

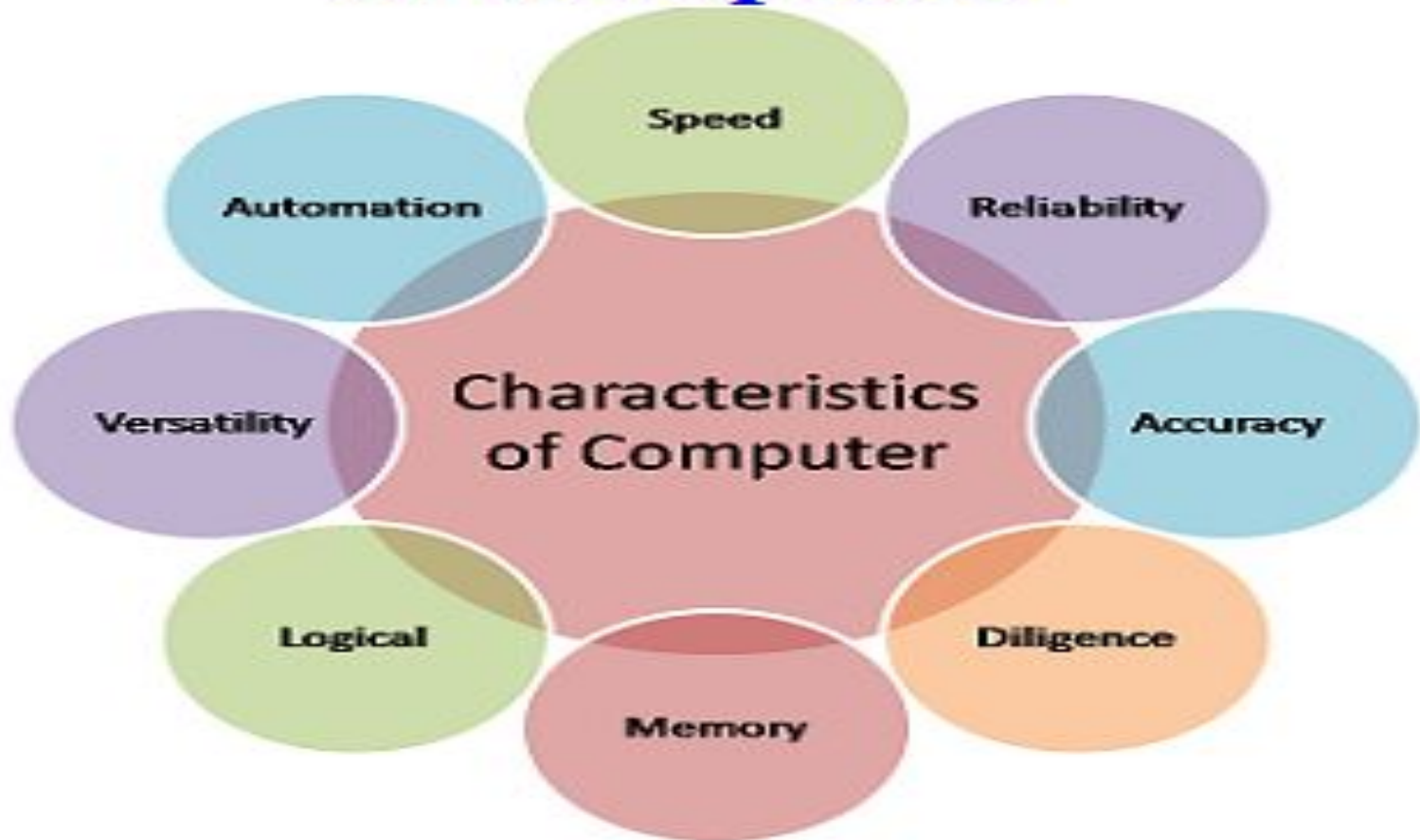
UNIT 1

WHAT IS A COMPUTER??

- A computer is a *machine* that can be instructed *to carry out sequences* of arithmetic or logical operations automatically via computer programming.
- *Modern computers* have the ability to follow *generalized sets of operations*, called *programs*. These programs enable computers to perform an extremely wide range of tasks.

Characteristics of a Computer

Characteristics / Features of Computer



- **Speed:** A computer is a very fast device. The computer takes a fraction of seconds to perform any operation. The speed of computer is measured in micro seconds (10^{-3}), Milliseconds (10^{-6}), nanoseconds (10^{-9}) and even Picoseconds (10^{-12}). A powerful computer is capable of performing about 3-4 million simple operations per second.
- **Accuracy:** The accuracy of computer is very high and the degree of a particular computer depends upon its design. But for a particular computer, each and every calculation is performed with the same accuracy.
Errors can occur in a computer but these are mainly due to human rather than technological weakness.
- **Storage Capacity :** Computers can store data and instruction with a lot of volume and very high efficiency.

- **Diligence**: Unlike human being a computer is free from **monotony, tiredness, lack of concentration** etc. and hence **can work for hours** together without creating any error. A computer can **perform the last calculation** with exactly the same accuracy and **speed as the first one**.
- **Automation**: Once a Program is in the computer's memory, **CPU follows the instructions until it meets the last instruction**. Though the program concept many tasks can be performed simultaneously, some on **foreground** and some on **background**. Thus automation bring the program execution fast

- **Reliability**: Because, computer is an electronic device thus it perform all operations with 100 % accuracy and reliability. Reliability can affect only error prone by human mind.
- **Versatility**: Versatility is one of the most **wonderful things** about the computer. One moment it can do any one operation and next moment it can perform any other operation. A computer is capable of performing almost any task according to given instructions.

Limitation or Drawback of Computer

- **No I.Q.**: Computer is not a magical device. It performs only those works which man can do but the main difference is that computer can work those operations with very high speed and reliable accuracy. It has no any intelligence quality or thinking power
- **No Feeling**: Because computer is only a machine, it has no feeling like human being. It has no brain for thinking as man can do. Man had successes to make computer memory be different inventions of technology but he couldn't make heart.

- **Data Machine Readable** : Computer data is read by machine, meaning data obtained from the computer can be read by the computer itself.
- It required power to operate.
- Problem may occur due to system breakdown.

GENERATION OF COMPUTERS

FIRST GENERATION: VACUUM TUBES (1940-1956)

- The first [computer systems](#) used vacuum tubes for circuitry and [magnetic drums](#) for [memory](#), and were often enormous, taking up entire rooms. These computers were very expensive to operate and in addition to using a great deal of electricity, the first computers generated a lot of heat, which was often the cause of malfunctions.
- First generation computers relied on [machine language](#), the lowest-level [programming language](#) understood by computers, to perform operations, and they could only solve one problem at a time. It would take operators days or even weeks to set-up a new problem. Input was based on punched cards and paper tape, and output was displayed on printouts.
- The UNIVAC and [ENIAC](#) computers are examples of first-generation computing devices. The UNIVAC was the first commercial computer delivered to a business client, the U.S. Census Bureau in 1951.

Characteristics of first generation of computers (1940s-1950s)

- Main electronic component – vacuum tube
- Main memory – magnetic drums and magnetic tapes
- Programming language – machine language
- Power – consume a lot of electricity and generate a lot of heat.
- Speed and size – very slow and very large in size (often taking up entire room).
- Input/output devices – punched cards and paper tape.
- Examples – ENIAC, UNIVAC1, IBM 650, IBM 701, etc.
- Quantity – there were about 100 different vacuum tube computers produced between 1942 and 1963.

SECOND GENERATION: TRANSISTORS (1956-1963)

- The world would see [transistors](#) replace vacuum tubes in the second generation of computers. The transistor was invented at Bell Labs in 1947 but did not see widespread use in computers until the late 1950s.
- The transistor was far superior to the vacuum tube, allowing computers to become smaller, faster, cheaper, more energy-efficient, and more reliable than their first-generation predecessors. Though the transistor still generated a great deal of heat that subjected the computer to damage, it was a vast improvement over the vacuum tube. Second-generation computers still relied on punched cards for [input](#) and printouts for [output](#).

From Binary to Assembly

- Second-generation computers moved from cryptic binary machine language to symbolic, or assembly, languages, which allowed programmers to specify instructions in words. High-level programming languages were also being developed at this time, such as early versions of COBOL and FORTRAN. These were also the first computers that stored their instructions in their memory, which moved from a magnetic drum to magnetic core technology.

Characteristics of second generation of computers (1950s-1960s)

- Main electronic component – transistor
- Memory – magnetic core and magnetic tape / disk
- Programming language – assembly language
- Power and size – low power consumption, generated less heat, and smaller in size (in comparison with the first generation computers).
- Speed – improvement of speed and reliability (in comparison with the first generation computers).
- Input/output devices – punched cards and magnetic tape.
- Examples – IBM 1401, IBM 7090 and 7094, UNIVAC 1107, etc.

THIRD GENERATION: INTEGRATED CIRCUITS (1964-1971)

- The development of the [integrated circuit](#) was the hallmark of the third generation of computers. Transistors were miniaturized and placed on [silicon chips](#), called [semiconductors](#), which drastically increased the speed and efficiency of computers.
- Instead of punched cards and printouts, users interacted with third generation computers through [keyboards](#) and [monitors](#) and [interfaced](#) with an [operating system](#), which allowed the device to run many different [applications](#) at one time with a central program that monitored the memory. Computers for the first time became accessible to a mass audience because they were smaller and cheaper than their predecessors.

Characteristics of third generation of computers (1960s-1970s)

- Main electronic component – integrated circuits (ICs)
- Memory – large magnetic core, magnetic tape / disk
- Programming language – high level language (FORTRAN, BASIC, Pascal, COBOL, C, etc.)
- Size – smaller, cheaper, and more efficient than second generation computers (they were called minicomputers).
- Speed – improvement of speed and reliability (in comparison with the second generation computers).
- Input / output devices – magnetic tape, keyboard, monitor, printer, etc.
- Examples – IBM 360, IBM 370, PDP-11, UNIVAC 1108, etc.

