices that communicate using standardized protocols (TCP/IP). The World Wide Web (WWW) is a collection of webpages and digital content accessed through the Internet using browsers and the HTTP protocol. Think of the Internet as the infrastructure (roads) and the Web as the service running on it (shops along the roads).

5.1.1 Types of Internet Services

The Internet provides a wide range of services that enable communication, information sharing, and resource access. Below are the key services:

1. Electronic Mail (Email)

Allows users to send and receive text messages, attachments, and multimedia over the Internet. Examples: Gmail, Yahoo Mail, Outlook. Uses protocols like SMTP (Simple Mail Transfer Protocol) for sending, and POP3/IMAP for receiving.

2. World Wide Web (WWW)

A system of interlinked hypertext documents and multimedia content accessed via web browsers. Websites are built using HTML, CSS, and JavaScript, and served over HTTP/HTTPS protocols. This is the most widely used Internet service.

3. File Transfer Protocol (FTP)

Enables uploading and downloading files between a client and a server on a network. Commonly used for website management and large file transfers. Example software: FileZilla. Secure version: SFTP.

4. Chat and Instant Messaging

Real-time text, voice, and video communication between users over the Internet. Examples: WhatsApp, Telegram, Microsoft Teams, Google Meet. Enables both personal and professional communication globally.

5. Search Engines

Services that index and retrieve information from the web based on user queries. Examples: Google, Bing, DuckDuckGo. They use automated web crawlers (spiders) and complex ranking algorithms to deliver relevant results.

6. Streaming Services

Allow real-time transmission of audio and video content over the Internet. Examples: YouTube, Netflix, Spotify, Amazon Prime Video. They use adaptive bitrate streaming to adjust quality based on connection speed.

How Internet Services Work: User Device → ISP (Internet Service Provider) → Internet Backbone (global network of high-capacity routers and fiber-optic cables) → Destination Server → Specific Service (Email/Web/FTP) delivers the content back to the user.

5.1.2 Hardware Components

Essential hardware devices that enable Internet connectivity and communication:

1. Modem (Modulator-Demodulator)

A modem converts digital data from your computer into analog signals for transmission over telephone lines or cable systems, and vice versa. It is the primary device that connects your network to the Internet Service Provider (ISP).

- Types: DSL Modem, Cable Modem, Fiber Modem, Dial-up Modem
- Function: Modulation (digital → analog) and Demodulation (analog → digital)
- Speed: Ranges from 56 Kbps (dial-up) to over 1 Gbps (fiber)
- Usually provided by the ISP and connects to a wall outlet (telephone, cable, or fiber)

Key Point: A modem alone connects one device. To share the connection among multiple devices, a router is needed.

2. Router

A router directs data packets between different networks. It takes the single Internet connection from the modem and distributes it to multiple devices (computers, phones, smart TVs) either via Ethernet cables or wirelessly (Wi-Fi).

- Function: Routes data between the local network (LAN) and the Internet (WAN)
- Features: NAT (Network Address Translation), DHCP (assigns IP addresses), Firewall, Port Forwarding
- Wi-Fi Standards: Wi-Fi 5 (802.11ac), Wi-Fi 6 (802.11ax), Wi-Fi 6E
- Many modern devices are combo modem+router units provided by ISPs

3. Bluetooth

Bluetooth is a short-range wireless technology standard for exchanging data between fixed and mobile devices over short distances using UHF radio waves (2.402 GHz to 2.48 GHz).

- Range: Typically 10 meters (Class 2), up to 100 meters (Class 1)
- Versions: Bluetooth 5.0, 5.1, 5.2, 5.3 — each improving speed, range, and features
- Common Uses: Wireless headphones, keyboards, mice, file transfer, smartwatches, speakers
- Pairing: Devices must be "paired" once; subsequent connections are automatic
- Low power consumption makes it ideal for battery-powered devices (BLE — Bluetooth Low Energy)

Note: Bluetooth is NOT the same as Wi-Fi. Bluetooth is for short-range device-to-device communication, while Wi-Fi is for connecting devices to a network/Internet over longer distances.

4. Fire Stick

Amazon Fire Stick is a streaming media player that plugs directly into a TV's HDMI port, transforming a regular TV into a smart TV. It connects to the Internet via Wi-Fi to stream content from various services.

- Connectivity: Wi-Fi (dual-band), Bluetooth, HDMI output
- Features: Voice search (Alexa), app ecosystem, screen mirroring from mobile devices
- Streaming Apps: Prime Video, Netflix, YouTube, Disney+, Hotstar, and thousands more
- Hardware: Quad-core processor, 8GB storage, remote control included
- Requires a Wi-Fi Internet connection and an HDMI-compatible TV

Hardware Comparison Table

Device	Primary Function	Range	Internet Required?
Modem	Converts signals for ISP connection	N/A (wired)	Yes
Router	Distributes Internet to multiple devices	30-100m (Wi-Fi)	Yes
Bluetooth	Short-range device-to-device communication	10-100m	No
Fire Stick	Streams media content to TV	N/A (Wi-Fi)	Yes

5.1.3 Types of Internet Connections

1. Wi-Fi (Wireless Fidelity)

Wi-Fi uses radio waves to provide wireless Internet access within a local area. A wireless router creates a Wi-Fi network that multiple devices can connect to simultaneously.

- Range: Typically 30-50 meters indoors, up to 100 meters outdoors
- Speed: Wi-Fi 6 can deliver up to 9.6 Gbps theoretically; real-world speeds are lower
- Security: Protected by WPA2/WPA3 encryption; always use a strong password
- Bands: 2.4 GHz (longer range, slower) and 5 GHz (shorter range, faster)

2. Mobile Hotspot

A hotspot turns a mobile device (smartphone or dedicated hotspot device) into a portable Wi-Fi router, sharing its cellular data connection with other devices.

- Source: Uses 4G/5G cellular data network
- Devices Supported: Typically 5-10 devices simultaneously
- Battery Impact: Drains phone battery quickly; portable hotspot devices last longer
- Use Case: Travel, temporary setups, areas without fixed broadband

3. Cable Internet (Wired/Ethernet)

Cable Internet uses coaxial cables (the same type used for cable TV) to deliver high-speed Internet. Ethernet cables (Cat5e, Cat6) provide wired connections from the router to devices.

- Speed: 50 Mbps to 1 Gbps+ depending on the plan
- Advantage: More stable and consistent than wireless; no interference from walls or other devices
- Ethernet: Cat6 cable supports up to 10 Gbps over short distances
- Best For: Gaming, streaming, servers, desktop computers

Connection Comparison Table

Feature	Wi-Fi	Hotspot	Cable
Medium	Radio waves	Cellular + Wi-Fi	Coaxial / Fiber cable
Mobility	Within router range	Highly Mobile	Fixed location
Speed Stability	Moderate	Variable	Most Stable
Setup	Router + modem	Phone setting toggle	Modem + router + cable
Cost	Monthly ISP plan	Cellular data plan	Monthly ISP plan

5.2 Introduction to Cloud

5.2.1 Concepts of Cloud

Cloud Computing is the delivery of computing services — including servers, storage, databases, networking, software, analytics, and intelligence — over the Internet ("the cloud"). Instead of owning and maintaining physical data centers and servers, you rent access to these resources from a cloud provider like Amazon (AWS), Google (GCP), or Microsoft (Azure).

Key Characteristics of Cloud Computing

On-Demand Self-Service: Users can provision computing resources automatically without requiring human interaction with the service provider. **Rapid Elasticity:** Capabilities can be elastically provisioned and released to scale rapidly. **You pay only for what you use.** **Broad Network Access:** Resources are available over the network through standard mechanisms (browsers, mobile apps). **Measured Service:** Cloud systems automatically control and optimize resource use. You are billed based on actual consumption. **Resource Pooling:** Provider's computing resources are pooled to serve multiple consumers using a multi-tenant model.

Cloud Service Models

Model	Full Name	What You Get	Examples
SaaS	Software as a Service	Fully managed applications via browser. No installation needed.	Gmail, Google Docs, Netflix, Salesforce
PaaS	Platform as a Service	Development platform with tools, databases, middleware. Focus on coding.	Google App Engine, Heroku, Microsoft Azure App Service
IaaS	Infrastructure as a Service	Raw computing resources: VMs, storage, networking. Full control over OS.	AWS EC2, Microsoft Azure VMs, Google Compute Engine

Cloud Deployment Models

- **Public Cloud:** Owned and operated by third-party providers. Resources are shared among many customers. Most cost-effective option. Examples: AWS, Azure, GCP.