Characteristics of fourth generation of computers (1970s-present)

- Main electronic component – very large-scale integration (VLSI) and microprocessor.
- VLSI– thousands of transistors on a single microchip.
- Memory – semiconductor memory (such as RAM, ROM, etc.)
 - RAM (random-access memory) – a type of data storage (memory element) used in computers that temporary stores of programs and data (volatile: its contents are lost when the computer is turned off).
 - ROM (read-only memory) – a type of data storage used in computers that permanently stores data and programs (non-volatile: its contents are retained even when the computer is turned off).

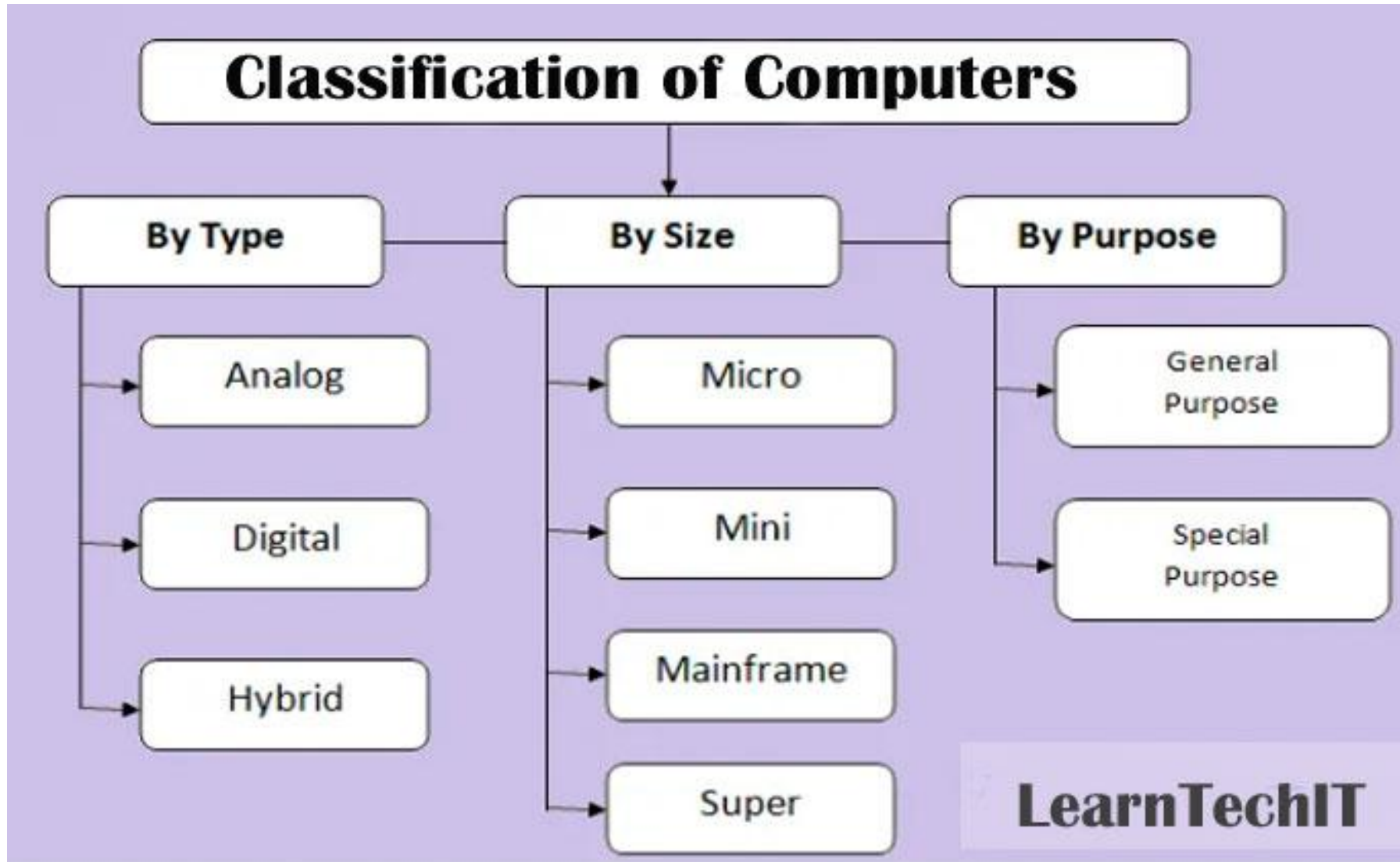
- Programming language – high level language (Python, C#, Java, JavaScript, Rust, Kotlin, etc.).
 - A mix of both third- and fourth-generation languages
- Size – smaller, cheaper and more efficient than third generation computers.
- Speed – improvement of speed, accuracy, and reliability (in comparison with the third generation computers).
- Input / output devices – keyboard, pointing devices, optical scanning, monitor, printer, etc.
- Network – a group of two or more computer systems linked together.
- Examples – IBM PC, STAR 1000, APPLE II, Apple Macintosh, etc.

Fifth Generation of Computers

- Main electronic component: based on artificial intelligence, uses the Ultra Large-Scale Integration (ULSI) technology and parallel processing method.
 - **ULSI** – millions of transistors on a single microchip
 - **Parallel processing method** – use two or more microprocessors to run tasks simultaneously.
 - AI
- Language – understand natural language (human language).
- Power – consume less power and generate less heat.
- Speed – remarkable improvement of speed, accuracy and reliability (in comparison with the fourth generation computers).
- Size – portable and small in size, and have a huge storage capacity.

- Input / output device – keyboard, monitor, mouse, trackpad (or touchpad), touchscreen, pen, speech input (recognise voice / speech), light scanner, printer, etc.
- Example – desktops, laptops, tablets, smartphones, etc.

CLASSIFICATION OF COMPUTERS



<https://digitalworld839.com/classification-of-computers/>

REFER TO THE ABOVE LINK

COMPUTER HARDWARE

INPUT AND OUTPUT DEVICES

- An **input device** sends information to a computer system for processing, and
- An **output device** reproduces or displays the results of that processing.
- **Input devices** only allow for **input** of data to a computer and
- **Output devices** only receive the **output** of data from another **device**.

INPUT DEVICES

KEYBOARD

- A computer or laptop keyboard is kind of hardware device that you can use to type data in a computer system. It usually plugs and play device.
- A computer keyboard includes a set of alphabets (A-Z), numbers (0-9), symbols and function keys.
- A computer keyboard type should be PS/2 (5-Pin DIN or 6-Pin DIN), USB (Universal Serial Bus), Wireless.
- Now days USB and Wireless keyboard are common in use.
- Earlier, PS/2 was the most used keyboard.



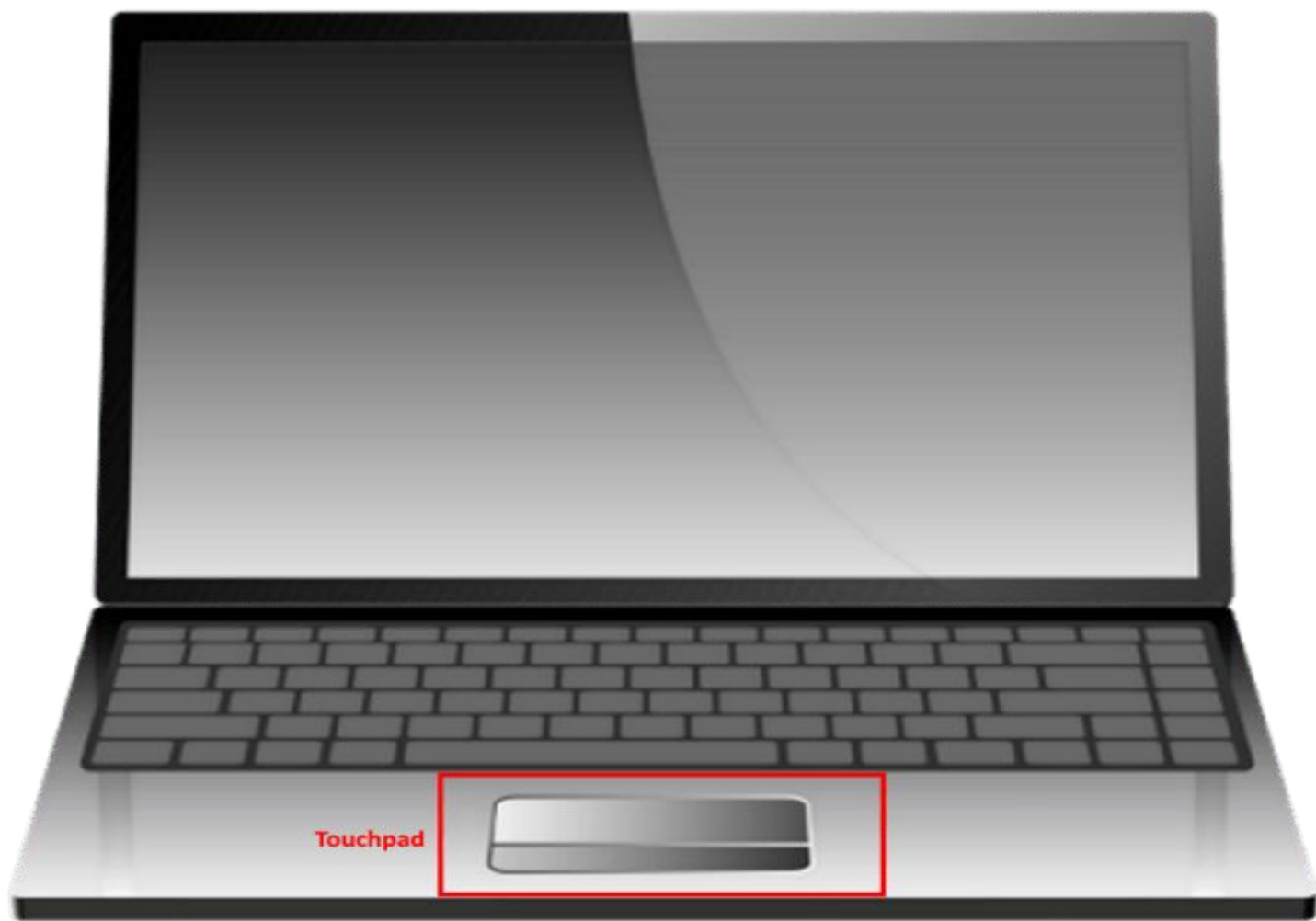
MOUSE

- A computer mouse is an *input and a hardware, pointing device* that you can connect to your computer system.
- You can move cursor on your screen. It's a *hand held device* that you can move with your hand and do clicks (right or left) on your screen to send commands to your computer screen area.
- Earlier PS/2 mouse was in existence but now a days USB and Wireless Mouse have taken place.



TOUCHPAD

- A touchpad or track pad is a kind of input device that has a limited area wherein you can *Point, scroll, click and swipe.*
- A Touchpad most commonly found on computer laptops
- Touchpad allows to use all the features as you do with a computer mouse.



Touchpad

TRACKPOINT

- Most commonly TrackPoint found in IBM ThinkPad Notebook computers, and originally introduced by IBM in 1992.
- TrackPoint is a cursor control device that's built between laptop keyboard and also known as *pointing stick*.
- Now a days track point is not in existence.



Trackpoint, pointing stick

SCANNER

- A scanner is an electronic and input device that allows user to ***scan any of document, images, etc.*** and ***convert them to digital formats that you can see on your computer screen.***
- It's a ***kind of hardware device*** that you can connect to your desktop computer/laptop by using USB connection.
- Most uses in offices to create an image files of physical documents.



MICROPHONE

- Also known as its common name “Mic”.
Basically ***Microphone converts*** your ***voice/sound into electrical signals*** and you will get an output on connected speakers.
- Can be used to record voice.

JOY STICK

- Joystick is a kind of control stick that most used for ***computer gaming's*** that allows users to ***control characters or machine.***



WEBCAM

- Webcam is a short form of Web Camera is an input device.
- It should be connected to computer directly or indirectly.
- It allows users to ***stream live video calling, take pictures, etc.***



OUTPUT DEVICES

PRINTERS

- A printer is an output device that can print any document, web page, photographs, etc by command send by your computer desktop or laptop.
- There are several brands and type of printers available for an example: Laser-jet, Office jet, Ink jet, Line printers.
- Now days most of the printers includes the feature of scanner and copier.



PROJECTORS

- A projector is a hardware device that you can connected to computer desktop/laptop by using HDMI or VGA cable (depends compatibility) to project your computer display in a large screen. If you are using a projector, you also required a projection screen where you can project the computer display.



PLOTTERS

- A Plotter is a big size printer that allow users to get big size print that cannot be done by basic printers.
- Most of the plotter has the feature of LTP, LAN and USB printing ports that connectivity to your computer.
- Generally, plotters are used to take prints of line-art application, big maps, architecture designs, drawings, etc



MONITORS

- In computing, a monitor screen is a computer display.
- A monitor could be a CRT, LED or LCD.
Whatever you do in your computer, monitor is the hardware device that shows you the output.
- So, without monitor you can't work in your computer.



SPEAKERS

- Computer speaker is an output device because you are getting sound from it whenever you play any online or offline music, video or anything that has sound in it.
- Basically, speaker is a hardware device that you can connect to your computer to generate sound.



HEAD PHONE

- A head phone is an output device that also generate sound.
- Headphones are a pair of small loudspeakers. Headphones can be placed inside or outer part of your ears to listen anything and won't disturb anyone else while playing anything.
- Can be used on computers or smartphones.



FUNCTIONS OF DIFFERENT UNITS OF COMPUTERS

- A computer can process data, pictures, sound and graphics.
- They can solve highly complicated problems quickly and accurately.
- A computer ***performs basically five major computer operations*** or functions irrespective of their size and make.
- These are:

- it **accepts data or instructions** by way of input,
- it **stores** data,
- it **can process data** as required by the user,
- it **gives results** in the form of output, and
- it **controls** all operations inside a computer.

INPUT

- This is the process of entering data and programs in to the computer system.
- Computer is an **electronic machine** like any other machine which takes as **inputs raw data** and performs some processing giving out processed data.
- Therefore, **the input unit** takes data from us to the computer in an organized manner for processing.

STORAGE

- The **process of saving data and instructions permanently** is known as storage.
- Data has to be fed into the system before the actual processing starts.
- It is because the processing speed of **Central Processing Unit (CPU)** is so **fast** that the data has to be provided to CPU with the same speed.
- Therefore the data is first stored in [the storage unit](#) for faster access and processing.
- This **storage unit** or the **primary storage** of the computer system is designed to do the above functionality.
- It provides space for storing data and instructions.

The storage unit performs the following major **functions:**

- All data and instructions are stored here before and after processing.
- Intermediate results of processing are also stored here.

PROCESSING

- The task of performing operations like arithmetic and logical operations is called processing.
- The **Central Processing Unit (CPU)** takes data and instructions from the **storage unit** and makes all sorts of calculations based on the instructions given and the type of data provided.
- It is then sent back to the storage unit.

OUTPUT

- This is the process of **producing results** from the data for getting useful information.
- Similarly the output produced by the computer after processing must also be kept somewhere inside the computer before being given to you in human readable form.
- Again the output is also stored inside the computer for further processing.

CONTROL

- The manner how instructions are executed and the above operations are performed.
- Controlling of all operations like **input**, **processing** and **output** are performed by **control unit**.
- It takes care of **step by step** processing of all operations inside the computer.

FUNCTIONAL UNITS

□ In order to carry out the operations mentioned in the previous section the **computer allocates the task between its various functional units**. The computer system is divided into three separate units for its operation. They are

1) Arithmetic logical unit

2) Control unit.

3) Central processing unit.

ARITHMETIC LOGICAL UNIT

- **Logical Unit :**
- After you enter data through the **input device** it is stored in the **primary storage unit**.
- The **actual processing** of the data and instruction are performed by **Arithmetic Logical Unit**.
- The **major operations** performed by the ALU are addition, subtraction, multiplication, division, logic and comparison.
- Data is transferred to **ALU from storage unit** when required.
- After processing the **output is returned back to storage unit for further processing or getting stored**.

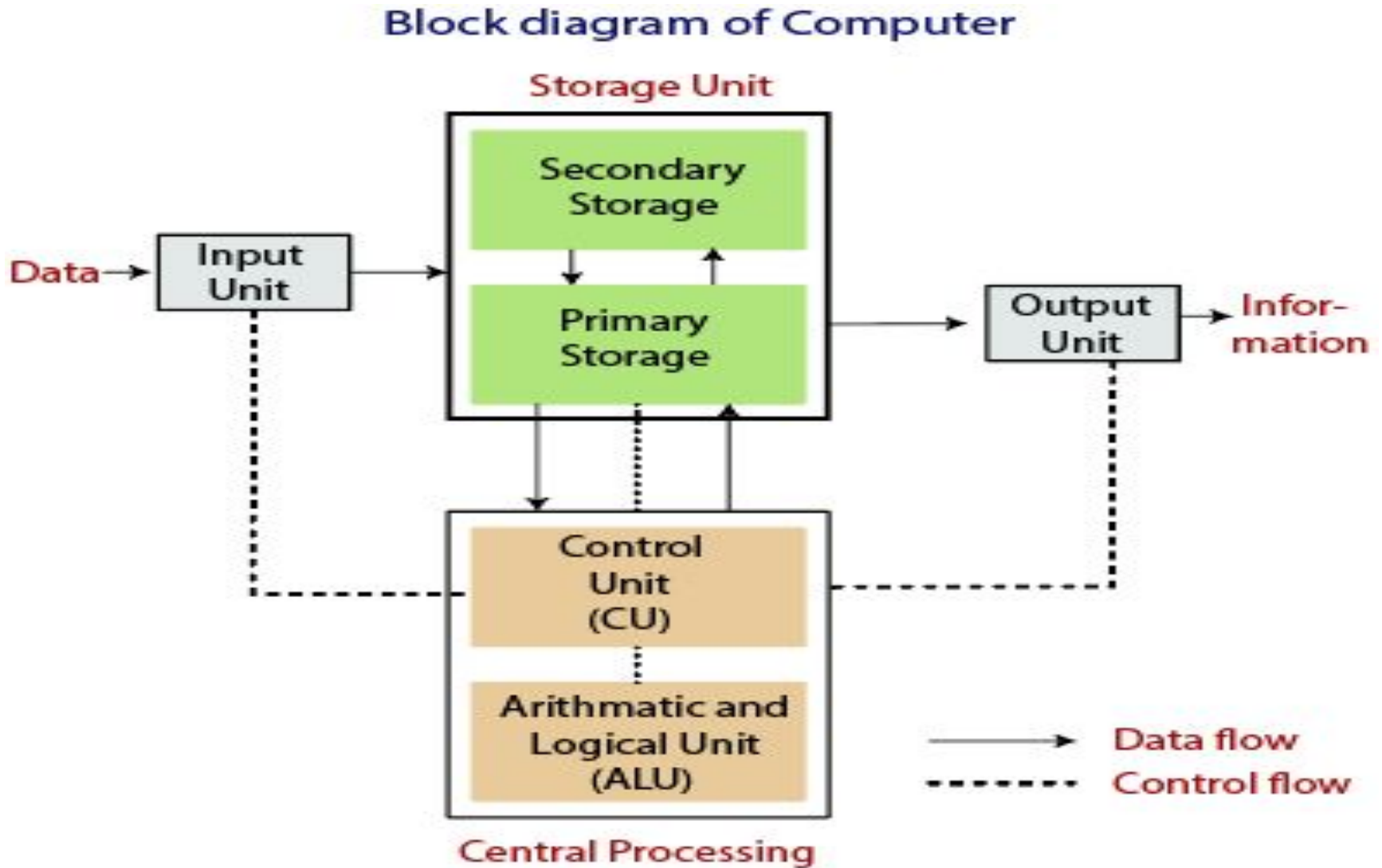
CONTROL UNIT (CU)

- The next component of computer is the **Control Unit**, which acts like the supervisor seeing that things are done in proper fashion.
- **Control Unit is responsible for coordinating various operations using time signal.**
- The **control unit determines the sequence** in which computer programs and instructions are executed.
- Things like **processing** of programs stored in the main memory, **interpretation** of the instructions and **issuing of signals for other units** of the computer to execute them.
- Thereby **it coordinates** the activities of computer's peripheral equipment as they perform the input and output.