- **Private Cloud:** Exclusive to one organization. Can be on-premises or hosted by a third party. Offers greater control and security at higher cost.
- **Hybrid Cloud:** Combines public and private clouds, allowing data and applications to move between them. Offers flexibility and optimization.

5.2.2 Purpose and Application of Cloud (Example: Google Docs)

Why Use Cloud Computing?

- **Cost Savings:** No upfront investment in hardware. Pay-as-you-go model eliminates capital expenses.
- **Scalability:** Instantly scale resources up or down based on demand without purchasing new hardware.
- **Accessibility:** Access your data and applications from anywhere with an Internet connection, on any device.
- **Automatic Updates:** Cloud providers handle software updates, security patches, and maintenance automatically.
- **Disaster Recovery:** Data is replicated across multiple data centers, ensuring business continuity.
- **Collaboration:** Multiple users can work on the same document or project simultaneously from different locations.

Case Study: Google Docs (SaaS Example)

Google Docs is a perfect example of a cloud-based application demonstrating key cloud computing concepts:

1. **No Local Storage Needed:** Documents are stored on Google's servers, not your hard drive. You never lose your work if your computer crashes.
2. **Real-time Collaboration:** Multiple people can edit the same document simultaneously. You see others' cursors and changes in real-time — a hallmark of cloud computing.
3. **Access Anywhere:** Open your documents from any device with a browser — laptop, phone, tablet — anywhere in the world with Internet access.
4. **Version History:** Every change is tracked. You can revert to any previous version of the document, providing automatic backup and audit trail.

5. Zero Installation: No software to install or update. Everything runs in the browser, managed entirely by Google on their cloud infrastructure.

Other Cloud Application Examples

- Cloud Email: Gmail, Outlook — emails stored and accessible from anywhere
- Cloud Storage: Google Drive, Dropbox, OneDrive — store files online and sync across devices
- Cloud Streaming: Spotify, Netflix, Amazon Prime — content delivered from cloud servers on demand
- Cloud Productivity: Microsoft 365, Google Workspace — office suites in the cloud

5.2.3 Concepts of Online Data Backup

Online Data Backup (also called cloud backup or remote backup) is the process of sending a copy of your data over the Internet to a remote server maintained by a third-party service provider. This ensures your data is safe even if your local device is lost, stolen, damaged, or affected by malware.

How Online Backup Works

Your Device (files, photos, documents) → Data is encrypted (AES-256) → Uploaded over the Internet → Stored securely on cloud servers with redundancy.

Benefits of Online Data Backup

- Easy Recovery: Restore your files quickly from any device with an Internet connection.
- Automatic and Scheduled: Set it once and backups run automatically at scheduled intervals. No manual intervention needed.
- Secure Encryption: Most services use AES-256 encryption — the same standard used by governments and military.
- Scalable Storage: Start with free storage and upgrade as needed. No physical storage limits.
- Offsite Protection: Data is stored in a different physical location, protecting against local disasters.

Popular Online Backup Services

Service Free Storage Key Feature Best For

Google Drive

15 GB Deep integration with Google Workspace

General users, students

OneDrive 5 GB Windows integration, Office 365 Windows users, professionals

iCloud 5 GB Seamless Apple ecosystem sync iPhone/Mac users

Dropbox 2 GB Excellent file sync technology Teams, file sharing

Backblaze None Unlimited backup for one flat price Full system backup

3-2-1 Backup Rule (Gold Standard): Keep at least 3 copies of your data — 2 on different storage media (e.g., hard drive + cloud), with at least 1 copy stored offsite (e.g., cloud backup).

This ensures maximum data protection.

5.3 Introduction to Web Browser and Relevant Terminologies

A web browser is application software used to access and view websites on the Internet.

Popular browsers include Google Chrome, Mozilla Firefox, Microsoft Edge, and Apple Safari.

5.3.1 URL, Address Bar, Domain, Links, Navigation Buttons

1. URL (Uniform Resource Locator)

The web address used to locate a specific resource on the Internet. Every webpage, image, video, or file on the web has a unique URL.