CENTRAL PROCESSING UNIT

- The **ALU** and the **CU** of a computer system are jointly known as the central processing unit.
- You may call **CPU as the brain of any computer system.**
- It is **just like brain** that takes all major decisions, **makes all sorts of calculations** and directs different parts of the computer functions by activating and controlling the operations.

Block Diagram of a Computer



PRIMARY MEMORY

RAM AND ROM

What is Memory?

- Memory is very much like our brain as it is used to store data and instructions.
- Computer memory is the storage space where **data is to be processed**, and instructions needed **for processing** are stored.
- The memory is divided into a large number of **smaller portions called the cell**.
- Every cell/ location has a unique address and a size.

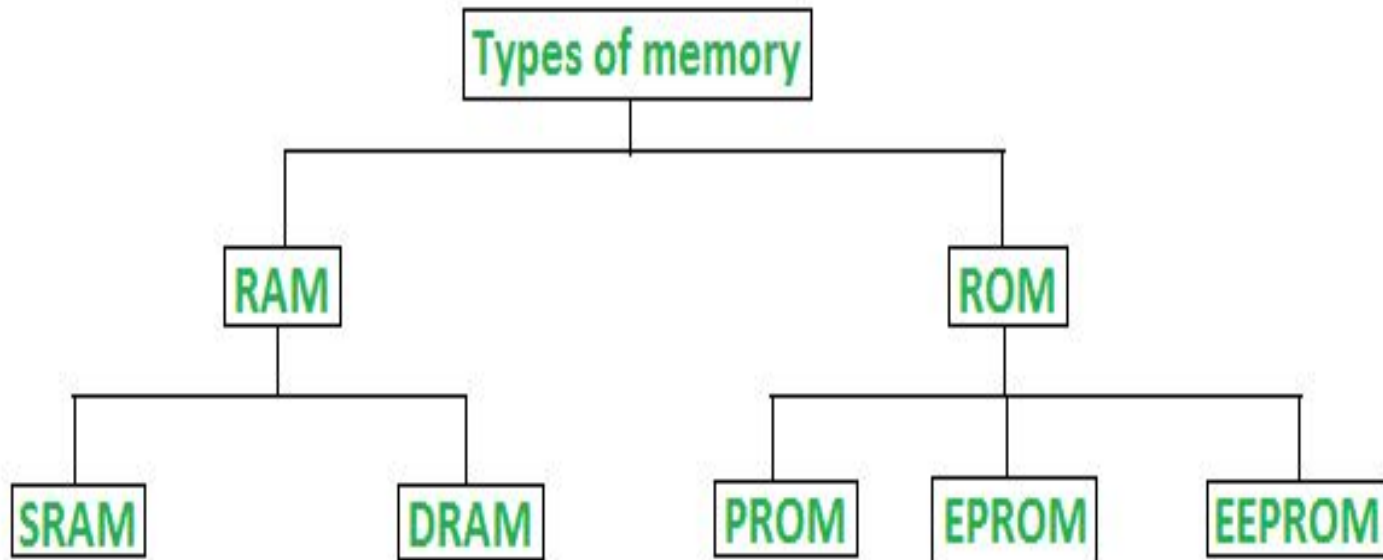
TYPES OF MEMORY

- Primary Memory
- Secondary Memory

MEMORY

- Computer memory is any physical device that can temporarily store [information](#), such as RAM (Random Access Memory), or permanently, such as ROM (Read-Only Memory).
- Memory devices use built-in circuits and are used by [operating systems](#), applications, and [hardware](#).

CLASSIFICATION OF MEMORY



Classification of computer memory

RANDOM ACCESS MEMORY



RANDOM ACCESS MEMORY

PRIMARY MEMORY

- Primary memory is the **main memory** of the computer system.
- Accessing data from primary memory is faster because it is an internal memory of the computer.
- The primary memory is most **volatile** which means data in primary memory does not exist if it is not saved when a power failure occurs.
 - The primary memory is a ***semiconductor memory***. It is costlier compared with secondary memory. The capacity of primary memory is very much limited and is always smaller compares to secondary memory.
- Two types of Primary Memory are:
 - RAM
 - ROM

RANDOM ACCESS MEMORY

- Volatile storage is a memory that loses its contents if the device or computer loses its power. RAM is volatile high-speed memory.
- When applications for software, records, and files are opened, they are copied from secondary storage into RAM. They remain in RAM until we close the files or applications.
- The operating system is copied from the secondary storage to the RAM when a computer boots up. This is the reason you lose something that hasn't been saved if your computer crashes or restarts while you work on a program.

RAM (Random Access Memory)

- Random access memory which is also known as RAM is generally known as a **main memory of the computer system.**
- It is called temporary memory.
- The information stored in this type of memory is lost when the power supply to the PC or laptop is switched off.

DRAM-DYNAMIC RANDOM ACCESS MEMORY

- **DRAM** (Dynamic Random Access Memory) –
- DRAM Is commonly used as the main memory for the computer.
- Inside an integrated circuit, each DRAM memory cell consists of a transistor and a capacitor and a data bit is stored in the capacitor.
- Because transistors often leak a small amount, the condensers gradually discharge, allowing the information stored in it to drain thus, DRAM has to be refreshed every few milliseconds (given a new electronic charge) to maintain data.

SRAM-STATIC RANDOM ACCESS MEMORY

- SRAM is composed of 4 to 6 transistors.
- It holds data in the memory as long as power is supplied to the device, unlike DRAM, which needs to be regularly refreshed.
- As such, SRAM is more costly but quicker, making DRAM the more widespread memory in computer systems.

ROM (Read Only Memory)

- It stands for Read Only Memory. ROM is a permanent type of memory.
- Its content is not lost when the power supply is switched off.
- The computer manufacturer decides the information of ROM, and it is *permanently* stored at the time of manufacturing which *can not be overwritten by the user*.

PROM

- **PROM**–PROM or programmable
- ROM is a computer memory chip that can be programmed once it is created.
- When the PROM is programmed, the written information is permanent and cannot be removed or erased.

EPROM

- **EPR**OM—Erasable Programmable Read-Only Memory,
- EPROM is a non-volatile memory chip, developed in 1971 by Dov Frohman.
- When exposed to ultraviolet light, an EPROM can be reprogrammed if necessary,
- Computer manufacturers use EPROM when it might be necessary to modify the data stored on the EPROM.
- EPROM chips are not commonly used in computers and have been replaced by EEPROM chips.

EEPROM

- **EEPROM**—The EEPROM is an electrically erasable programmable read-only memory *which can be erased and reprogrammed using an electrical charge.*
- George Perlegos developed EEPROM while at Intel in 1978, and unlike most of the memory inside a computer, this memory remembers data when the power is switched off.
- EEPROM was a substitute for the PROM and EPROM chips and is used for the BIOS of later computers designed after 1994.
- Using an EEPROM machine helps a computer user to update the BIOS on their device without the need to open the computer or remove chips.

Different Types of RAM

DRAM	SRAM
1. Constructed of tiny capacitors that leak electricity.	1. Constructed of circuits similar to D flip-flops.
2. Requires a recharge every few milliseconds to maintain its data.	2. Holds its contents as long as power is available.
3. Inexpensive.	3. Expensive.
4. Slower than SRAM.	4. Faster than DRAM.
5. Can store many bits per chip.	5. Can not store many bits per chip.
6. Uses less power.	6. Uses more power.
7. Generates less heat.	7. Generates more heat.
8. Used for main memory.	8. Used for cache.

Difference between SRAM and DRAM

DRAM	SRAM
<i>It is slower than SRAM.</i>	<i>It is faster than DRAM.</i>
<i>It is made up of capacitors that leak Electricity.</i>	<i>It is constructed of circuits similar to D flip-flops</i>
<i>It uses less power.</i>	<i>It uses more power.</i>
<i>It generates less heat.</i>	<i>It generates more heat than DRAM.</i>
<i>It is used for main memory.</i>	<i>It is used for cache memory part.</i>
<i>It is less costly than SRAM.</i>	<i>It is more expensive.</i>
<i>It can store more data.</i>	<i>It cannot store more bits.</i>

Comparison between DRAM and SRAM

ADVANTAGES OF RAM

- It increases the computer system speed, and the higher the system speed, the greater the RAM.
- The CPU can read data quicker than the RAM. (Compared to hard disk, CD, DVD, FLOPPY, DISK, and USB)
- There is very little use of battery life.
- It can write and delete operations.

ADVANTAGES OF ROM

- It is non-volatile and is cheaper than RAM
- As they are static they do not need refreshing every time.
- Circuits are simple and ROM is more reliable than RAM.
- Data can be stored permanently
- It helps to start the computer and loads the OS.

SECONDARY MEMORY

What is Secondary Memory?

- All secondary storage devices which are capable of **storing high volume data** is referred to **secondary memory**.
- It's **slower than primary memory**. However, it can save a substantial amount of data, in the range of **gigabytes to terabytes**.
- This memory is also called **backup storage or mass storage media**.

- **Secondary storage is non-volatile**, long-term storage.
- Without secondary storage all programs and data would be lost the moment the computer is switched off.

Types of Secondary Storage Devices

There are three main types of secondary storage in a computer system:

- solid state storage devices, such as USB memory sticks
- optical storage devices, such as CD, DVD and Blue-ray discs
- magnetic storage devices, such as hard disk drives

- However, not all computers require secondary storage.
- **Embedded computers**, such as those found in a washing machine or central heating system, do not need to store data when the power is turned off.
- The **instructions** needed to run them are stored in read-only memory (**ROM**) and any user data is held in RAM.

SOLID STATE STORAGE DEVICES

- **Solid state storage** is a special type of storage made from silicon microchips. It can be written to and overwritten like RAM. However, unlike RAM, it is non-volatile, which means that when the computer's power is switched off, solid state storage will retain its contents.
- Solid state is also used as external secondary storage, for example in USB memory sticks and solid state drives.
- One of the major benefits of solid state storage is that it has no moving parts. Because of this, it is more portable, and produces less heat compared to traditional magnetic storage devices. Less heat means that components last longer.

- Solid state storage is also faster than traditional **hard disk drives** because the data is stored electrically in silicon chips called cells.
- Within the cells, the **binary** data is stored by holding an electrical current in a transistor with an on / off mode.
- Unlike RAM which uses a similar technique, solid state storage retains this even when the power is switched off by using a technology known as **flash memory**.
- Solid state is an ideal storage medium for many modern devices such as tablets, smart phones and digital cameras.

MAGNETIC DEVICES

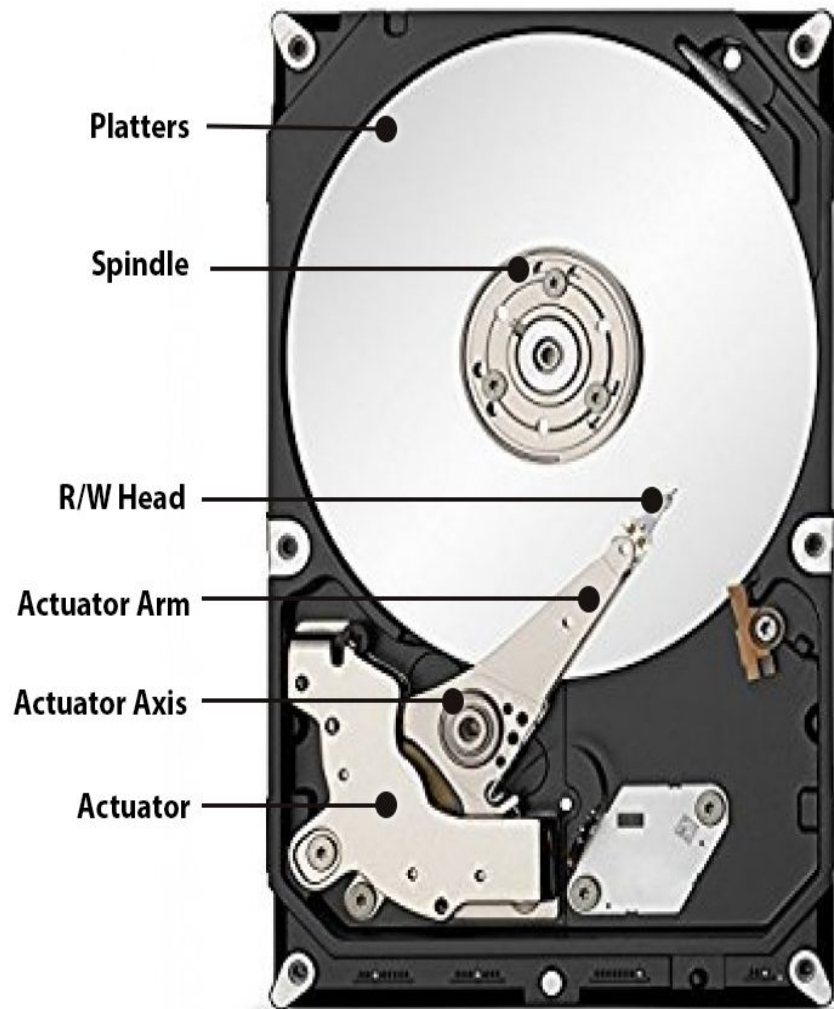
- Magnetic devices such as hard disk drives use magnetic fields to magnetise tiny individual sections of a metal spinning disk.
- Each tiny section represents one **bit**.
- A magnetised section represents a binary '1' and a demagnetised section represents a binary '0'.
- These sections are so tiny that disks can contain **terabytes (TB)** of data.

- As the disk is spinning, a read/write head moves across its surface.
- To write data, the head magnetises or demagnetises a section of the disk that is spinning under it.
- To read data, the head makes a note of whether the section is magnetised or not.

- Magnetic devices are fairly cheap, high in capacity and durable.
- However, they are susceptible to damage if dropped.
- They are also vulnerable to magnetic fields - a strong magnet might possibly erase the data the device holds.

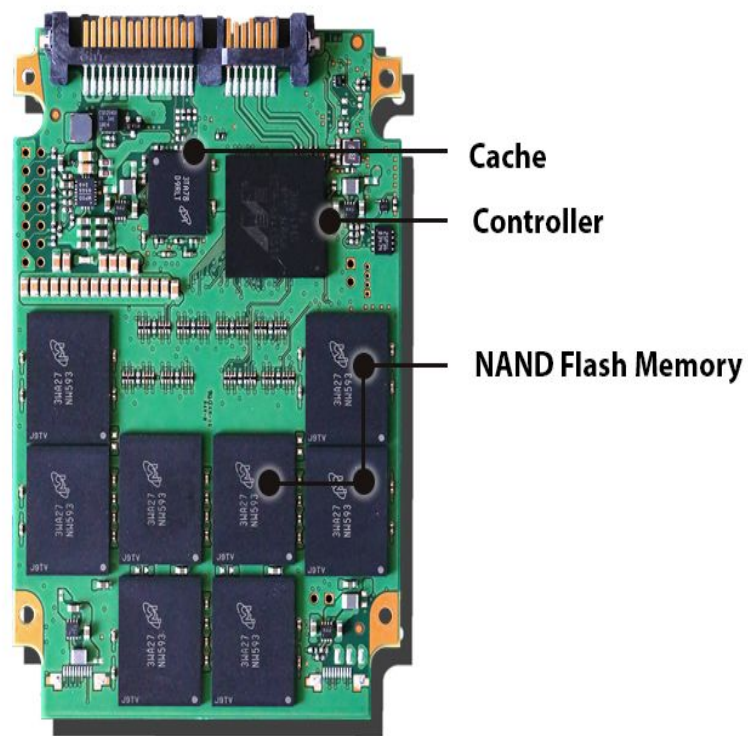
HDD

3.5"



SSD

2.5"



HDD OR SDD

- Whenever we are buying a new computer we have to choose from a solid state drive or a hard disk drive. Which one is better?
- The answer is not a simple yes or no!
- It is a tad bit more complicated than that. Each person has different needs and it all depends on how they are planning to use the device.

HDD

- Hard Disk Drives (HDD) were first introduced in 1956, and they have been utilised in our devices since a very long time.
- A traditional hard drive contains a circular disk, platter, and uses an arm to read and write data. It utilises magnetism to store data on a rotating platter.
- A read/write head, installed on the arm, floats above the spinning platter to read and write data.
- Performance of HDD depends on the speed of the spinning platter.
- A regular hard drive ranges from 5,400 RPM and 7,200 RPM and some server-based platters can go up to 15,000 RPM.



- The faster the drive spins the faster it is able to load data.
- It impacts how quickly your system responds and how long it takes for an installed application to load and open.

SSD

- A Solid State Drive or SSD is a newer storage drive which is already integrated into many devices.
- It is a type of drive in which information is stored on microchips and doesn't include any moving parts. It is a flash storage device.
- SSD doesn't rely on a mechanical arm to read and write data but on an embedded processor called controller helps to read and write data into interconnected flash memory chips.
- This controller helps to determine the speed of the SSD as it makes decisions on how to store, retrieve, cache and clean up data.
- The controller also keeps track of where the data is stored.



- It is capable of much faster speeds than HDD as it relies on electronic storage rather than magnetic.
- NAND (Negative-AND) is the technology used in solid-state drives, it doesn't need to be powered continuously to store data.
- With SSDs the waiting time to boot up, loading files, etc. is dramatically reduced.

OPTICAL DRIVES

- Optical devices use a **laser** to scan the surface of a spinning disc made from metal and plastic. The disc surface is divided into tracks, with each track containing many flat areas and hollows.
- The flat areas are known as lands and the hollows as pits.
- When the laser shines on the disc surface, lands reflect the light back, whereas pits scatter the laser beam.
- A sensor looks for the reflected light. Reflected light - land - represents a binary '1', and no reflection - pits - represents a binary '0'.

Optical drives:

- This secondary storage device is from which data is read and written with the help of lasers. Optical disks can hold data up to 185TB.
- Examples
 - CD
 - DVD

USB drives:

- It is one of the most popular types of secondary storage device available in the market.
- USB drives are removable, rewritable and are physically very small.
- The capacity of USB drives is also increasing significantly as today 1TB pen drive is also available in the market.

[https://theintactone.com/2019/06/28/ca-u1-to-pic-6-secondary-memory-hard-disk-optical-disk/
k/](https://theintactone.com/2019/06/28/ca-u1-to-pic-6-secondary-memory-hard-disk-optical-disk/)

Characteristic of Primary Memory

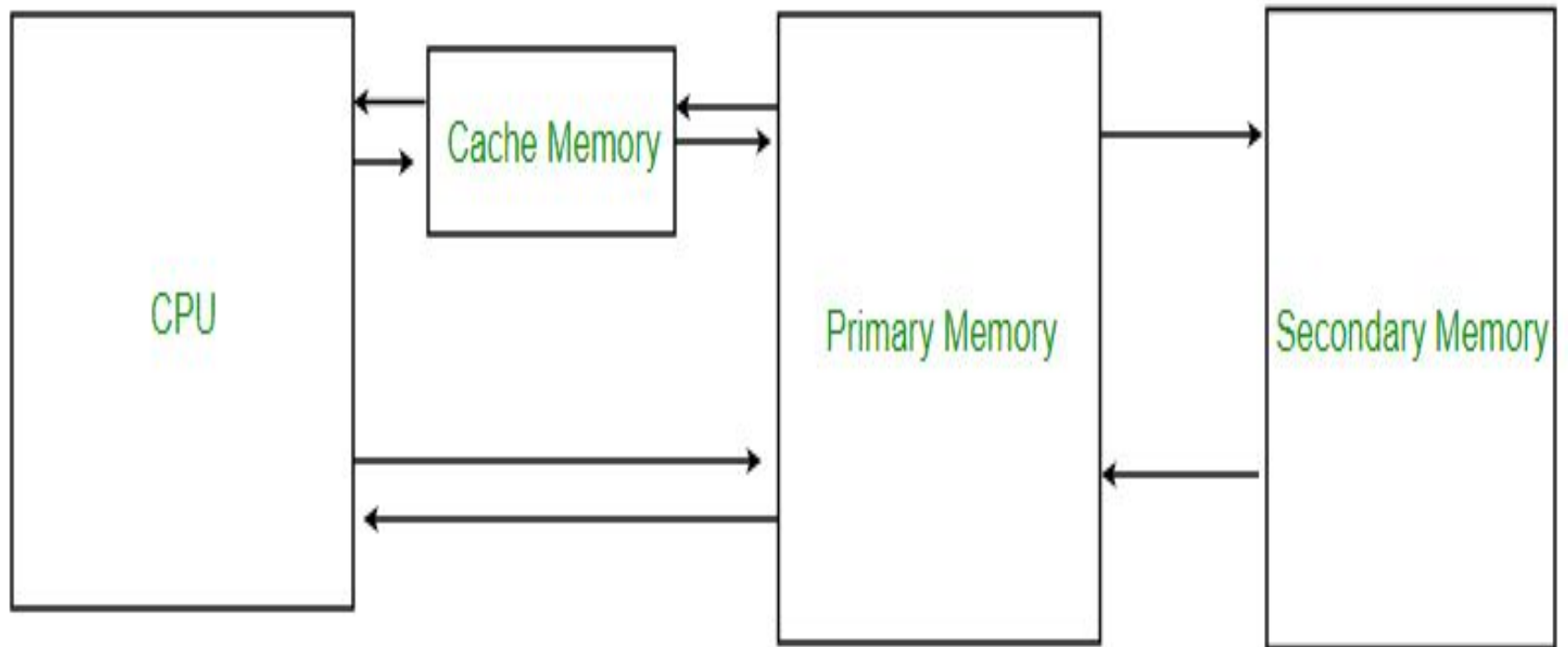
- The computer can't run without primary memory
- It is known as the main memory.
- You can lose data in case power is switched off
- It is also known as volatile memory
- It is a working memory of the computer.
- Primary memory is faster compares to secondary memory.