Structure: <https://www.example.com/page/article>

- <https://> — Protocol (HTTPS = secure, HTTP = unsecure)
- www — Subdomain
- [example.com](https://www.example) — Domain name
- [/page/article](https://www.example.com/page/article) — Path to the specific resource

Complete URL Anatomy

<https://www.example.co.in:443/blog/post?id=10#comments>

Part Example Description

Protocol <https://> Communication protocol (secure)

Subdomain www Sub-section of the domain

Domain [example](https://www.example) Registered name of the website

TLD [.co.in](https://www.example.co.in) Top-level domain (country code: India)

Port [:443](https://www.example.co.in:443) Port number (default for HTTPS)

Path /blog/post Location of the resource on the server

Query ?id=10 Additional parameters sent to the server

Fragment #comments Specific section within the page

2. Address Bar

Also called the URL bar or omnibox (in Chrome). It displays the current page's URL and allows you to type a new URL or search query directly. It shows a padlock icon for secure (HTTPS) sites and a "Not Secure" warning for HTTP sites.

3. Domain

The registered name of a website on the Internet (e.g., google.com). Domains have extensions called TLDs (Top-Level Domains):

TLD Meaning Example

.com Commercial google.com

.org Organization wikipedia.org

.edu Education mit.edu

.gov Government india.gov.in

.in India (country code) example.in

.net Network example.net

4. Links (Hyperlinks)

Hyperlinks are clickable elements (text, images, buttons) that navigate you to another page or resource when clicked. Created using the HTML <a> (anchor) tag. They can link to:

- Another page on the same website (internal link)
- A page on a different website (external link)
- A specific section on the same page (anchor link using #)
- An email address, file download, or phone number

Links usually appear as blue underlined text, but can be styled in any way by the website designer.

5. Navigation Buttons

Button Function Shortcut (Win) Shortcut (Mac)

Back (←) Goes to the previously visited page Alt + Left Cmd + [

Forward (→) Goes to the next page (after going back) Alt + Right Cmd +]

Refresh/Reload Reloads the current page from the server F5 or Ctrl+R Cmd+R

Home Goes to your configured homepage Alt + Home Option+Cmd+H

Stop Stops loading the current page Esc Esc

5.3.2 Tabbed Browsing, Bookmarks, History

1. Tabbed Browsing

Tabbed browsing allows you to open multiple web pages within a single browser window, each in its own tab. This keeps your taskbar clean and makes switching between pages fast.

Action Windows / Linux macOS

Open new tab Ctrl + T Cmd + T

Close current tab Ctrl + W Cmd + W

Reopen closed tab Ctrl + Shift + T Cmd + Shift + T

Switch to next tab Ctrl + Tab Ctrl + Tab

Switch to previous tab Ctrl + Shift + Tab Ctrl + Shift + Tab

Open link in new tab Ctrl + Click on link Cmd + Click on link

Move tab to new window Drag tab out of window Drag tab out of window

2. Bookmarks (Favorites)

Bookmarks save the URL of a webpage so you can quickly return to it later without remembering or typing the address. They function like digital bookmarks in a book.

- Add Bookmark: Click the star icon in the address bar or press Ctrl+D
- Organize: Create folders to group related bookmarks (e.g., "Work", "News", "Learning")
- Bookmarks Bar: A toolbar below the address bar showing your most-used bookmarks for one-click access
- Sync: Modern browsers sync bookmarks across all your devices when signed into your account
- Export/Import: Bookmarks can be exported as an HTML file and imported into another browser
- Manage: Press Ctrl+Shift+O to open the Bookmark Manager

3. Browsing History

The browser history is a chronological log of all the web pages you have visited, organized by date and time. It is also used for address bar auto-suggestions.

- View History: Press Ctrl+H to open the history panel
- Search History: Type a keyword in the history search box to find specific pages
- Clear History: Press Ctrl+Shift+Delete to open the "Clear browsing data" dialog
- Time Range Options: Last hour, Last 24 hours, Last 7 days, Last 4 weeks, All time
- Incognito/Private Mode: In private browsing, history is NOT saved to disk. Useful for sensitive activities.
- Data Types to Clear: Browsing history, Download history, Cookies, Cached images, Passwords, Form data