Characteristic Secondary Memory

- These are magnetic and optical memories
- Secondary memory is known as a backup memory
- It is a non-volatile type of memory
- Data is stored permanently even when the power of the computer is switched off
- It helps store data in a computer
- The machine can run without secondary memory
- Slower than primary memory

Cache Memory

- **Cache Memory** is a special very high-speed memory.
- It is used to speed up and synchronizing with high-speed CPU.
- Cache memory is costlier than main memory or disk memory but economical than CPU registers.
- Cache memory is an extremely fast memory type that acts as a buffer between RAM and the CPU.
- It holds frequently requested data and instructions so that they are immediately available to the CPU when needed.

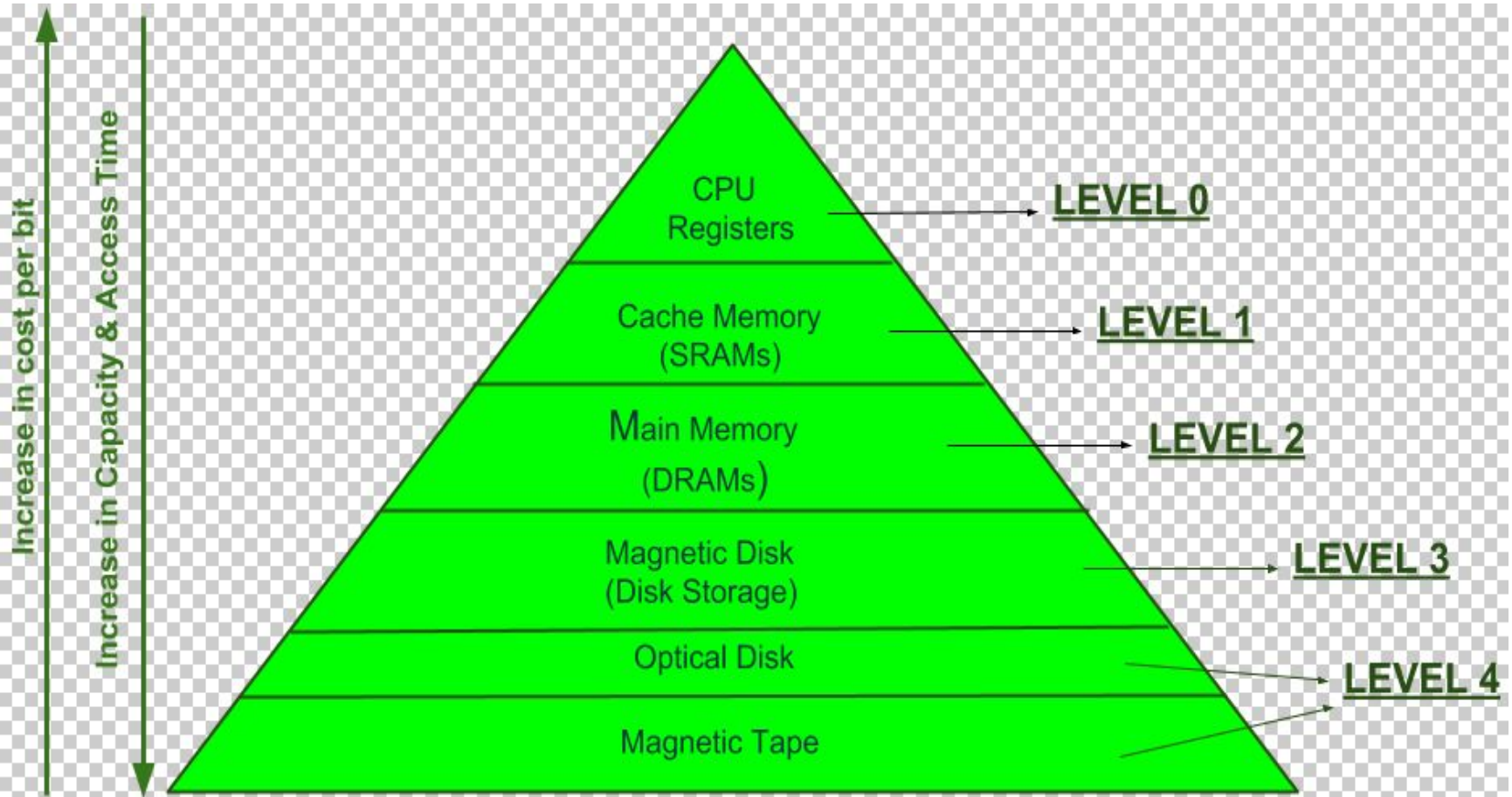


Levels of Cache

- **L1 cache**, or primary cache, is extremely fast but relatively small, and is usually embedded in the processor chip as CPU cache.
- **L2 cache**, or secondary cache, is often more capacious than L1. L2 cache may be embedded on the CPU, or it can be on a separate chip or [coprocessor](#) and have a high-speed alternative system bus connecting the cache and CPU. That way it doesn't get slowed by traffic on the main system bus.

□ **Level 3 (L3) cache** is specialized memory developed to improve the performance of L1 and L2. L1 or L2 can be significantly faster than L3, though L3 is usually double the speed of DRAM.

Memory Hierarchy

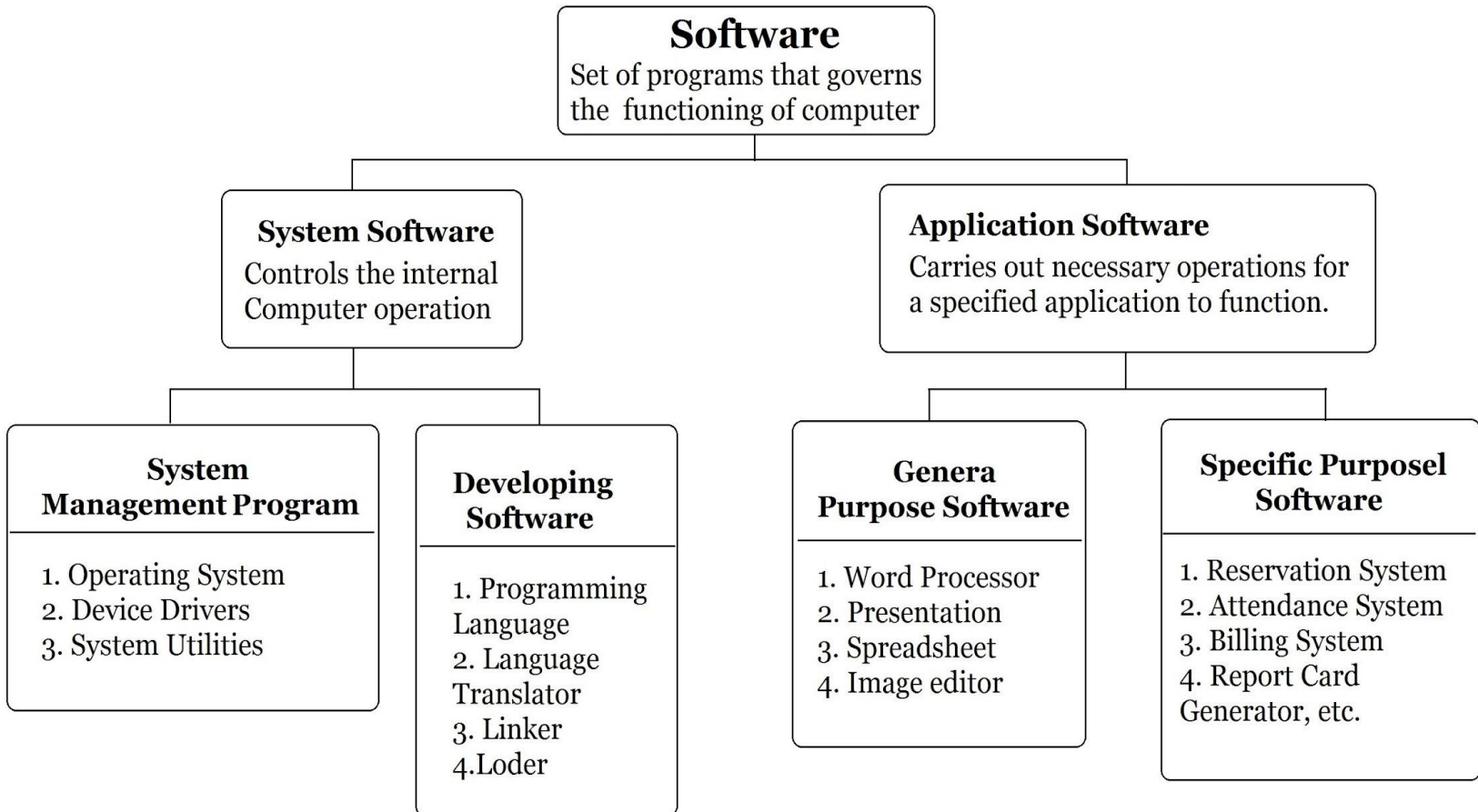


MEMORY HIERARCHY DESIGN

SOFTWARE:DEFINITION

- **Software**, instructions that tell a computer what to do.
- Software comprises the entire set of programs, procedures, and routines associated with the operation of a computer system.
- The term was coined to differentiate these instructions from hardware—*i.e.*, the physical components of a computer system.
- A set of instructions that directs a computer's hardware to perform a task is called a program, or software program.

TYPES OF SOFTWARE



SYSTEM SOFTWARE

- System software controls a computer's internal functioning, chiefly through an [operating system](#), and also controls such [peripherals](#) as monitors, printers, and storage devices.
- System software helps the user, the computer or mobile device, and an application all work together seamlessly. This makes system software crucial to running any kind of application software as well as the whole computer system.

- Think about when your laptop or phone has an update.
- This is system software in action: there is a tweak made to the system software that helps your computer or phone continue to work well and keep applications running.
- Apple's iOS is an example of system software, as is Microsoft Windows.
- System software is always running in the background of your device, but it is never something you will use directly.
- In fact, the only time most people remember it's there is when it is time for an update.

PROGRAMMING SOFTWARE

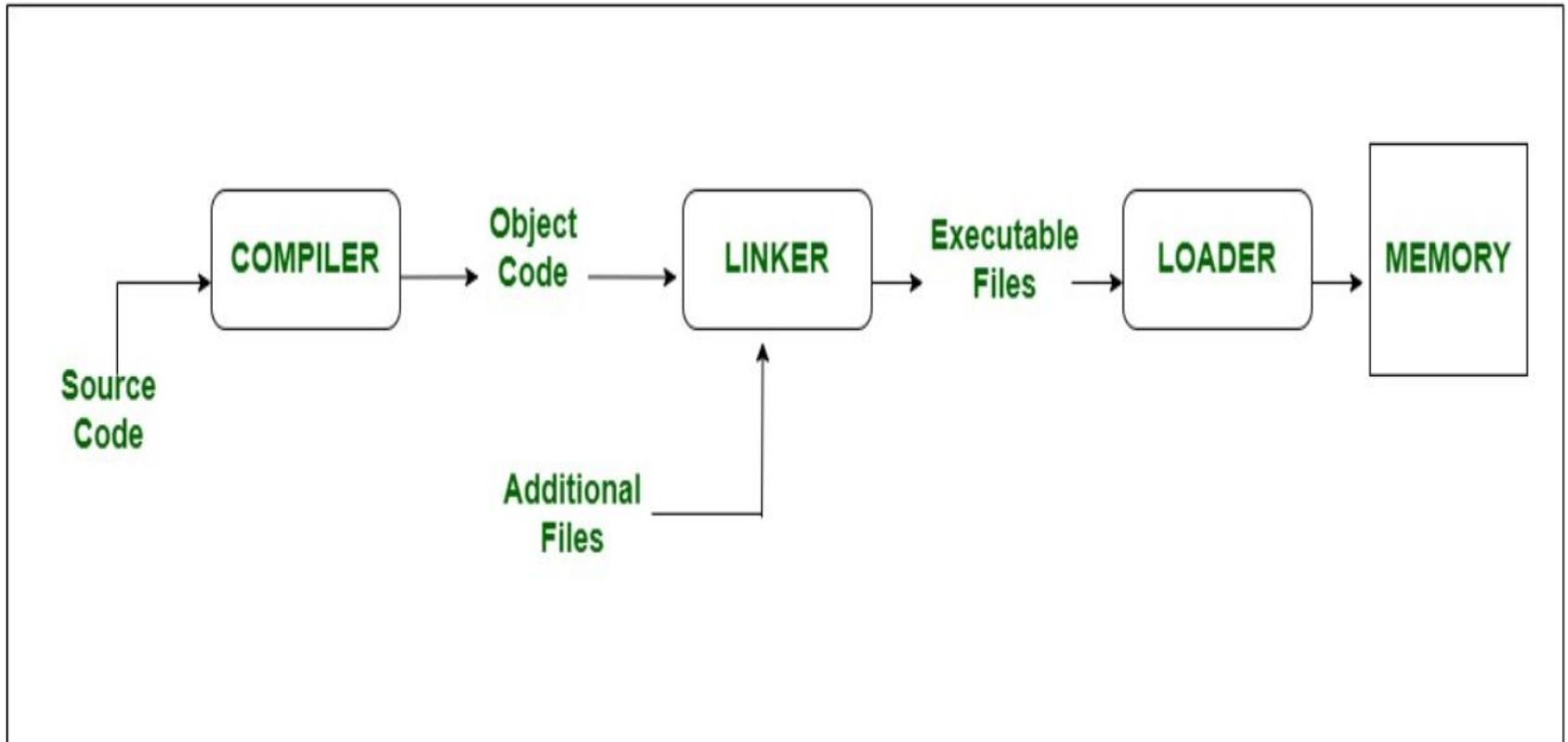
- While application software is designed for end-users, and system software is designed for computers or mobile devices, programming software is for computer programmers and developers who are writing code.
- These are programs that are used to write, develop, test, and debug other software programs.
- It's helpful to think of these programs as a translator of sorts: they take programming languages like Laravel, Python, C++, and more and translate them into something a computer or phone will understand.

LINKER

- A linker is special program that combines the object files, generated by compiler/assembler, and other pieces of codes to originate an executable file have. exe extension.
- In the object file, linker searches and append all libraries needed for execution of file.
- It regulates the memory space that will hold the code from each module.
- It also merges two or more separate object programs and establishes link among them.

LOADER

- The loader is special program that takes input of object code from linker, loads it to main memory, and prepares this code for execution by computer.
- Loader allocates memory space to program. Even it settles down symbolic reference between objects.
- It is in charge of loading programs and libraries in operating system.
- The embedded computer systems don't have loaders. In them, code is executed through ROM.



LINKER

VS

LOADER

1)The main function of Linker is to generate executable files.

Whereas

Main objective of Loader is to load executable files to main memory.

2)The linker takes input of object code generated by compiler/assembler.

And the loader takes input of executable files generated by linker.

3) Linking can be defined as process of combining various pieces of codes and source code to obtain executable code.

Loading can be defined as process of loading executable codes to main memory for further execution.

4) Linkers are of 2 types: Linkage Editor and Dynamic Linker.

Loaders are of 4 types: Absolute, Relocating, Direct Linking, Bootstrap.

5) Another use of linker is to combine all object modules.

Loader helps in allocating the address to executable codes/files.

6) Linker is also responsible for arranging objects in program's address space.

Loader is also responsible for adjusting references which are used within the program.

DRIVER SOFTWARE

- This software is often considered to be a type of system software.
- Driver software operates and controls devices that are plugged into a computer.
- These drivers make it possible for devices to perform their necessary functions.
- A very good example of this is your printer. When you are first setting up your printer to work with your computer, you have to install software to connect the two so that they communicate and print anything you need.

APPLICATION SOFTWARE

- [Application software](#) directs the computer to execute commands given by the user and may be said to include any program that processes data for a user.
- Application software thus includes word processors, spreadsheets, database management, inventory and payroll programs, and many other “applications.”

- General purpose applications and custom software are the two major types of application software.
- General purpose applications, which are sometimes referred to as **off-the-shelf applications**, are designed as fully-featured packages while ,
- Custom software/Specific purpose is tailor-made for a client's specific needs.

TRANSLATORS

- A program written in high-level language is called as source code. To convert the source code into machine code, translators are needed.
- A translator takes a program written in source language as input and converts it into a program in target language as output.
- It also detects and reports the error during translation.

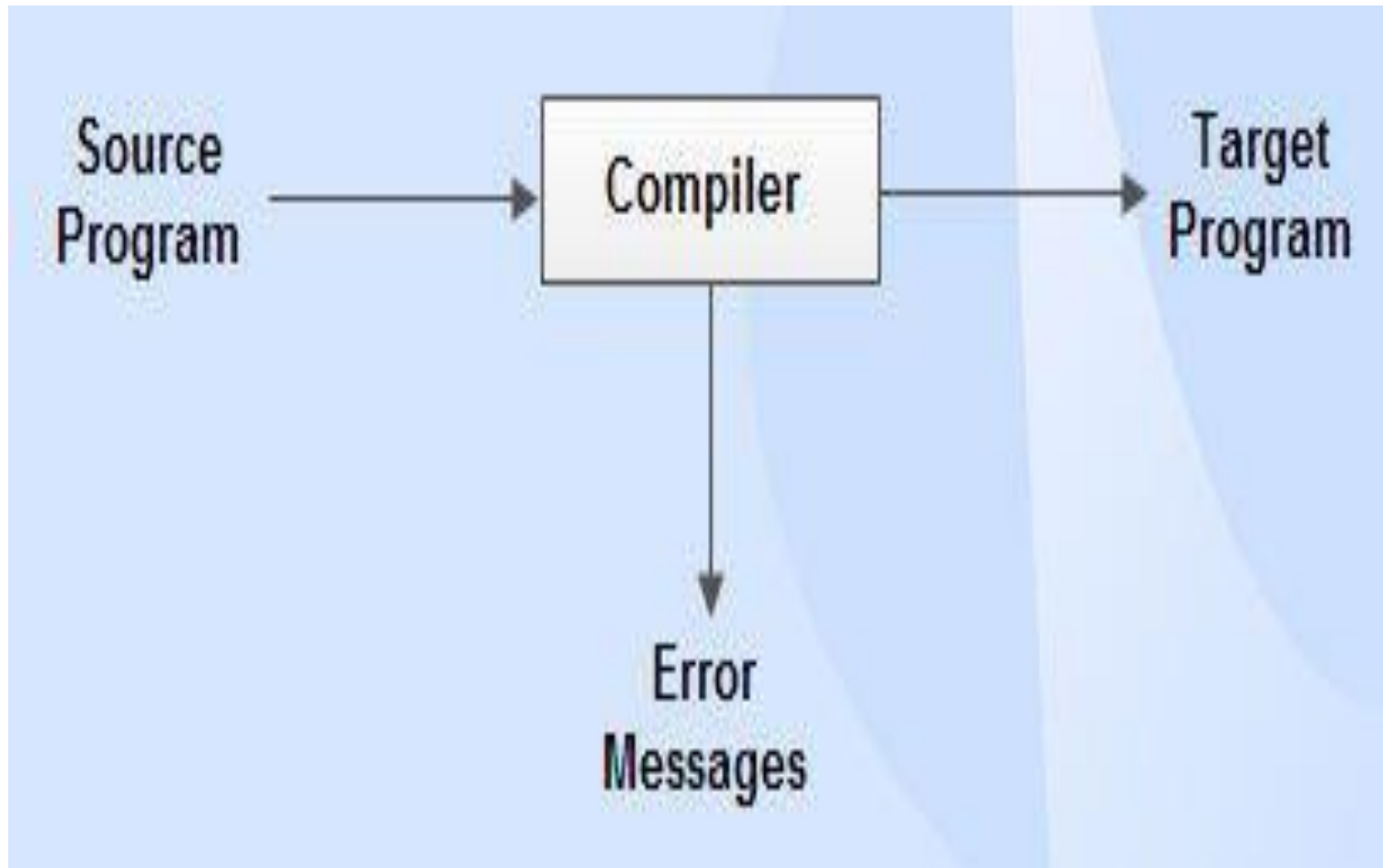
Roles of translator are:

- Translating the high-level language program input into an equivalent machine language program.
- Providing diagnostic messages wherever the programmer violates specification of the high-level language program.

Compiler

- Compiler is a translator which is used to convert programs in high-level language to low-level language.
- It translates the entire program and also reports the errors in source program encountered during the translation.

COMPILER



INTERPRETER

- Interpreter is a translator which is used to convert programs in high-level language to low-level language. Interpreter translates line by line and reports the error once it encountered during the translation process.
- It directly executes the operations specified in the source program when the input is given by the user.
- It gives better error diagnostics than a compiler.

INTERPRETER



COMPILER vs INTERPRETER

Difference between Compiler and interpreter

No	Compiler	Interpreter
1	Compiler Takes Entire program as input	Interpreter Takes Single instruction as input .
2	Intermediate Object Code is Generated	No Intermediate Object Code is Generated
3	Conditional Control Statements are Executes faster	Conditional Control Statements are Executes slower
4	Memory Requirement : More (Since Object Code is Generated)	Memory Requirement is Less
5	Program need not be compiled every time	Every time higher level program is converted into lower level program
6	Errors are displayed after entire program is checked	Errors are displayed for every instruction interpreted (if any)
7	Example : C Compiler	Example : BASIC

Difference between Compiler & Interpreter

Compiler	Interpreter
1. Compiler converts a program into machine code as a whole.	1. Interpreter converts a program into machine code one statement at one time.
2. Compiler creates object code file.	2. Interpreter does not create object code file.
3. Program execution is fast. Since once program is compiled successfully, an object code file is produced. Now this object code file is executed. No need of re-compilation unless we change the source code.	3. Program execution is slow. Because every time we want to run a program it is interpreted again.
4. Error detection and removal is comparatively difficult. Because, compiler will show a list of many errors in the whole program.	4. Error detection is instant and correction is relatively simple and easy, since only one line is translated at a time and if any error, then error message is displayed. We can correct one error at a time easily.

ASSEMBLERS

- An assembler is a program that converts assembly language into machine code.
- It takes the basic commands and operations from assembly code and converts them into binary code that can be recognized by a specific type of processor.






- Assemblers are more simplistic since they only convert low-level code (assembly language) to machine code.
- Since each assembly language is designed for a specific processor, assembling a program is performed using a simple one-to-one mapping from assembly code to machine code.



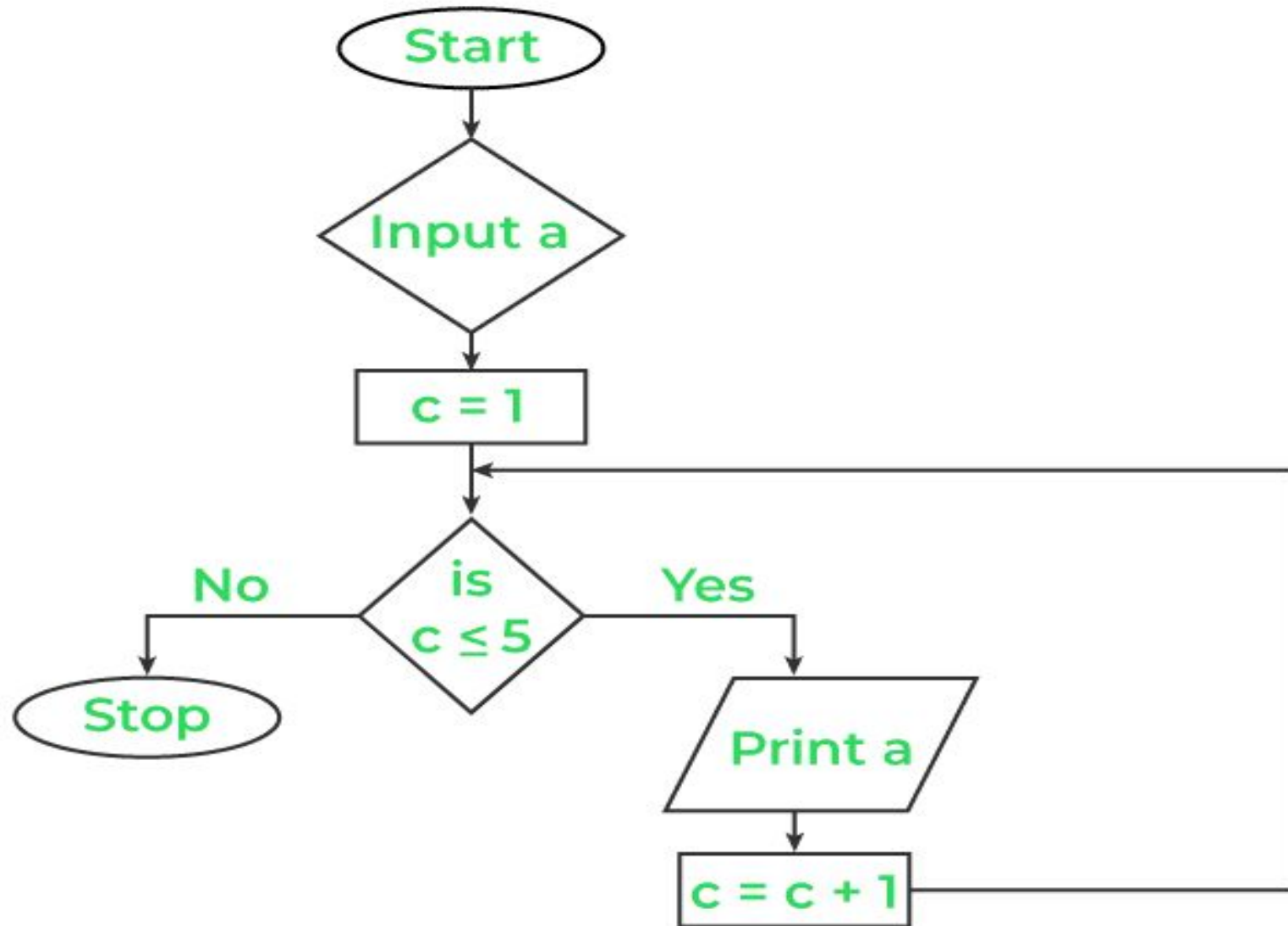
FLOW CHARTS

- A flowchart is a type of diagram that represents a workflow or process.
- A flowchart can also be defined as a diagrammatic representation of an algorithm, a step-by-step approach to solving a task.
- The flowchart shows the steps as boxes of various kinds, and their order by connecting the boxes with arrows.

BASIC SYMBOLS USED IN FLOW CHART

Symbol	Name	Function
	Start/end	An oval represents a start or end point
	Arrows	A line is a connector that shows relationships between the representative shapes
	Input/Output	A parallelogram represents input or output
	Process	A rectangle represents a process
	Decision	A diamond indicates a decision

EXAMPLE:



ALGORITHM

- The word Algorithm means " A set of finite rules or instructions to be followed in calculations or other problem-solving operations "
- Therefore Algorithm refers to a sequence of finite steps to solve a particular problem.

Algorithms can be simple and complex depending on what you want to achieve.

- It can be understood by taking the example of cooking a new recipe. To cook a new recipe, one reads the instructions and steps and executes them one by one, in the given sequence. The result thus obtained is the new dish is cooked perfectly. Every time you use your phone, computer, laptop, or calculator you are using Algorithms. Similarly, algorithms help to do a task in programming to get the expected output.
- The Algorithm designed are language-independent, i.e. they are just plain instructions that can be implemented in any language, and yet the output will be the same, as expected.

Algorithm: to add 3 numbers and print their sum:

- Time to Try!!

Difference between Information and Data

- Information is delineate because the structured, organized, and processed data, conferred inside context, that makes it relevant and helpful to the one who desires it. Data suggests that raw facts and figures regarding individuals, places, or the other issue, that is expressed within the type of numbers, letters or symbols.
- Information is the knowledge that is remodeled and classified into an intelligible type, which may be utilized in the method of deciding. In short, once knowledge end up to be purposeful when conversion, it's referred to as info. It's one thing that informs, in essence, it provides a solution to a specific question. It may be obtained from numerous sources like newspapers, the internet, television, people, books, etc.

- Data is a raw and unorganized fact that is required to be processed to make it meaningful. It can be considered as facts and statistics collected together for reference or analysis.
- Data are individual units of information. In analytical processes, data are represented by variables. Data is always interpreted, by a human or machine, to derive meaning. So, data is meaningless. Data contains numbers, statements, and characters in a raw form.
- Let's understand it with an example, see it is a fact (or data) that an apple a day can keep the doctor away. But why it is not told, means this doesn't tell us about what makes apple healthy but if it tells that apple provides different vitamins, minerals, and fiber, which keeps us healthy and are needed by our body; then it is information as it conveys the full meaning of the fact.

Difference between Information and Data:

Refer to this link students:

<https://www.geeksforgeeks.org/difference-between-information-and-data/>